FINAL REPORT

GLNG Environmental Impact Statement - EPBC Controlled Action Assessment Report

Prepared for

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ES 1 Introduction

This executive summary provides an outline of the assessment of the Gladstone Liquefied Natural Gas Project (GLNG Project) in accordance with the provision of the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The objective of this executive summary is to describe the key features of the existing environment in the project area as they relate to matters of national environmental significance, assess the potential impact of the project on such matters, and to outline the proposed management and mitigation measures proposed to minimise such impacts. .

This report has been prepared as part of the project's environmental impact statement (EIS) which has been prepared in accordance with the requirements the Queensland Government's *State Development and Public Works Organisation Act 1971* (SDPWO Act) and the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

ES 2 Project Description

Santos Limited (Santos) and its joint venture partner PETRONAS are proposing to develop their Queensland coal seam gas (CSG) resources in the Bowen and Surat Basins in the area between Roma and Emerald as feed gas for a liquefied natural gas (LNG) liquefaction and export facility on Curtis Island, near Gladstone, Queensland. The LNG facility will have an initial capacity of 3-4 million tonnes per annum (Mtpa) but will have the potential for later expansion to a nominal 10 Mtpa.

The GLNG Project has the following major components:

- Coal seam gas fields;
- Gas transmission pipeline; and
- LNG liquefaction and export facility (LNG facility).

Other components of the project include a potential bridge, road and service corridor to provide access to Curtis Island; and supporting marine infrastructure including a product loading facility, a materials offloading facility and channel dredging.

The CSG fields will be developed over a period of approximately 25 years to provide approximately 5,300 PJ of coal seam gas to the LNG facility.

The gas transmission pipeline will link the CSG fields to the LNG facility.

The LNG facility will be located in the south-west section of Curtis Island and will liquefy the gas to enable it to be transferred to ships for export.

ES 3 EPBC Act Referrals

On 28 February 2008 and 13 March 2008, Santos lodged five separate referrals to the Department of Water, Environment, Heritage and the Arts (DEWHA) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to cover the Project's components. All five EPBC referrals were declared controlled actions under the Australian Government's EPBC Act and an Environmental Impact Statement (EIS) was developed pursuant to the bilateral agreement between the Australian and Queensland Governments for the assessment under Part 8 of the EPBC Act. This EPBC Controlled Action Assessment Report has been prepared, as required by the EIS Terms of Reference, as a compilation of those matters relevant under the EPBC Act.

The Matters of National Environmental Significance (MNES) that were triggered were; World Heritage Values, National Heritage Places, listed threatened species and communities and listed migratory species. At least one of these MNES is triggered for each of the five referrals.

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The five EPBC referrals (Table 1-1) that have been lodged are:

- The Liquefied Natural Gas (LNG) facility on Curtis Island (LNG facility);
- The proposed bridge, road and services corridor (to access the LNG facility on Curtis Island);
- The marine facilities (product loading facility (PLF), materials off-loading facility (MOF), and channel dredging to service the LNG facility) all of which are located in the area around Port Curtis;
- The coal seam gas (CSG) fields (located around Roma); and
- The gas transmission pipeline (435 kilometres long) for the delivery of the gas from the CSG fields to the LNG facility.

ES 4 Environmental Values, Impacts and Mitigation

ES 4.1 LNG facility, Marine Facilities, Potential Bridge and Marine Pipeline Corridor

Port Curtis

Port Curtis is a partially enclosed embayment within the Great Barrier Reef World Heritage Area (GBRWHA) with shallow estuaries including small, continental rocky islands, intertidal flats and estuarine islands (Figure 1-1 – note all figures are at the end of the report). Significant freshwater input from the Calliope and Boyne rivers results in elevated natural turbidity levels throughout the area. Subtidal communities of sponges, hydroids and soft corals occur within Port Curtis, particularly on the rocky slope between China Bay and around Hamilton Point. Soft corals, sea pens, sponges, tubeworms, macroalgae and other marine species are scattered throughout the embayments and channels within Port Curtis. Seagrass meadows, mangrove communities, saltmarsh, saltflats and intertidal mudflats occur in significant proportion within Port Curtis (Figure 1-2).

The World Heritage values of the Great Barrier Reef (GBR) include coral reefs covering approximately 20,055 km^2, with 300 coral cays and 600 continental islands. The reef morphologies reflect historical and on-going geomorphic and oceanographic processes including changing sea levels and provide an outstanding example representing a major stage of the earth's evolutionary history.

Mangroves and Saltmarsh Communities

Impacts to intertidal communities are anticipated from the construction of the proposed LNG facility, proposed bridge, road and services corridor and associated marine facilities. Disturbance to mangroves and saltmarsh communities will impact the areas immediately within the footprint of the proposed LNG facility and the haul roads to the PLF and MOF in China Bay. Of the 6,736 ha of mangrove communities estimated within Port Curtis (Connelly *et al*, 2006) 0.01% of mangrove communities are estimated to be impacted in China Bay from the construction of the LNG facility, PLF and MOF and 0.06% of the 4,573 ha of saltmarsh and saltpan areas within Port Curtis (Connelly *et al*, 2006) are estimated to be impacted by the construction of the LNG facility.

Mangrove, saltmarsh and intertidal communities in the vicinity of Laird Point and Friend Point will be disturbed by the construction of the proposed bridge and trenching of the marine component of the gas transmission pipeline.

The dredge material placement facility will result in the clearance of 37 ha of intertidal communities in the embayment south of Laird Point. This will include 31 ha of saltmarsh and saltpan communities (0.68% of that existing in Port Curtis) and 6 ha of mangroves (0.09% of that existing in Port Curtis). Together they represent approximately 0.3% of all intertidal communities within Port Curtis and their loss is not expected to significantly affect the World Heritage values of the area.

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Water Quality

Port Curtis is a well connected estuary which allows dissolved material to be dispersed relatively evenly, however material does not as readily leave the estuary to the offshore environment. This reduced flushing time may contribute to the anomalous bioaccumulation (irregular accumulation of substances) of some metals in the biota (flora and fauna of the area) of Port Curtis. Turbidity increases with depth and tidal velocity, most likely due to bottom sediment re-suspension. Levels of pH and temperature are relatively uniform with depth (over both campaigns) with evidence of only slight thermal stratification. Salinity appears to be responsive to rainfall and associated inflow events, although it is not clear whether local or remote inflows (or a combination of both) dominate in this regard. Catchment-derived pollutants may enter the area (either locally or remotely) with freshwater inflows.

When compared with relatively stringent water quality guidelines, it can be surmised that water quality is high, although variable across the area. Water quality levels appear to be relatively strongly correlated with tidal state and hence bed load re-suspension. In particular, low tides exhibit generally a lower water quality than high tides. Tides in the area are semi-diurnal and the (spring) tidal range is of the order of 4 metres, with significant wetting and drying of mangrove and inter-tidal areas occurring. The area of interest represents a high energy environment, with strong tidal flows dominating the local hydrodynamics. Typical peak (spring) tidal velocities reach 1.2 to 1.3 m/s. Velocities are relatively uniform throughout the water column, however some evidence of vertical shear was found around areas of local bathymetric features. Tidal flows largely follow natural and constructed channels, with these locations consistently experiencing the highest velocities, as measured with ADCP transects. There is a local asymmetry in the magnitude of the tidal velocities, with ebbing tides being characterised by greater velocities than flooding tides. This is attributed to local bathymetric and geomorphological features. Small tidal velocity reversals were noted on flood tides in the vicinity of the shoreline at the southern end of China Bay.

The major impacts of the GLNG Project on the marine water quality are likely to be as a result of dredging and dredge material disposal. Physical disturbance to the area's marine features will occur through development of the PLF, MOF, swing basin, berthing pockets and approach channel, as well as the, construction of the proposed bridge and trenching of the gas transmission pipeline at the marine crossing between Friend Point and Laird Point.

Sediment transport fate modelling of dredging operations was conducted to quantify the potential impact of sediment re-suspension on ambient water quality levels and to gain an understanding of the potential spatial extent of sediment plumes likely to be generated from capital and maintenance dredging works. The modelling results indicate there will be elevated Total Suspended Sediment (TSS) concentrations in and around the area of proposed dredging works affecting an area of approximately 150m by 500m during neap tides and 200m by 150m during spring tides. Outside of these areas, a TSS concentration of 25mg/L is predicted which is within typical variability when compared with background levels in this region of Port Curtis. Further afield, maximum TSS concentrations of approximately 5mg/L are predicted. These would be close to undetectable.

Similar behaviour was observed in the model results for the potential bridge and gas transmission pipeline construction scenarios. The immediate impact zones were in the order of hundreds of metres in dimension during neap tides (and considerably smaller during spring tides) with maximum additional TSS concentrations outside this zone of 14 to 16 mg/L.

Potential impacts from capital dredging will result in some smothering and disturbance of subtidal communities such as soft corals, sponges and hydroids at Hamilton Point and within the silted embayments of China Bay. These species are represented regionally and dredging activities are not expected to significantly impact the World Heritage values. There are no coral reefs or coral cays within Port Curtis as the turbid estuarine environment is not suitable for coral reef communities. The nearest coral reef communities are at Farmers Point on the western side of Facing Island approximately 10km from Clinton Channel, and Manning Reef approximately 15km from the proposed dredging site. Due to the distance of these reefs from the proposed dredging areas, they are not expected to incur any impacts from potential increased turbidity.

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Seagrass

Port Curtis seagrass meadows are generally confined to the lower intertidal or shallow water subtidal zones due to relatively high turbidity and low light penetration (Rasheed *et al*, 2003).. Connelly and Guest (2004) found that in Port Curtis, the subtidal seagrass *Halophila* was more likely to provide carbon to intertidal crustaceans, while *Zostera* (intertidal) provided a more important contribution to fish species. Results from a monitoring study conducted by Rasheed *et al* (2003) indicate that seagrass meadows north of Fisherman's Landing consist of *Zostera capricorni* with *Halophila ovalis* in the intertidal areas and *Halophila decipiens* with aggregated patches of *Halophila ovalis* in the subtidal zone (Figure 1-2). These meadows are most likely to be impacted by dredging and trenching activities at Friend Point. Some aggregated patches of *Zostera capricorni* were recorded south of Laird Point on the western side of Curtis Island during the seagrass monitoring conducted by Rasheed *et al* (2003). Aggregated patches of *Zostera capricorni* with *Halophila ovalis* were also recorded around North Passage Island and around South Passage Island, with some isolated patches of aggregated *Zostera capricorni* on the northern side of China Bay.

Potential impacts predicted for seagrass meadows between Fisherman's Landing and Friend Point from dredging and trenching activities include smothering from increased sedimentation and decreased photosynthesis associated with a reduction in light penetration from increased turbidity. Trophic implications from smothering of intertidal seagrass may include changes to available carbon utilised by fish, crabs and prawns (Connelly *et al,* 2006). These impacts are generally temporary in nature with regeneration of seagrass meadows predicted following completion of dredging and trenching activities. Results from a monitoring study conducted by Rasheed *et al* (2006) found that following significant declines in biomass and area of seagrass meadows within Port Curtis between 2002 and 2005, the ephemeral seagrass meadows north of Fisherman's Landing took longer to recover than other seagrass meadows within Port Curtis. It was hypothesised that the highly patchy nature with low overall biomass of the seagrass meadows north of Fisherman's Landing may have lower resilience and no substantial seedbank to support rapid regeneration of seagrass species.

Results from sediment plume modelling indicate that levels of increased turbidity are relatively low when compared with the typical background levels within Port Curtis region. Worst case scenario indicates a sediment plume of up to 600m around the Friend Point area of dredging activity. Potential impacts will be mitigated through measures such as timing dredging activities during spring tide cycles. Changes to foraging behaviour of dugong and turtles that feed on these meadows may occur.

Potential impacts to seagrass meadows from capital dredging are expected to be minimal. Seagrass meadows are not within the dredge plume areas identified from the modelling results. One isolated patch of aggregated seagrass north of China Bay was recorded in 2002 (Rasheed *et al*, 2003) and was absent during the survey conduct in May 2008.

Marine Fauna

Turtle nesting for flatback and other turtles occurs on the eastern side of Curtis Island. Given the significant distance from the proposed LNG facility location, it is considered unlikely that potential impacts to nesting turtles, eggs and hatchlings from construction and operation of the LNG facility and associated infrastructure are unlikely to occur. Limpus and Gilmore (1999) described predation on turtle eggs from foxes on Curtis Island. Although dogs, pigs and goannas are present on the island, no direct predation on turtle eggs was observed at the time of the study. Impacts from cattle grazing on frontal dunes and trampling turtle eggs was of concern, particularly with flatback turtles laying shallow egg nests in the sand (Limpus and Gilmore, 1999). Predation on adult turtles from sharks was also observed during this study (Limpus and Gilmore, 1999). Of the 77 turtles examined in the study 7% had fractured carapaces most likely from propeller damage and 4% possibly from fishing interactions.

The loggerhead, green and flatback turtles are known to move through Port Curtis and into the Narrows. Interactions with marine turtles and other marine fauna from dredging gear and shipping activities have occurred previously (SPRAT database, DEWHA). The development and implementation of the GLNG Project's construction environmental management plan and dredge management plan will ensure that

mitigation measures to avoid interactions between dredging gear and shipping operations and marine fauna are implemented to minimise any potential impacts to these species.

Dugongs and dolphins were sighted within Port Curtis during field surveys in 2008. The EPA maintains records of interactions with dolphins and dugongs within Queensland including Port Curtis. Some of these interactions have been attributed to impacts from fishing activities and boat strike, determined by visible markings that were reported at the time. The development and implementation of Construction Environmental Management Plans and Dredge Management Plans that include measures to avoid interactions will minimise any potential impacts to these species.

Avifauna

The following bilateral agreements oblige contracting parties to protect migratory bird species and their environments that regularly migrate between Australia, Japan, the Peoples Republic of China and the Republic of Korea:

- Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment (JAMBA);
- Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment (CAMBA); and
- Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA).

A number of birds listed under JAMBA, CAMBA and ROKAMBA occur throughout the area. High tide roosts for colonies of waders occur at Chinaman Island on the southern side of Curtis Island adjacent to Pelican Banks, the ash ponds in Gladstone and the western side of Facing Island. The main feeding areas for these waders are recorded as the Targinie Banks and Pelican Banks on the southern side of Curtis Island.

It is expected that potential impacts to migratory birds will be negligible due to the vast expanse of low tidal mudflats throughout Port Curtis. A total of 22 wader and shorebird species were identified within or near the study area during the December 2008 survey, of which 11 are listed as migratory species under the EPBC. The BAAM (2008) study determined that habitat values for wader birds throughout the study area appeared to be relatively poor. Migratory species such as eastern curlew (*Numenius madagascariensis*), whimbrel (*Numenius phaeopus*) and eastern reef egret (*Egretta sacra*) were observed in the study area in low numbers. Whimbrels were also heard calling from some mangrove areas indicating that whilst this habitat was being used, it was in low usage as roost habitat.

Very few wader birds were observed foraging at the study sites at low tide during the field survey period. There was a high abundance and diversity of wader bird species observed foraging on sand/mudflats at low tide on the south-east of the island adjacent to the township of South End (approximately 9 km to the east of the study area). From these observations it is considered that habitat values in the study area are relatively low for wader species. It is likely that the LNG facility site is irregularly used at times for foraging/roosting by some wader species in low numbers.

Environmental Hazards

With the implementation of mitigation measures through the project's environmental management plan, impacts to MNES will be minimised. During the operation of the project, any LNG facility or shipping related discharges or spills, such as oil or site runoff, represent potential impacts to the marine environment and World Heritage values. However they will be managed so that the risk of any such spills or discharges will be minimised. The introduction of exotic organisms in ballast water also represents a potential threat to World Heritage values of the area. The Curtis Coast Regional Coastal Management Plan, recognises the Gladstone State Development Area as an area of state and national significance that has been established by the government for large scale industry development (EPA, 2003) Given the extent of the GBRWHA and the existing loss of marine habitat from current industrial activities and urban pressures, the potential impacts from construction, operation and decommissioning of the GLNG

Project will be minimal. Further, there are no migratory or threatened species or communities that have core habitats within Port Curtis that will be lost or damaged due to the proposed project.

ES 4.2 CSG Field and Land Based Pipeline Corridor

Field Development

The GLNG Project will include development of Santos' CSG resources in the Bowen and Surat Basins in the area between Roma and Emerald in central Queensland.

Figure 1-2 shows the extent of the petroleum authorities and names of the CSG fields as they existed in February 2008 which was when the EIS baseline studies commenced. Since that time the boundaries of some petroleum authorities have changed as some of the authorities to prospect (ATPs) have been converted to petroleum leases (PLs) and some areas have been relinquished in accordance with the governing legislation. This is a normal part of managing CSG fields and it is possible that Santos may acquire additional gas acreage in the future.

Projections of future CSG production are difficult to make. Several variables complicate such forecasts, including new exploration or production techniques, increases or decreases in demand for natural gas/LNG, and price increases or decreases that may prompt larger or smaller production programs. For the GLNG Project a reasonably foreseeable development (RFD) scenario has been established to assess the degree of CSG development that can be reasonably expected to occur over a given period of time.

CSG field development to support the initial 3 – 4 Mtpa LNG facility (Train 1) is proposed to be located in the RFD area. The RFD area comprises tenements in the Roma (part), Fairview, Arcadia Valley and part of the Comet Ridge fields. The RFD tenements as they existed in February 2009 are shown on Figure 1-3. Santos proposes to drill and complete enough development wells within the RFD area to supply approximately 5,300 PJ (140 billion m^3) of gas to Train 1. This will likely require up to 1,200 development wells prior to 2015 and up to 1,450 wells after 2015 (excluding exploration wells).

Gas in quantities beyond 5,300 PJ required for the second and third trains of the LNG facility is likely to be supplied by a combination of the following:

- From the development of the wells discussed above.
- From the development of the future development area which includes tenements in the Mahalo, Denison, Scotia, Comet Ridge and Roma Other fields shown on Figure 1-3.
- By utilising Santos' share of gas from tenements in which Santos has an interest but is not the operator. These tenements are listed in Figure 1-3 as "Other CSG Fields".
- From third parties.

The CSG field nature conservation study was split into two study areas (Northern and Southern CSG fields) and two disciplines (terrestrial flora and terrestrial fauna). Four threatened ecological communities listed under the EPBC Act were recorded from within the CSG field, with three being recorded from within the gas transmission pipeline corridor. The potential impacts from placement of the wells, pipelines and associated infrastructure in the CSG field will be restricted as much as practicable to areas previously cleared of vegetation. Potential impacts to EPBC Act listed threatened ecological communities will be avoided through positioning the wells and pipelines in areas of the CSG field that avoid these communities, particularly in the northern section.

The 435 km long gas transmission pipeline for the delivery of the gas from the CSG fields to the LNG facility. It will commence in the vicinity of the Fairview CSG field near Injune, travel north towards Rolleston, and then travel east north-east to Gladstone. The proposed pipeline route is shown on Figure 1-4.

The proposed action is not expected to significantly impact upon EPBC Act listed threatened ecological communities or species. For the gas transmission pipeline, clearing will be required for a 30m wide pipeline Right of Way (ROW). Based upon this ROW only minimal clearing is expected to be required within these communities and no significant impacts are anticipated.

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Plants

No plant species listed in the EPBC Act were identified as being present in the CSG field, however one plant species, *Cycas megacarpa*, listed under the EPBC Act, was recorded from field studies of the gas transmission pipeline corridor and a number of other species are expected to be present within areas of remnant vegetation. The corridor avoids the core populations of *Cycas megacarpa* within the range crossings, and intersects the margins of the populations where plant densities are lower. Individual plants are likely to require translocation, but the number will be low and unlikely to impact the overall population.

A number of EPBC Act listed species and threatened ecological communities were either recorded during field surveys or are anticipated to be present within the CSG field and land based gas transmission pipeline corridor, however, no World Heritage Areas (WHA) are present in the area.

Avifauna

One bird species (squatter pigeon) listed under the EPBC Act was recorded in the CSG field and the gas pipeline corridor, and a number of other species are expected to utilise the area. However, the areas to be impacted by the development of the CSG field are not considered to provide core habitat for any of these species and limited short term activities will occur along the gas transmission pipeline corridor, minimising impacts.

Fish

The Murray cod is widespread throughout the Murray-Darling system. Potential impacts to this species from the CSG field are unlikely due to their widespread distribution and local restocking programs. The boggomoss snail is found at localised sites in south-eastern Queensland. However, it is considered unlikely that the boggomoss snail occurs within the CSG field area. Likely impacts to these species from the CSG field development are considered to be negligible.

Reptiles

No reptile species listed in the EPBC Act were identified as being present in the CSG field or land based gas transmission pipeline corridor.

Mammals

No mammal species listed in the EPBC Act were identified as being present in the CSG Field or land based gas transmission pipeline corridor.

Section 1 Introduction

1.1 Project Overview

Santos is proposing to develop coal seam gas (CSG) resources (also known as coal bed methane) in the Surat and Bowen Basins in the area between Roma and Emerald in Queensland. The CSG fields will supply gas for a proposed liquefied natural gas (LNG) liquefaction and export facility (LNG facility) on Curtis Island, near Gladstone in Queensland. A high pressure gas transmission pipeline is proposed to be constructed to link the CSG fields to the LNG facility. These components are collectively referred as the Gladstone LNG Project (GLNG Project).

Figure 2-1 the regional location of the main project components.

Approvals are being sought for the following components of the GLNG Project:

- Production of approximately 5,300 petajoules (PJ) (140 billion m^3) from the CSG fields to supply the first stage of the LNG facility. This will involve the development of approximately 2,650 exploration and production wells. It is anticipated that up to 1,200 wells will be established prior to 2015, with potential for up to 1,450 wells after 2015. Additional supporting infrastructure including field gathering lines, nodal compressor stations, centralised compression and water treatment facilities, accommodation facilities, power generation and water management facilities will also be installed.
- A 435 km long gas transmission pipeline for the delivery of the gas from the CSG fields to the LNG facility.
- An LNG facility of approximately 10 million tonnes per annum (Mtpa) capacity on Curtis Island. The LNG facility is proposed to be developed in three stages (called trains), the first of which will have a capacity of approximately 3 - 4 Mtpa. The LNG facility will consist of the following key elements (for which approvals will be sought):
  - A liquefaction facility which includes the on-shore gas liquefaction and storage facilities;
  - Marine facilities which will include a product loading facility (PLF) for loading LNG into ships for export, and a materials offloading facility (MOF) and haul road for the delivery of equipment, plant and materials to the LNG facility site;
  - A swing basin and an access channel from the existing Targinie Chanel in Port Curtis;
  - A dredge material placement facility at Laird Point; and
  - A maximum 2,000-person capacity accommodation facility on Curtis Island for construction workers.
- Access to the LNG facility from the mainland will occur by either of the following options:
  - The provision of road access to Curtis Island by way of a potential access road and bridge from the mainland crossing Port Curtis between Friend Point and Laird Point. Construction phase access to the site for at least Train 1 will be by barge and ferry as the access road and bridge will not be constructed by that time; or
  - Access to the site by barge or ferry for the life of the GLNG Project (for both construction and operation) if the access road and bridge is not constructed.

Construction of the first train (Train 1) including the marine facilities and capital dredging is proposed to commence in 2010 with construction taking approximately four years. During this period the gas transmission pipeline will also be constructed. This will take approximately two years.

The LNG facility operations are planned to commence in 2014. Depending on demand, it is possible that construction of Train 2 could commence in 2014 and Train 3 in 2018, which will bring the LNG facility up to its ultimate capacity of 10 Mtpa by 2021. However the timing of these trains is dependant on market conditions, gas availability, labour availability and the economic climate and may be earlier or otherwise vary from what is described in the EIS. It is possible that construction of Trains 1 and 2 and/or Trains 2 and 3 may overlap.

Section 1 Introduction

1.2 Report Structure

This EPBC Act Controlled Action Assessment Report has been prepared, as required by the EIS Terms of Reference, as a compilation of those matters relevant under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The information within this report relates to five EPBC referrals, which are identified in Table 2-1. Section 3 to Section 7 present specific information on each of the referrals, allowing each to be read independently (without cross-reference). As a result of this, there is substantial duplication of information, as the assessments of impacts on matters of national significance for a number of the referrals are similar.

1.3 Environment Protection and Biodiversity Conservation Requirements

1.3.1 Matters of National Environmental Significance

Part 3 of the EPBC Act protects matters of national environmental significance (MNES). Part 3 of the EPBC Act prohibits the taking of "actions" which have, will have, or are likely to have, a significant impact on MNES. The EPBC Act identifies seven MNES:

- World Heritage properties;
- National Heritage places;
- Ramsar wetlands of international importance;
- Nationally listed threatened species and communities;
- Listed migratory species;
- Nuclear actions; and
- Commonwealth marine areas.

Section 67 of the act provides for an action to be a controlled action if the taking of the action without approval would be prohibited, namely it has, will have or is likely to have a significant impact on one or more of the MNES or is a nuclear action. Section 68(1) requires a person who proposes to take an action that the person thinks may be or is a controlled action to refer the proposal to the Minister administering the Commonwealth Department of Environment, Water, Heritage and the Arts for the Minister's decision whether or not the action is a controlled action. If an action is determined by the Minister to be a controlled action, the proponent will require the Minister's approval under Pt 9 of the EPBC Act to carry out the action.

1.3.1.1 EPBC Act Referrals

On 28 February 2008 and 13 March 2008, Santos lodged five separate EPBC referrals (Table 1-1) to describe the components of the project potentially considered as controlled actions under Part 3 of the EPBC Act.

Section 1 Introduction

Table 1-1 EPBC Referral Details

Referral Number	Project Component	MNES
EPBC 2008/4057	Development of a natural gas liquefaction and export park with a 10mtpa capacity	• World Heritage (Section 12, 15A) • National Heritage Places (Section 15B, 15C) • Listed Threatened Species and Communities (Section 18, 18A) • Listed Migratory Species (20, 20A)
EPBC 2008/4058	Construction of marine facilities including a Product Loading Facility, berthing pockets, materials Off-loading facility and channel dredging	• World Heritage (Section 12, 15A) • National Heritage Places (Section 15B, 15C) • Listed Threatened Species and Communities (Section 18, 18A) • Listed Migratory Species (20, 20A)
EPBC 2008/4059	Development of coal seam gas resources across 2 million hectares in the area around Roma, Queensland	• Listed Threatened Species and Communities (Section 18, 18A) • Listed Migratory Species (20, 20A)
EPBC 2008/4060	Construction of a bridge, road and services corridor to access the LNG plant	• World Heritage (Section 12, 15A) • National Heritage Places (Section 15B, 15C) • Listed Threatened Species and Communities (Section 18, 18A) • Listed Migratory Species (20, 20A)
EPBC 2008/4096	Gas Transmission Pipeline and route option	• World Heritage (Section 12, 15A) • National Heritage Places (Section 15B, 15C) • Listed Threatened Species and Communities (Section 18, 18A) • Listed Migratory Species (20, 20A)

All five referrals were declared to be controlled actions under the EPBC Act due to the potential for a significant impact on the following MNES:

- World Heritage properties (sections 12 and 15A);
- National Heritage Places (Sections 15B & 15C);
- Nationally listed threatened species and communities (Sections 18 and 18A); and
- Listed migratory species (Sections 20 and 20A).

As a consequence, the proposed actions require assessment and approval under the EPBC Act. The environmental assessment process for the proposed actions will be conducted under the Queensland Government's *State Development and Public Works Organisation Act 1971 (Qld)* in accordance with the Bilateral Agreement between the Australian and Queensland Governments pursuant to section 87(1)(a) of the EPBC Act.

This report addresses the assessment requirements for controlled actions of the GLNG Project with the potential to affect MNES as described in Table 1-1. This report has been developed in accordance with the Terms of Reference (ToR) issued by the Queensland Co-ordinator General in August 2008 and the requirements of the Bilateral Agreement between the Australian and Queensland Government's for the purposes of the environmental impact assessment under Part 8 of the EPBC Act.

The Minister determined that each of the five referrals relates to a controlled action and that the approval of the Minister is required. The controlled action is subject to the bilateral agreement.

Section 1 Introduction

The following sections highlight the key MNES that are potentially affected by the overall project. Sections 3 to 7 provide a detailed review and assessment of each of the EPBC referrals noted in Table 1-1.

1.3.1.2 World Heritage Properties

In 1981, the Great Barrier Reef (GBR) was inscribed as a World Heritage Area (WHA) by the United Nations Educational, Scientific and Cultural Organization (UNESCO) due to its outstanding universal value. UNESCO seeks to encourage the identification, protection and preservation of cultural and natural heritage around the world considered to be of outstanding value to humanity. This is embodied in an international treaty called the Convention concerning the Protection of the World Cultural and National Heritage adopted by UNESCO in 1972. The GBR WHA was nominated for all four *natural* criteria set out in Article 2 of the World Heritage Convention under the 'Operational Guidelines for the Implementation of the World Heritage Convention'. (UNESCO Website; http://whc.unesco.org/en/141). These criteria relate to natural attributes of a World Heritage Area and are listed in Table 1-2 as:

- Containing unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty; and
- Being an outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment;
- Being an outstanding example representing a major stage of the earth's evolutionary history;
- Providing habitats where populations of rare and endangered species of plants and animals still survive.

According to a study conducted by Lucas *et al* (1998) on the outstanding universal values of the GBR WHA, it was determined that specific attributes of 'outstanding universal value', such as the world's largest aggregation of breeding green turtles, can be identified. Further consultation with experts on physical, biological and aesthetic attributes led to the conclusion that 'outstanding universal value' of the World Heritage Area relied on the scale of the GBR WHA and the potential for effective conservation management.

The Great Barrier Reef Marine Park Authority (GBRMPA) negotiated a Memorandum of Understanding (MoU) with other Commonwealth departments and agencies that have responsibilities related to World Heritage in the Great Barrier Reef region. The MoU identifies the GBRMPA as the lead agency for any actions that may affect the Commonwealth's obligations under the World Heritage Convention in relation to the Great Barrier Reef World Heritage Area.

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Table 1-2 Critical Values and Attributes for the Great Barrier Reef World Heritage Area (GBRMPA Website, 2009)

World Heritage criteria	Examples of values / attributes
(VII) - Exceptional natural beauty and aesthetic importance	• Spectacular seascapes and landscapes; for example, Whitehaven Beach, Whitsunday islands, Hinchinbrook Island, mosaic patterns on reefs; • Spectacular coral assemblages (hard and soft corals); • >1500 species of fish providing a myriad of colours, shapes and sizes.
(VIII) - Significant geomorphic or physiographic features	• The world's largest coral reef ecosystem, extending over 14 degrees of latitudinal range; about 3000 separate coral reefs ranging from inshore fringing reefs to mid shelf, exposed outer reefs and deep water reefs and shoals; • Deep water features of the adjoining continental shelf including canyons, channels, plateaux and slopes.
(IX) - Significant ongoing ecological and biological processes	• An extensive diversity of reef morphologies and ongoing geomorphic processes; • ~ 900 islands ranging from small coral cays (in various stages of geomorphic development) to large continental islands; • Complex cross-shelf, longshore and vertical connectivity facilitated by dynamic current flows, incorporating important ecological processes such as larval dispersal; • Breeding and spawning grounds for unique coral reef associated species, including threatened and vulnerable species such as turtles, whales and humphead Maori wrasse.
(X) - Significant natural habitat for *in-situ* conservation of biological diversity	• Over 2000 km^2 of mangroves including 54 per cent of the world's mangrove diversity; • ~ 43 000 km^2 of seagrass meadows in both shallow and deep water areas supporting one of the world's most important dugong populations and six of the world's seven species of marine turtle; • 70 bioregions (broad-scale habitats) have been identified comprising 30 reef bioregions and 40 non-reefal bioregions; these include algal and sponge gardens, sandy and muddy bottom communities, continental slopes and deep ocean troughs; • The reef bioregions contain one third of the world's soft coral and sea pen species (80 species); • 800 species of echinoderms (for example sea stars) equalling 13 per cent of the world's total species; • The location of the world's largest green turtle breeding area, other key breeding areas, regionally important seabird nesting islands, significant spawning ground (for example black marlin) and a significant area for humpback whale calving and rearing.

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The Great Barrier Reef World Heritage Area (GBRWHA) covers approximately 347,800 km^2 and stretches for over 2,000 km along the north-eastern coast of Australia, from the low water mark on the mainland, including most islands and internal Queensland waters. Under a memorandum of understanding, the Great Barrier Reef Marine Park Authority (GBRMPA) acts as a lead agency for the Commonwealth in matters relating to the GBRWHA. Port Curtis is within the WHA (Figure 1-1).

1.3.1.3 National Heritage Places

The Australian Commonwealth Government developed legislation to establish a heritage system to compliment and enhance the World Heritage Management regime. The system includes the establishment of a National Heritage List of Places that have outstanding national heritage values, including cultural, natural and indigenous heritage values. In accordance with the provisions of item 1A of Schedule 3 of *the Environment and Heritage Legislation Amendment Act (No. 1) 2003* the World heritage properties included in the World Heritage list are included in the National Heritage List for those world heritage values that the World Heritage Committee has identified the property as having (Commonwealth Gazette, May 2007). Each world heritage value that each place has, because it meets the world heritage criterion listed in the Schedule, is taken to cause the relevant World Heritage property to meet a National Heritage criterion corresponding to that world heritage value. The Great Barrier Reef's corresponding National Heritage Criteria to the World Heritage property values XII; XIII; IX and X is (a); (b); (c); (d); and (e) are listed in Table 1-3:

Table 1-3 National Heritage Value for the Great Barrier Reef

Outstanding Heritage Value	Examples of value
The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural cultural history;	The GBR has 70 bioregions (broad-scale habitats) have been identified comprising 30 reef bioregions and 40 non-reefal bioregions; these include algal and sponge gardens, sandy and muddy bottom communities, continental slopes and deep ocean troughs;
The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;	The Great Barrier Reef World Heritage Area covers approximately 347,800 km^2 and stretches for over 2,000 km along the north-eastern coast of Australia, from the low water mark on the mainland, including most islands and internal Queensland waters. Under a memorandum of understanding, the Great Barrier Reef Marine Park Authority acts as a lead agency for the Commonwealth in matters relating to the World heritage area. Over 2000 km^2 of mangroves including 54 per cent of the world's mangrove diversity; ~ 43 000 km^2 of seagrass meadows in both shallow and deep water areas supporting one of the world's most important dugong populations and six of the world's seven species of marine turtle; The reef bioregions contain one third of the world's soft coral and sea pen species (80 species); Breeding and spawning grounds for unique coral reef associated species, including threatened and vulnerable species such as turtles, whales and humphead Maori wrasse. 800 species of echinoderms (for example sea stars) equalling 13 per cent of the world's total species; The location of the world's largest green turtle breeding area, other key breeding areas, regionally important seabird nesting islands, significant spawning ground (for example black marlin) and a significant area for humpback whale calving and rearing.

Outstanding Heritage Value	Examples of value
The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;	An extensive diversity of reef morphologies and ongoing geomorphic processes; ~ 900 islands ranging from small coral cays (in various stages of geomorphic development) to large continental islands; Complex cross-shelf, longshore and vertical connectivity facilitated by dynamic current flows, incorporating important ecological processes such as larval dispersal.
The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: a class of Australia's natural or cultural places; or a class of Australia's natural or cultural environments	The GBR is international recognised as a World Heritage area having the largest and most significant expanse and diversity of coral reef formation in the world. The GBR is important for its cultural heritage for indigenous populations within Australia in providing habitat for species used as a food source and as cultural purposes.
The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics values by a community or cultural group	Spectacular seascapes and landscapes; for example, Whitehaven Beach, Whitsunday islands, Hinchinbrook Island, mosaic patterns on reefs; Spectacular coral assemblages (hard and soft corals); >1500 species of fish providing a myriad of colours, shapes and sizes.

The National Heritage values are discussed in terms of the World Heritage values throughout this report as the values are linked with the World heritage values.

1.3.1.4 Ramsar Wetlands of International Importance

There are no Ramsar wetlands present within close proximity to the proposed CSG field, gas transmission pipeline, bridge, road and services corridor, LNG facility and marine facilities. The MNES search recorded the Narran Lake Nature Reserve and the Shoalwater and Corio Bays Ramsar Wetland as being within the catchment area. However, as they are more than 350km and 80km away from the CSG fields and gas transmission pipeline respectively. It is not expected that Santos' proposal would have any impacts on this Ramsar site.

It should be noted that the proposed LNG facility and associated infrastructure is within Port Curtis, which is listed on the Directory of Important Wetlands in Australia (but not a Wetland of International Significance). This area has been identified for its extensive range of marine wetlands encompassing seagrass beds, mangrove forest and intertidal mud flats that provide habitat for a range of significant migratory water birds, reptiles and mammals. The Directory of Important Wetlands lists The Narrows, Port Curtis and Colosseum Inlet/Rodds Bay as important wetlands.

An important wetland may be considered for inclusion on this list if it meets one of the six criteria (Miller & Deacon 2005):

1) *It is a good example of a wetland type occurring within a biogeographic region in Australia.*
2) *It is a wetland that plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex.*
3) *It is a wetland that is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.*
4) *The wetland supports 1% or more of the national populations of any native plant or animal taxa.*
5) *The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level.*
6) *The wetland is of outstanding historical or cultural significance.*

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This report refers to potential impacts to matters of national environmental significance under the EPBC Act from the construction, operation and decommissioning of the GLNG project. Impacts to Port Curtis as as a wetland that is listed on the Directory of Important Wetlands are discussed in the Nature Conservation section of the EIS (Section 8.4).

1.3.1.5 Nationally Listed Threatened Species and Communities

The EPBC Act provides for the listing of nationally threatened native species and ecological communities, native migratory species and marine species. Certain species that are listed as threatened under the EPBC Act will be impacted by the Project. EPBC Act *Policy Statement 1.1 – Significant Impact Guidelines* (Guidelines) provides that an action is likely to have a significant impact on a threatened species if there is a real chance or possibility that it will:

- Lead to long term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of the species;
- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to the species becoming established;
- Introduce disease that may cause the species to decline; or
- Interfere with the recovery of the species.

Certain species that are listed as threatened under the EPBC Act may be impacted in some way by the Project, but there will not be a real chance or possibility of one of the items listed above occurring due to the fact that the LNG facility, marine facilities, road, bridge and service corridors and marine crossing of the gas transmission pipeline do not represent core habitat for nationally listed threatened species and communities found within the World Heritage Area.

1.3.1.6 Listed Migratory Species

Australia is a signatory to the Convention for the Conservation of Migratory Species of Wild Animals (CMS) or Bonn Convention. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme. The aims of the CMS are to conserve terrestrial, marine and avian migratory species throughout their range. Australia has also entered into agreements and memorandums of understanding (MoU's) related to protecting migratory species. Australia delivers its international obligations to protect migratory species through the EPBC Act.

The guidelines provide that an action is likely to have a significant impact on a migratory species if there is a possibility it will:

- Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles) destroy or isolate an area of important habitat for a migratory species; and/or
- Result in invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

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The following information is taken from the CMS Website (2009) and provides background for species listings under the EPBC Act and their conservation status as migratory species.

Birds

Over the last five years, under the framework of the *Asia-Pacific Migratory Waterbird Conservation Strategy: 1996-2000*, the Governments of Australia and Japan have worked with other governments of the Asia-Pacific region, Non-Government Organisations (NGO) including Wetlands International, Bird Life International, World Wide Fund for Nature, the Convention on Wetlands and the Convention of Migratory Species, technical experts and local communities to promote the conservation of waterbirds and wetlands. The initiative is coordinated by Wetlands International. Significant progress has been made across a wide range of actions. Three international networks of sites (for Anatidae, cranes and shorebirds) have been established. These Networks have been built by people for people and sites. Training courses, dissemination of wetland awareness and technical material in many languages, have been undertaken. Regional and national meetings have been organised to share experiences and expertise in such areas as conducting research and managing wetlands. All this has been possible through the active participation and cooperation of the peoples of the region.

The *Asia-Pacific Migratory Waterbird Conservation Strategy: 2001-2005* offers a sound framework for governments, local people, NGOs, the corporate sector, donor agencies and international conventions to continue to work together in a common cause to save wetlands and migratory waterbirds. It offers the opportunity for greater participation to build on a successful program and to achieve conservation on the ground, and at a national and international level. The Governments of Australia and Japan strongly support continuation of the *Asia-Pacific Migratory Waterbird Conservation Strategy: 2001-2005*.

The Asia Pacific Migratory Waterbird Conservation Strategy 2001- 2005, lists 175 species of divers, grebes, pelicans, cormorants, herons, storks, ibises, flamingos, geese, cranes, rails, sun grebes, jacanas, crab plovers, oystercatchers, stilts and avocets, pratincoles, plovers, scolopacids, gulls and terns. Thirteen of the species are already listed on Appendix I of the Bonn Convention.

Australia's involvement in the World Summit on Sustainable Development (WSSD) Type II Partnership for Migratory Waterbirds in the East Asian- Australasian Flyway has been through cooperative policy position on conservation of migratory birds and migratory shorebirds across the entire range of the migration of these species. The following bilateral agreements oblige contracting parties to protect migratory bird species and their environments that regularly migrate between Australia, Japan, the Peoples Republic of China and the Republic of Korea:

- Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment (JAMBA);
- Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment (CAMBA); and
- Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA).

Mammals

Whales, dolphins and porpoises (cetaceans) migrate over large distances, connecting ocean ecosystems and cultures throughout the Pacific Islands Region. Although currently protected by an international moratorium on whaling, most of these species that frequent the Pacific Islands Region remain endangered or vulnerable.

To provide an international framework for coordinated conservation efforts, a Memorandum of Understanding (MoU) was launched on 15 September 2006 under the auspices of the Convention for the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) and in collaboration with the South Pacific Regional Environment Programme (SPREP). The MoU includes plans to protect and conserve Pacific cetaceans and their habitats, including their migratory corridors. The survival of many cetacean populations that frequent the waters of the Pacific Islands Region, particularly those that have

been severely depleted, can be affected by interactions with fisheries, hunting, pollution, collisions with boats, noise, habitat degradation, climate change, disruption of food chains and irresponsible tourism. The EPBC Act lists these species as migratory marine species protecting them under international obligations.

Australia has international, national and state obligations to conserve dugongs. The dugong (*Dugong dugon)* is listed as Vulnerable to extinction at a global scale by the International Union for Conservation of Nature (IUCN) and is also listed on Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and on Appendix II of the Bonn Convention. Australia is a signatory to both conventions. In Australia, dugongs are protected under the EPBC Act as both a listed migratory species and a listed marine species. The Great Barrier Reef (GBR) region supports globally significant populations of the dugong. Dugongs are the only marine mammal that are herbivorous and are the only surviving species in the Family Dugonidae (GBRMPA Website, 2007). Dugongs have a high conservation value as well as cultural, social and spiritual significance for Indigenous Australians and are considered an indicator of ecosystem health for coastal marine habitats, particularly seagrass systems.

Reptiles

A Memorandum of Understanding (MoU) for the following marine reptiles: the loggerhead turtle (*Caretta caretta*), Ridley turtle (*Lepidochelys olivacea*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*) and flatback turtle (*Natator depressus*) was concluded under the auspices of the Bonn Convention and became effective on 1 September 2001. It applies to the waters and coastal States of the Indian Ocean and South-East Asia and adjacent seas, including Australia. The MoU puts in place a framework through which the signatories can work together to conserve and replenish depleted marine turtle populations for which they share responsibility.

Major threats to marine turtles include unsustainable exploitation, destruction of nesting and feeding habitats and incidental mortality in fishing operations. Threatened or endangered in many parts of the world, marine turtles are considered as flagship species on which to base interventions aimed at protecting habitats of importance for a myriad of other marine species.

Sharks

The Bonn Convention establishes several shark species as migratory species, the vital ecosystem role played by sharks and the continuing and significant mortality of sharks through a range of impacts including habitat destruction, target fisheries, illegal, unreported and unregulated fishing and fisheries by-catch. The Bonn Convention requests that all signatories strengthen measures to protect migratory sharks against threatening processes and the whale shark is listed under the EPBC Act.

1.3.1.7 Nuclear Actions

This section does not apply to this proposal.

1.3.1.8 Commonwealth Marine Areas

The Commonwealth Marine Area stretches from 200 nautical miles offshore (the Exclusive Economic Zone) to 3 nautical miles from the shoreline on the eastern side of Curtis Island. The proposed LNG facility, marine facilities, potential bridge and access road, and the gas transmission pipeline are located on the western side of Curtis Island and will not be located within the Commonwealth Marine Area. Consequently, the construction phase of the LNG facility is not expected to have a significant impact on these areas.

Increased shipping activities during the operational phases of the project may potentially impact on the Commonwealth Marine Area through increased passage of ships through the area. LNG ships are constructed in accordance with the provisions of the IMO “International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk”. Assuming 155,000 m^3 capacity ships, at the initial single train LNG production rate of 3 - 4 Mtpa, there will be approximately 50 ship loads exported each

year, or about one ship per week. This rate will increase to 160 ships per year or about one ship every 2 days when the production rate increases to 10 Mtpa. Using larger ships will involve correspondingly fewer ship movements.

Shipping in the Great Barrier Reef Marine Park (the Marine Park) is managed by several government agencies including the Australian Maritime Safety Authority, Maritime Safety Queensland, the Great Barrier Reef Marine Park Authority and the Department of Infrastructure, Transport, Regional Development and Local Government. The Great Barrier Reef Marine Park Authority (GBRMPA) is the principal adviser to the Australian Government on the management and development of the Marine Park. GBRMPA's role includes regulating the entry and use of the Marine Park by ships and other vessels through the Great Barrier Reef Marine Park Zoning Plan 2003 (the Zoning Plan).

As prescribed by the Zoning Plan, ships may transit the Marine Park through the General Usage Zone (light blue) or through other designated shipping areas by permit. The shipping area designated in the Zoning Plan is designed to minimise the potential impact on the shipping industry whilst having regard for Australia's international obligations. The placement of the designated shipping area reflects vessel usage patterns in the inner and outer shipping routes, existing recommended tracks, and new routes to allow for growth in shipping (GBRMPA 2003a).

The movement of the LNG ships through the Great Barrier Reef is not expected to have any significant impact on any matter of national environmental significance for the following reasons:

- Ship movements will be limited to existing shipping channels.
- At peak production the project will generate 160 shipments of LNG per year (one every two days). The current level of shipping through the designated shipping channels of the Great Barrier Reef is approximately 2,000 ship movements per year.
- The LNG industry has had an impressive safety record over the last 47 years. Since international commercial LNG shipping began in 1959, tankers have carried over 33,000 LNG shipments without a serious accident at sea or in port.
- LNG ships are generally fuelled by LNG rather than bunker oil. Consequently in the event of an accident, the amount of oil on board that could potentially spill is significantly less than for normal shipping.
- All newer ships have double hull protection around the forward and aft bunker fuel tanks. However, while on some of the approximately 30 year old LNG ships the engine room bunker fuel tanks are not within the double hull, for fuel efficiency and boiloff rate reasons many of these older vessels will no longer be carrying LNG cargo by the time Gladstone LNG terminal starts operations.
- Santos will ensure that its shipping charter parties adopt the necessary controls to ensure compliance with all relevant international conventions including the International Convention for the Control and Management of Ships Ballast Water and Sediments and the International Convention for the Prevention of Pollution from Ships.

1.3.2 Ecologically Sustainable Development

The principles of ecologically sustainable development (ESD) have influenced the manner and extent to which possible impacts on the matters of national environmental significance have been assessed and addressed in the planning and design of the GLNG Project. The principles of ESD are:

- Decision making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
- If there are threates of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;

- The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
- The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making; and
- Improved valuation, pricing and incentive mechanisms should be promoted.

These principles will continue to guide Santos in the context of matters of national environmental significance in the construction, operational, decommissioning and rehabilitation of the GLNG Project.

Climate change is a global issue requiring significant resources to meet complex environmental, energy, economic and political challenges. As a global stakeholder in the energy business, Santos recognises that one of its most important environmental responsibilities is to pursue strategies that address the issue of greenhouse gas (GHG) emissions. A clean energy strategy is the cornerstone of Santos' Climate Change Policy published in December 2008 (Climate Change Policy).

1.3.2.1 Listed Threatened Species and Ecological Communities

The Minister nominated sections 18 and 18A of the EPBC Act as controlling provisions for the purpose of each of the referrals lodged in respect of the GLNG Project. Consequently, pursuant to section 136(1)(a) of the EPBC Act, the Minister will be obliged to consider matters relevant to various categories of listed threatened species and listed threatened ecological communities in deciding whether or not to approve the GLNG Project, and what conditions to attach to the approval.

Santos has specifically integrated the principles of ESD into its environmental assessment and design of the GLNG Project in the context of listed threatened species and ecological communities by way of:

- Identifying the "Endangered" and "Of Concern" species that are present within the project area and assessing the likely impact of the project on these species having regard to the principles of ESD;
- Developing protocols for construction to avoid disturbance of "Endangered" and "Of Concern" vegetation communities;
- Developing protocols for construction to avoid creation of isolated stands of vegetation to retain habitat connectivity, and to retain habitat hollows and other habitat features wherever practicable;
- Developing offsets to compensate for areas of reduced habitat for listed threatened species to be directly impacted; and
- Developing protocols for construction to minimise impact including ensuring qualified fauna spotters are actively present during clearing of woodland vegetation and any other areas of faunal habitat.

1.3.2.2 Listed Migratory Species

The Minister nominated sections 20 and 20A of the EPBC Act as controlling provisions for the purpose of each of the referrals lodged in respect of the GLNG Project. Consequently, pursuant to section 136(1)(a) of the EPBC Act, the Minister will be obliged to consider matters relevant to listed migratory species in deciding whether or not to approve the Project and what conditions to attach to the approval.

Santos has specifically integrated the principles of ESD into its environmental assessment and design of the GLNG Project in the context of listed migratory species by way of:

- Identifying the migratory species that are present within the project area and assessing the likely impact of the project on these species having regard to the principles of ESD;
- Identifying the importance of the GLNG Project area as habitat for migratory species; and
- Developing management protocols for minimising impacts to migratory species and essential habitats.

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1.3.2.3 Declared World Heritage Property

The Minister nominated sections 12 and 15A of the EPBC Act as controlling provisions for the purpose of referrals EPBC 2008/4057, EPBC 2008/4058, EPBC 2008/4060 and EPBC 2008/4096 lodged in respect of the GLNG Project. Consequently, pursuant to section 136(1)(a) of the EPBC Act, the Minister will be obliged to consider matters relevant to the world heritage values of declared World Heritage property in deciding whether or not to approve the GLNG Project, and what conditions to attach to the approval.

Santos has specifically integrated the principles of ESD into its environmental assessment and design of the GLNG Project in the context of World Heritage property by way of:

- Identifying the locations of world heritage areas in relation to the project area and assessing the likely impact of the project having regard to the principles of ESD; and
- Developing management protocols for minimising impacts to world heritage areas.

1.3.2.4 National Heritage Places

The Minister nominated sections 15B and 15C of the EPBC Act as controlling provisions for the purpose of referrals EPBC 2008/4057, EPBC 2008/4058, EPBC 2008/4060 and EPBC 2008/4096 lodged in respect of the GLNG Project. Consequently, pursuant to section 136(1)(a) of the EPBC Act, the Minister will be obliged to consider matters relevant to the National Heritage values of National Heritage places in deciding whether or not to approve the GLNG Project, and what conditions to attach to the approval.

Santos has specifically integrated the principles of ESD into its environmental assessment and design of the GLNG Project in the context of National Heritage places by way of:

- Identifying the locations of national heritage places in relation to the project area and assessing the likely impact of the project having regard to the principles of ESD;
- Developing protocols to avoid disturbance of heritage sites where possible and all state significant sites;
- Developing protocols to ensure that unexpected heritage sites are identified and assessed appropriately; and
- Developing management systems to ensure that heritage sites in Santos ownership are appropriately managed.

1.3.2.5 Greenhouse Gas Emissions

GHG emissions were inventoried and assessed as a total from the entire GLNG Project. The organisational boundary of the GLNG Project is delineated by the physical LNG facility site on Curtis Island, the gas transmission pipeline easement, and the CSG field development area. Auxiliary infrastructure such as communications infrastructure, water management systems, and wastewater treatment facilities are not included within the project organisational boundary. Third-party shipping and end use of the LNG product are also outside the project organisational boundary, though included as part of the discussion of Scope 3 emissions.

The Scope 1 emission sources from the CSG fields included in the inventory are:

- Fuel consumption in process equipment;
- Diesel fuel consumption in vehicles for all stages of the GLNG Project;
- Flaring and venting of gas;
- Fugitive emissions of gas from process equipment and drilling activities; and
- Land clearing during all stages of the GLNG Project.

Scope 2 emissions are considered to be immaterial as there will be no significant purchases of electricity for the CSG field operations. Field operations will primarily be gas or diesel-powered.

GHG emissions have been estimated for drilling activities on both an average annual basis and a total lifetime basis. The estimates assume a project life of 25 years.

Gas will be flared during drilling activities and well development, before the well is connected to the in-field gathering pipeline network, to reduce the GHG impacts from fugitive gas releases. Flaring and venting will be minimised as much as practical. Flaring will convert the GHG content of the released gas from CH_4 to CO_2 which has a lower greenhouse warming potential. Santos has provided an average flaring rate for well development activities based on its experience.

Carbon sequestration due to rehabilitation of cleared areas has not been included in the inventory.

Estimates of emissions resulting from the GLNG Project (10 million tonnes per annum (Mtpa)) are given in Table 1-4

Table 1-4 Greenhouse Gas Emissions

Stage	Scope 1 Emissions (million tonnes)		Percentage of Queensland's Total Emissions	Percentage of Australia's Total Emissions
	Annual	Total		
3 Mtpa	2.6	66.4	1.55%	0.46%
10 Mtpa	5.0 - 7.2	110.4 - 166.0	2.90 – 4.21%	0.86% - 1.25%

Scope 3 emissions for the GLNG Project relate primarily to the GHG emissions generated by the transportation and end use of the LNG. The most likely destinations for export of the LNG are in Asia, specifically Japan, China and Korea. An indicative estimate of Scope 3 emissions resulting from the transport of the GLNG product to Japan and its combustion in a power plant is 68.3 Mtpa of GHG from the 3 train stage of 10 Mtpa of LNG. This is 47% of the 146.6 Mtpa of GHG that would be generated by burning coal to produce the same amount of power.

1.3.3 Key Threatening Processes

The EPBC Act provides for the identification and listing of key threatening processes if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.

The following listed threatening processes are relevant to this EIS:

- Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris;
- Land clearance; and
- Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases.

1.3.3.1 Injury and Fatality to Vertebrate Marine Life Caused by Ingestion of, or Entanglement in, Harmful Marine Debris

Harmful marine debris consists of plastic garbage washed or blown from land into the sea, fishing gear abandoned by recreational and commercial fishers, and solid non-biodegradable floating materials (such as plastics) disposed of by ships at sea.

Marine debris resulting from the legal disposal of garbage at sea is excluded from this key threatening process. Under the International Convention for the Prevention of Pollution of Ships, overboard disposal

of food, paper, glass, metal and crockery (but not plastics) is permitted from vessels more than 12 nautical miles from land.

Endangered, vulnerable and migratory marine species listed under the EPBC Act are susceptible to impacts from ingestion and entanglement of harmful marine debris.

Threat Abatement Plans are being developed for the process and will build on existing activities to mitigate marine debris. This includes government programs to improve waste retrieval from water courses; anti-littering laws; laws controlling overboard disposal of ship and boat garbage and fishing gear and plans to reduce litter from plastic shopping bags.

The most important convention regulating marine pollution by ships is the International Maritime Organisations International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 (MARPOL). The legislation giving effect to MARPOL in Australia is the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and the *Navigation Act 1912* and parts of several marine orders made under this legislation.

The GLNG Project's EMP will include waste management strategies designed to ensure that all waste is contained and managed responsibly so that no waste is able to be washed or blown from either the construction sites or the operational facility and pose a threat to marine life by either ingestion or entanglement. In addition, Santos will ensure that all contractual arrangements with third party shipping companies specify compliance with the requirements of Threat Abatement Plans whilst in Commonwealth Waters and conditions under MARPOL arrangements. On this basis no significant impacts on marine life is likely from ingestion of or entanglement in harmful marine debris.

1.3.3.2 Land Clearance

Land clearance consists of the destruction of the above ground biomass of native vegetation and its substantial replacement by non-local species or human artefacts. Native vegetation is defined as vegetation in which native species constitute more than 70% of the plant cover or other vegetation containing populations of species listed under the EPBC Act. Substantial replacement by non-local species or human artefacts is defined as the achievement of more than 70% of the total cover by species or human artefacts that did not occur previously on the site.

Land clearing includes clearance of native vegetation for crops, improved pasture, plantations, gardens, houses, mines, buildings and roads. It also includes infilling of wetlands or dumping material on dry land native vegetation, and the drowning of vegetation through the construction of impoundments. It does not include silvicultural operations in native forests and manipulation of native vegetation composition and structure by grazing, burning or other means.

The greatest area of land disturbance associated with the GLNG Project will be the development of the CSG fields. The northern fields of Arcadia Valley, Comet Ridge, Fairview, Mahalo and the southern part of the Denison Trough have similar landscape characteristics consisting of mountain ranges, scarps and ledges. These areas are primarily densely vegetated and much less amenable to agricultural development. The southern gas fields of Roma and Eastern Surat Basin are primarily located in cleared areas of largely flat agricultural land. These areas have been largely modified due to agricultural development and significantly less remnant vegetation remains than is evident in the northern gas fields.

Whiles the CSG fields cover a large area, the extent of clearing required is relatively very small. The reasonably foreseeable development area (i.e. that part of the field required for Train 1 of the LNG facility) is approximately 6,900 km^2. The footprint of the CSG field development in this area will be approximately one third of this. However only a small part of this will need clearing as the majority of the works will be located on cleared land.

Santos has considerable flexibility as to where the gas wells and access roads can be located and hence it is able to implement a number of strategies to minimise impacts relating to vegetation clearing including the following:

- Avoiding sites of known scientific and natural significance and/or cultural heritage sites;

- Minimising or where possible avoiding clearance of trees and shrubs;
- Minimising disturbance of natural drainage patterns;
- Minimising risks to wildlife and stock;
- Locating accommodation facilities as close to work areas as possible;
- Using existing roads or tracks where possible (ie. rationalising access);
- Using common or adjacent easements for pipelines, roads or seismic lines;
- Avoiding impact on floodplains, wetlands or permanent waterholes;
- Avoiding introduction of weeds;
- Using a central waste facility whenever possible; and
- Rehabilitating areas once they are no longer required for exploration or production purposes.

For these reasons it is considered that the GLNG Project will not cause significant land clearing issues in accordance with this listed threatening process.

1.3.3.3 Loss of Terrestrial Climatic Habitat Caused by Anthropogenic Emissions of Greenhouse Gases

The 'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' consists of reductions in the bioclimatic range within which a given species or ecological community exists due to emissions induced by human activities of greenhouse gases. Human activities are described in the National Greenhouse Gas Inventory and include: energy; industrial processes; solvent and other product use; agriculture; land use change and forestry; and waste. Greenhouse gases are the main greenhouse gases identified in the National Greenhouse Gas Inventory.

The distribution of the nominated process is continental. Ecosystems in which the process occurs include: alpine habitats; coral reefs; wetlands and coastal ecosystems; polar communities; tropical forests; temperate forests; and arid and semi-arid environments.

Non-biological components of the process include: temperature rise; changes in rainfall patterns; changes to the El Nino Southern Oscillation; and sea level rise.

Recommendation was made that a nationally co-ordinated Threat Abatement Plan would not be feasible, effective or efficient way to abate the process as the Commonwealth, States and Territories have actions underway to abate this process. Along with the issues of emissions reduction, the adaptation requirements of species and communities likely to be affected by climate change could be given greater priority.

The estimated GHG emissions from the GLNG Project at full production (10 Mtpa) have been estimated to be 0.86 % - 1.25 % of Australia's total emissions (Section 6.9.4.5 of the EIS). This, of itself, will not contribute in any significant way to a loss of terrestrial climatic habitat. In addition, there are no climate change sensitive habitats within the project region.

1.3.4 Environmental Performance

Santos has a long history of conducting its activities in a way that avoids or minimises potential impacts on the environment. This is based on a thorough understanding of the receiving environment, coupled with proven techniques tailored to specific ecosystems. Environmental performance is monitored by tracking against strategic company-wide and site-specific key performance indicators.

Santos has a company-wide environment, health and safety management system which will be applied to the GLNG Project. The EHSMS provides a structured framework for effective environmental and safety

Section 1 Introduction

practice across all of Santos' activities and operations. The framework has been developed to ensure compliance with Australian Standard 4801:2000 *Occupational Health and Safety Management Systems – Specification* and AS/NZS ISO 14001:1996 *Environmental Management Systems – Specification*.

Management standards have been developed as part of the EHSMS and define the requirements necessary to ensure that environmental, health and safety risks are systematically managed. Hazard standards detail the controls required to manage the risks of specific hazards to acceptable levels. They contain specific requirements for planning and undertaking activities and include checklists and references to internal and external approvals and controls. Environment hazard standards have also been developed under the EHSMS.

In line with PETRONAS' commitment to continuous growth and sustainable development for the future, PETRONAS works in the best possible way to balance and integrate economic, environmental and social considerations into its business decisions. To this end PETRONAS is guided by a comprehensive HSE (Health, Safety and Environment) Management System which is implemented across the PETRONAS group of companies.

Section 2 LNG Facility- EPBC 2008/4057

2.1 Description of Proposed Action

EPBC Act referral number EPBC 2008/4057 relates to the LNG facility and its associated infrastructure.

The LNG facility will be located at the Hamilton Point West site adjacent to China Bay on Curtis Island. The location of the proposed site was selected based on a number of criteria including shipping access, geotechnical suitability, environmental suitability and proximity to infrastructure.

The LNG facility is proposed to be developed in three stages (called trains), the first of which will have a capacity of approximately 3 - 4 Mtpa. The overall size of the site is approximately 190 ha. The initial 3 - 4 Mtpa facility (Train 1) will have a footprint of about 40 ha increasing to 100 ha for the 10 Mtpa facility (Trains 1-3).

Construction of the LNG facility will take approximately four years. The construction workforce will peak at approximately 3,000 people for the stick-built option. If pre-assembled modules are used this may reduce to 2,000. Construction workers will work 10-hour days for 10 days and then have a 4-day leave period.

Whilst on roster, the construction workforce will live in an accommodation facility to be established on Curtis Island. This will include both local and non-local (distant) workers so as to avoid the significant time delay that will otherwise be incurred if workers had to travel by ferry to and from the site each day. All workers will be transported to and from Curtis Island by ferry. During their rostered time off, the non-local workers will return to their places of residence under a fly-in/fly-out arrangement. As not all workers will be on site at the same time, the capacity of the accommodation facility will be 2,000.

The purpose of the LNG facility is to liquefy coal seam gas to facilitate its transport via tanker. The liquefaction technology uses a refrigeration process whereby the refrigerant is expanded and compressed in a closed loop system to achieve the cold temperatures needed for liquefaction. A number of liquefaction processes have been developed around the world, with the differences mainly confined to the types of refrigeration/ liquefaction technology employed.

The LNG facility will include the following associated infrastructure components:

- Gas pipeline inlet;
- Gas treatment to remove major components within the gas stream that are detrimental to the process of liquefaction of natural gas;
- Refrigeration and liquefaction facilities;
- LNG storage tank(s);
- Utilities including water, fuel systems, control systems and power generation;
- Flares including a plant flare, tank flare and/or PLF flare; and
- Supporting facilities (e.g. construction accommodation, roads and bridge)

The LNG facility will operate 24 hours per day 7 days per week. This will require four 20-person operation shifts for train 1. These shifts are likely to be 12 hour shifts, and may be on a 4 days on, 4 days off rotation. It is expected that maintenance and administration will work week days for eight hours with weekends off. The 3 - 4 Mtpa facility (Train 1) will have an operational on-site workforce of about 80 increasing to 130 for the 10 Mtpa facility (Trains 1-3).

Other aspects of the LNG facility such as the marine facilities and access provisions are described in Sections 4 and 6 respectively.

Section 2 LNG Facility- EPBC 2008/4057

2.2 Environmental Values - MNES

Curtis Island is located off the coast of central Queensland near Gladstone and forms part of the eastern rim of Port Curtis. It is approximately 40 km long and 20 km wide at its widest point. The island is essentially rural with undeveloped land parcels subject to cattle grazing. A residential development, South End, lies at the south-east corner of the island, approximately 8.5 km from the proposed LNG facility. There are approximately 50 dwellings which cater for 20 permanent and 90 seasonal residents.

A number of small islands are located near to Curtis Island in Port Curtis which has permanent or seasonal residents. These include Facing Island, She Oak Island, Tide Island and Compigne Island. Typical landforms on Curtis Island include moderate to steep wooded slopes, wooded alluvial plains, intermittent and semi-permanent watercourses, estuarine systems and fresh and saltwater wetlands. The Curtis Island area contains a high diversity of regional coastal vegetation and landscape types including cliffed coastlines, parabolic dunes, parallel beach ridges, saltpans, rock platforms, mud flats and marine plains.

The LNG facility study area is dominated by *Eucalyptus* and *Corymbia* woodlands on moderate to low slopes and alluvial plains. Mangrove and saltmarsh communities are present within intertidal areas. The study site displays impacts consistent with a long history of use that includes clearing, grazing, cropping, and selected timber felling. The presence of agricultural weeds and a history of fire have also impacted upon the ecological values of the site and, World Heritage values. It appears that much of the woodland is regrowth; however some mature trees are scattered throughout. A number of ephemeral streams, that only flow following sustained rain, drain into China Bay.

The regional landscape setting of Gladstone is strongly defined by mountain ranges that form the skyline to views to the west from the city and by the tree-covered central ridge of Curtis Island to the north. These visually prominent natural landforms are often seen in the context of the water surface of Gladstone Harbour and Port Curtis, which contributes to the visual quality of many views.

The original landscape character of the Port Curtis area has been significantly changed by development of a number of industrial plants in the area. Structures within these industrial plants are generally geometric in form and include colours that visually contrast with the surrounding remnant woodland vegetation. The industrial plants generally appear as islands of structure set within a tree-covered natural landscape. Views of these plants from public roads are generally limited to the upper portions of structures due to the visual screening effect of vegetation at ground level. Visible emissions from a number of the industrial plant stacks create a dynamic but visually prominent element in the landscape. Views from elevated locations within Gladstone urban areas include the industrial plants, Lighting on the existing industrial plants creates a strong contrast at night with the dark outline of the forest-covered mountains to the west.

While the hills and ridges that define the valley in which the LNG facility site is located are visible from surrounding areas, the centre of the valley itself is generally screened from most surrounding areas. Consequently, the base in the valley in which the facility will be located is only directly visible from boats travelling in Port Curtis.

Following a “point” type search conducted on the DEWHA MNES database on 31 January 2008, with a 5 km radius from coordinates -23.78361, 151.2155, Curtis Island, the LNG facility was deemed to have the potential to impact on the following matters protected under the EPBC Act 1999.

- World Heritage (Section 12, 15A);
- National Heritage Places (Section 15B, 15C);
- Listed Threatened Species and Communities (Section 18, 18A); and
- Listed Migratory Species (20, 20A).

Section 2 LNG Facility- EPBC 2008/4057

2.2.1 World Heritage Area / National Heritage Places

The proposed LNG facility site on Curtis Island is situated within the Great Barrier Reef World Heritage Area (GBRWHA) that is administered by the Great Barrier Reef Marine Park Authority (GBRMPA) in association with the Queensland Environmental Protection Agency (EPA). The boundary of the GBRWHA is set at mean low water on the mainland.

The GBRWHA is also listed as a National Heritage Place and the proposed LNG facility would also be located within a National Heritage Place.

The proposed LNG facility is adjacent to Port Curtis, listed on the Directory of Important Wetlands in Australia. This area has been identified for its extensive range of marine wetlands encompassing seagrass beds, mangrove forest and intertidal mud flats that provide habitat for a range of significant migratory water birds, reptiles and mammals.

The regional landscape setting of Gladstone is strongly defined by mountain ranges that form the skyline to views to the west from the city and by the tree-covered central ridge of Curtis Island to the north. These visually prominent natural landforms are often seen in the context of the water surface of Gladstone Harbour and Port Curtis, which contributes to the visual quality of many views.

2.2.2 Threatened and Migratory Species and Communities

Potential Values

A desktop database search of sources including the DEWHA Protected Matters MNES database, Queensland EPA Wildlife Online, Birds Australia database, Queensland Museum and Queensland Herbarium (HERBRECS) records was conducted. The Protected Matters search of the DEWHA MNES database provides a general guidance on matters of national environmental significance. The search was a “point search” with a 5 km radius for coordinates -23.78361, 151.2155 (the LNG facility search area).

The database searches revealed 26 threatened species and 2 threatened ecological communities were found to be listed under the EPBC Act as potentially occurring within the LNG facility search area and these are presented in Table 2-3. EPBC listed threatened species identified from these searches include eight bird species, four mammal species, eight reptile species, one shark species and five species of plants.

Although not identified in the EPBC MNES search, a listed threatened ecological community was identified as potentially being present from desktop searches of the state government databases. The Littoral Rainforest and Coastal Vine Thicket of Eastern Australia community (RE 12.2.2 microphyll / notophyll vine forest) was identified during field surveys within the study area, at the proposed MOF haul road location and has been included in this section. An assessment of the potential impacts to the threatened vegetation community listed under the EPBC legislation occurring within the LNG facility search area is provided in Table 2-4.

Thirty-three protected migratory bird and marine species were identified in the MNES search as potentially being present within the LNG facility search area.

The EPBC Act Protected Matters Report (DEWHA, 2008) sourced for the study site notes 19 terrestrial, wetland and marine migratory birds that may occur within the area. The list includes eight terrestrial migratory species. It should be noted that the LNG facility study area does not act as core habitat for any of these species due to similar vegetation communities and topography being found elsewhere in the region. Similarly, those wetland migratory species that favour freshwater wetland habitats are unlikely to be reliant on the two small water bodies present in the study area.

Surveyed Values

Ground truthing surveys were undertaken within LNG facility study area and included:

- A fauna survey over 8 days, including full terrestrial vertebrate survey, trapping and observational programs; and
- A flora survey conducted over 6 days, including a 1:20,000 vegetation mapping survey and full floristic census.

No flora or fauna species of EPBC conservation significance were identified as being present from these ground truthing surveys. However, it was noted that suitable habitat was identified as being present for black-breasted button-quail (*Turnix melanogaster*) and the squatter pigeon (*Geophaps scripta scripta*).

2.2.2.1 Birds

Threatened species that may be impacted include the black-breasted button-quail (*Turnix melanogaster*) and the squatter pigeon (*Geophaps scripta scripta*). Although no individuals were recorded on Curtis Island in the vicinity of the LNG facility, suitable habitat for these species is present at this location. Major impacts to these species have occurred historically through predation by introduced species such as foxes, and impacts to habitat from cattle grazing. It is considered unlikely that construction and operation of the LNG facility will impact significantly on potential populations that may be present on Curtis Island.

Suitable habitat for the Critically Endangered yellow chat (*Epthianura crocea macgregori*) was not found within the LNG facility study area (being confined to the northern sections of Curtis Island) and impacts are considered to be negligible.

Migratory wader bird surveys were undertaken during three periods in 2008, April, June and December. These surveys covered migratory and non-migratory periods to ensure seasonality was considered. The December study was undertaken within the wader bird migration season (BAAM, 2008). Wader and shoreline birds of the Curtis Island LNG facility and surrounds were surveyed over two days between 15 and 17 December 2008. Targeted surveys for wader birds were carried out at 12 coastal sand/mudflat and mangrove sites on the south-west coast of Curtis Island.

The surveys indicate that the LNG facility study area does not act as core habitat for any of these species as similar vegetation communities and topography is found elsewhere in the region. Similarly, those wetland migratory species that favour freshwater wetland habitats are unlikely to be reliant on the two small water bodies present in the study area. Three listed migratory marine species found for the site reliant on marine wetlands are Latham's snipe (*Gallinago hardwickii*), little curlew (*Numenius minutus*) and little tern (*Sterna albifrons*).

The south-west coast of Curtis Island contains marine habitat of limited value to wader and shoreline birds. The habitat values of these areas, particularly for foraging, have been reduced due to prior and ongoing disturbances in the area. The Gladstone Port and associated operations appear to have reduced the suitability of the area to waders through increases in development resulting in water and noise pollution, and a reduction in benthic invertebrate food sources. The significance of the habitats for wader birds within the project area is relatively low when compared to other marine wader habitats in Queensland (e.g. Great Sandy Straights and Moreton Bay). Overall, the potential for significant impacts on wader bird habitat or migratory wader species is considered to be relatively low.

The rainbow Bee-eater (*Merops ornatus*) was sighted on the hinterland margins of Curtis Island during the intertidal survey in June 2008. Potential impacts to this species may occur from removal of the vegetation at the hinterland margin with the development of the proposed LNG facility. Significant impacts to this species are not anticipated as this area does not represent core habitat for this species and there is considerable suitable habitat available in other areas within the region.

Suitable habitat for the rufous fantail (*Rhipidura rufifrons*) includes vine thicket as found at the potential haul road for the MOF on Curtis Island. Although no individuals were sighted during field surveys, potential impacts on suitable potential territory may occur due to loss of this habitat. Significant impacts are however, not anticipated as this vine thicket does not represent core habitat for the species.

Impacts to the little tern (*Sterna albifrons*) population are also considered negligible due to previous degradation of suitable habitat on Curtis Island from cattle grazing and anthropogenic impacts in the area.

Little terns are extremely sensitive to disturbance and it is unlikely that they occur in the vicinity of the LNG facility.

The great egret (or white egret) (*Ardea alba*) was sighted on low tidal mudflats adjacent to Curtis Island. Great egrets are listed in CAMBA and JAMBA agreements and are considered common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008. Potential impacts to this species are considered negligible due to minimal disturbance to low tidal mudflats resulting from the construction and operation of the LNG facility and the extent of mudflats dominating the lower intertidal habitats within Port Curtis. It is unlikely that significant impacts will occur to this species from the construction, operation and decommissioning of the LNG facility.

The white-bellied sea eagle (*Haliaeetus leucogaster*) is listed under the CAMBA Agreement. This species is commonly found in coastal and near coastal areas of Australia and was sighted on low tidal mud flats, mangroves and rocky foreshore habitat of Curtis Island during field surveys conducted in June 2008. Potential impacts to this species from the LNG facility may occur through some loss of mangrove habitat, however the extent of mangrove loss is anticipated to be minimal and it is considered that the impacts will not be significant due to the availability of suitable habitat regionally.

It is considered that potential impacts to threatened and migratory bird populations will be low from the construction, operation and decommissioning of the LNG facility generally due to low degrere of sutable habitat within the project site, and the availability of suitable habitat regionally.

2.2.2.2 Reptiles

Marine Reptiles

The beaches on the ocean side of southern Curtis Island and Facing Island support an important intermediate breeding population of flatback turtles (*Natator depressus*) (Limpus, 2007). The flatback turtle population utilising these beaches for nesting has remained consistent over 35 years of monitoring with approximately 50 females nesting annually (Limpus *et al*., 2006). Research indicates that predation, by foxes, pigs, dogs and goannas, is the most serious threat to flatback turtle nests on Curtis Island, along with the trampling of nests by cattle (Limpus & Gilmore, 1999). Estimates of 90-95% loss of clutches to feral dog predation from the late 1970s through to 1988 are noted (Limpus, 2007). Potential impacts to nesting flatback turtles are considered negligible due to the location of the LNG facility on the south-western side of Curtis Island. It is of note that there are no recorded turtle nesting beaches within estuarine environments, such as the western side of Port Curtis.

Loggerhead turtle (*Caretta caretta*) and green turtle (*Chelonia mydas*) occasionally nest on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Construction and operation of the LNG facility is not anticipated to interrupt the breeding cycle of these species.

The Yakka skink (*Egernia rugosa*) may occur within the LNG facility study area, however degradation of suitable habitat from cattle grazing and other activities imply that populations may already have diminished at this location. Significant impacts to this species from the LNG facility are considered to be negligible.

2.2.2.3 Mammals

Terrestrial

No terrestrial mammals listed under the EPBC Act were recorded within the LNG facility area during surveys. Based on the investigation of the area, none of these listed mammals would be expected to inhabit the area. It is concluded that potential impacts to EPBC Act listed terrestrial mammal species from development of the LNG facility will be negligible.

It is unlikely that the northern quoll (*Dasyurus hallucatus*) is present on Curtis Island due to habitat degradation and predation by introduced species. As a result, impacts to this endangered species are considered to be negligible.

There is a low probability of the water mouse (*Xeromys myoides*) being present within or adjacent to the proposed LNG facility site. However, prior to any construction activities it is recommended that further studies be conducted to ascertain presence or absence. If the water mouse is found to have a population present in the area then suitable management would be undertaken. Given knowledge of the site it is not expected that the proposed activities will significantly impact on this species.

Marine

Port Curtis is formally recognised as providing dugong habitat and is a designated as dugong protection area under the Queensland *Nature Conservation Act 1992* and *Fisheries Act 1994*. Although dugong (*Dugong dugon*) and sea turtle frequent the area the grazing potential of Port Curtis has not yet been quantified (Rasheed *et al*, 2003). Previous studies on seagrass following increased sedimentation indicate large scale seagrass mortality (Preen *et al*, 1995) with resulting migration and mortalities of dugong (Preen and Marsh, 1995). Any loss of subtidal seagrass beds, in particular, has significance as these deeper water seagrass species such as *Halophila spp.* are preferred by dugong. Dugongs also eat marine algae and invertebrates such as ascidians, but this is believed to occur only when seagrass is scarce (Preen, 1995).

Seagrass was not recorded during the June 2008 survey, however isolated patches of *Zostera capricorni* were recorded by Rasheed *et al* (2003). This is not a preferred species for dugong and, considering the patchy and small scale nature of seagrass, impacts on foraging behaviour for dugong is likely to be negligible. With the implementation of mitigation measures and the development of an Environmental Management Plan for all stages of the proposal, impacts are anticipated to be negligible.

No humpback whales (*Megaptera novaeangliae*) have been sighted within Port Curtis and impacts from the LNG facility are considered negligible as the proposed facility is above mean low water mark.

Interactions with marine fauna such as turtles, dolphins and dugong from ferries, barges and LNG carriers are considered and discussed as part of the EIS (Section 8.4.5.3). Records of interactions with migratory species such as marine mega-fauna are maintained in a database managed by the EPA and DEWHA. Mitigation measures to minimise interactions from increased shipping activities and dredging are integral to the development of the dredge management plan (DMP) and the environmental management plan (EMP).

2.2.2.4 Plants

No flora species listed under the EPBC Act were recorded within the LNG facility study area. It is concluded that potential impacts to EPBC Act listed flora species from development of the LNG facility is negligible.

One endangered ecological community, Littoral Rainforest and Coastal Vine Thicket of Eastern Australia (RE 12.2.2 microphyll / notophyll vine forest) community was identified during field surveys within the study area, at the proposed MOF haul road location

2.3 Potential Impacts and Mitigation Measures

An area of up to approximately 127 ha will be impacted by proposed vegetation disturbance associated with construction of the LNG facility and associated infrastructure. The disturbance to each terrestrial community on the site is summarised below together with the percentage (in brackets) that this represents of the area of that community existing within the Burnett-Curtis Hills and Ranges sub-region of the South-east Queensland bioregion.

- 0.4 ha of microphyll/notophyll vine forest on beach ridges (0.03%);
- 39.8 ha of open forest to woodland *Eucalyptus tereticornis* (0.14%);
- 63.6 ha of *Corymbia citriodora* and *Eucalyptus crebra* open forest to woodland (0.04%); and
- 19.5 ha *Eucalyptus crebra, E. tereticornis* grassy woodland (0.47%).

The microphyll/notophyll vine forest on beach ridges is listed as Critically Endangered under the EPBC Act. A small area (0.4 ha) of this community may potentially be cleared as part of the construction of the LNG facility's MOF haul road. This would represent a loss (0.03%) of the total area of this community in the sub-region.

As part of the project's front end engineering design (FEED) process further refining of the LNG facility design will occur. Practical opportunities to refine the alignment of the MOF haul road will be utilised to avoid impacts to the microphyll/notophyll vine forest where possible. Santos will assess the impacts of any footprint refinements in consultation with the relevant regulatory bodies.

None of the other terrestrial communities to be cleared is listed under the EPBC Act.

The construction of the LNG facility will involve earthworks within the mangrove lined embayment of China Bay. All works will be conducted in accordance with the Queensland Government's operational policy for the removal or disturbance of marine plants in accordance with the *Fisheries Act 1994*.

Impacts to saltmarsh and mangroves from construction of the LNG facility and haul road to the PLF and MOF are estimated to be as follows:

- Of the 6,736 ha of mangrove communities estimated within Port Curtis (Connelly *et al*, 2006) 0.5ha of mangrove communities are estimated to be impacted, representing 0.01% of the mangrove communities within Port Curtis; and
- Of the 4,573 ha of saltmarsh and saltpan areas within Port Curtis, approximately 2.8 ha of saltmarsh are estimated to be impacted, representing 0.06% of the saltmarsh and saltpan within Port Curtis.

Areas of vegetation to be cleared will be restricted to the minimum area required. The use of tape, pegs or other markers will be employed to clearly delineate areas to be cleared, prior to commencement. Particular attention will be paid when delineating clearing areas in proximity to 'Endangered' and 'Of Concern' vegetation communities that will not be disturbed.

Where clearing of vegetation is within or in close proximity to riparian communities, adequate erosion and sedimentation mitigation measures will be utilised to ensure waterways are not impacted and riparian vegetation is not unduly affected.

Any clearing involving the removal of expansive stands of woodland vegetation will be undertaken in stages to reduce disruption for fauna dispersal, thereby retaining habitat connectivity. That is, clearing will be undertaken towards the direction of any adjacent contiguous vegetation that is not to be cleared to ensure isolated stands of vegetation are not created.

A program to implement biodiversity offsetting of cleared vegetation communities will be undertaken in keeping with the objectives of the current Commonwealth and State legislation for the offsetting of significant vegetation communities. A biodiversity offset strategy and management plan will be developed for the GLNG Project. Criteria for offset suitability will be in keeping with EPA and DEWHA recommended guidelines and recognised best practice.

2.3.1 World Heritage / National Heritage Places

Potential impacts to the World Heritage Area values are anticipated during the construction phase of the LNG facility. The development and implementation of the Construction Environmental Management Plan (CEMP) for the LNG facility will ensure that World Heritage values are protected from earth moving activities, potential contamination issues and other works within the GBRWHA. Concentrating work to as small an area as possible and stripping and stockpiling usable topsoil away from drainage lines to protect it from erosion and increased sedimentation from run-off into the adjacent marine environment will minimise impacts to the world heritage area. Minimising vegetation disturbance such as riparian vegetation and mangroves and saltmarsh will also preserve world heritage values at this location.

Table 2-1 provides an assessment of potential impacts to each of the four World Heritage criteria and indicative mitigation measures to be implemented as part of the EMP.

Table 2-2 provides an assessment of outstanding heritage values, impacts and mitigations for the Great Barrier Reef World Heritage Area as a National Heritage Place. Impacts from greenhouse gas emissions are anticipated to be negligible to the GBRWHA.

The 25 Year Great Barrier Reef World Heritage Area Strategic Plan, which was published by the Great Barrier Reef Marine Park Authority in 1994, provides details of the management objectives and strategies for the GBRMP. The focus of the Plan is clearly on conservation and management of biological and ecological values as well as cultural heritage values, particularly those associated with indigenous people. The Plan does not identify scenic values or visual landscape values in any of the objectives or strategies.

Impacts to the natural beauty and aesthetic importance of Curtis Island to world heritage values will occur resulting from the proposed development of the LNG facility. These impacts include construction of the LNG facility and the gas flare stack. The greatest impact to the world heritage values is considered to occur to Criteria VII (exceptional natural beauty and aesthetic importance) and include:

- The LNG facility would be visible from Port Curtis;
- The flare stack and flame would be visible to varying degrees;
- The LNG train and storage tanks would be visible from Port Curtis and adjoining sections of Mount Larcom-Gladstone Road and the upper portions the structures would be visible from Tide, Witt and Turtle Islands;
- The LNG facility, including the flare stack, would not be visible from the portion of the GBRMP zoned Marine National Park that is located along the eastern edge of Cutis Island or Curtis Island National Park, due to the system of hills and ridges in the centre of Curtis Island; and
- Loss of vegetation from construction of the LNG facility.

Section 2 LNG Facility- EPBC 2008/4057

Table 2-1 Potential Impacts and Mitigation Measures to World Heritage/National Heritage Places for the LNG facility

World Heritage Criteria and Examples	Impacts and Mitigation Measures
(VII) - Exceptional natural beauty and aesthetic importance • Examples for the GBRWHA values are its vast extent and variety of reefs and islands; coastal mangrove systems of exceptional beauty; rich variety of landscapes and seascapes; spectacular breeding colonies of seabirds and butterflies; and migrating mammals. • Spectacular seascapes and landscapes for example, Whitehaven Beach, Whitsunday islands, Hinchinbrook Island, mosaic patterns on reefs • Spectacular coral assemblages (hard and soft corals)	Curtis Island has extensive areas of mangroves, saltmarsh, saltpan and intertidal mud flats areas. Vegetation types include tall shrubland, paperbark open forest and woodland dominated by *Melaleuca quinquenervia* and *M. dealbata*; headland grasslands; coastal heath communities; extensive marine plains of saltmarsh and sedges; tidal mudflats and saltpans; extensive mangrove communities; swamp mahogany; vine thickets; open forest. Impacts to mangroves represents0.006% of mangrove communities within Port Curtis and 0.11% of saltmarsh/saltpan communities. Curtis Island has undergone significant anthropogenic changes due to cattle grazing and the introduction of feral animals to the island. Direct impacts to the exceptional natural beauty and aesthetic importance will include visual impacts from loss of vegetation, construction of the LNG facility and flare stack on Curtis Island. Surface run-off and increased sedimentation may indirectly impact sub-tidal species, such as soft corals, along the subtidal rock wall at Hamilton Point due to increased sedimentation. Negative impacts to sub-tidal marine fauna and flora are anticipated. The implementation of sediment control devices will be developed in the Construction Environmental Management Plan to minimise potential impacts to subtidal communities. Mitigation measures for the operational phase of the LNG facility will include measures such as sediment/evaporation basins, appropriate construction of bund walls and measures such as grass swales to filter surface water run-off prior to entering the estuarine environment. Uncontrolled discharge of chemically contaminated areas such as refuelling is unlikely given adequate protection from overland flows by bunding of all storage areas. It is not expected that marine mammals will be impacted from construction of the LNG facility. Increased shipping activity from the use of barges and ferries during the construction phase is estimated up to 196 trips per 14 day work cycle. Shipping speed will be kept to a minimum to avoid potential interactions with marine mammals such as dolphins and dugong. GLNG ships calling at the Gladstone Port are expected to be about 50 per year (x 2 for each call) during operation of the LNG facility for the first LNG train and up to 160 per year for the 10 mtpa LNG facility (3 trains), compared to the existing ship calls at the port of over 1,300 per year. This represents a 3.8% - 12.3% increase in shipping movement within the port. Mitigation measures such as maintaining constant watch and reduced boat speed will be included in the Construction and Operational EMPs to avoid interactions with marine mammals.

World Heritage Criteria and Examples	Impacts and Mitigation Measures
(VIII) - Significant geomorphic or physiographic features • The world's largest coral reef ecosystem, extending over 14 degrees of latitudinal range; about 3000 separate coral reefs ranging from inshore fringing reefs to mid shelf, exposed outer reefs and deep water reefs and shoals • Deep water features of the adjoining continental shelf including canyons, channels, plateaux and slopes.	Construction of the LNG facility will result in physical disturbance due to land clearance. These activities will not result in impacts to significant geomorphic or physiographic features that contribute to the GBRWHA values as coral reefs will not be impacted. While there are no coral reefs or cays in the vicinity, the diversity of marine flora and fauna has been described in the EIS. Deep water features of the adjoining continental shelf will also not be impacted. The LNG facilityfacility is located in Port Curtis, which contains a deep water harbour and one of Queensland's busiest ports. LNG ship movements to and from the port are expected to be up to 160 per year. Ships will use existing shipping channels with the addition of the proposed channel to be dredged to the marine facilities at China Bay.
(IX) - Significant ongoing ecological and biological processes • An extensive diversity of reef morphologies and ongoing geomorphic processes • ~ 900 islands ranging from small coral cays (in various stages of geomorphic development) to large continental islands • Complex cross-shelf, longshore and vertical connectivity facilitated by dynamic current flows, incorporating important ecological processes such as larval dispersal • Breeding and spawning grounds for unique coral reef associated species, including threatened and vulnerable species such as turtles, whales and humphead Maori wrasse	Construction and operation of the LNG facility does not interfere with any reefs directly and it is anticipated that indirect impacts will be negligible. Although limited saltmarsh and mangroves are present at the location of the LNG facility, use by migratory shorebirds was not observed. It is anticipated that there will be negligible disturbance to breeding colonies of seabirds as a result of the LNG facility. The LNG facility is above mean low water and not expected to interfere with migratory path of marine mammals and other migratory marine species. Mitigation measures to avoid interactions with marine fauna from increased shipping activities will be developed and implemented for all phases of the LNG facility. Known turtle breeding grounds are located on the ocean side of Curtis and Facing Island, well away from the LNG facility. There will be no project generated disturbance to these breeding grounds. Whales are not known to breed within Port Curtis. The humpback whale has not been sighted within Port Curtis. No impacts are anticipated to the humpback whale. It is unlikely that China Bay and Hamilton Point provide preferred spawning ground habitat for unique coral reef associated species. Turtles are known to breed on the eastern side of the island and impacts from light and noise will not occur at these locations. Contractual arrangements with third party shipping companies will include compliance with the requirements of Threat Abatement Plans whilst in Commonwealth Waters and conditions under MARPOL arrangements.
(X) - Significant natural habitat for *in-situ* conservation of biological diversity • Over 2000 km^2 of mangroves including 54 per cent of the world's mangrove diversity • ~ 43 000 km^2 of seagrass meadows in both shallow and deep water areas supporting one of the world's most important dugong populations and six of the world's seven species of marine turtle • 70 bioregions (broad-scale habitats) have been identified comprising 30 reef bioregions and 40 non-reefal bioregions, these include algal and	There will be some direct impacts to mangrove and saltmarsh communities at the LNG facility site, particularly the construction of roads to product loading facility (PLF) and material Off-loading facility (MOF). The proportion of mangroves communities present within Port Curtis (0.006%) and saltmarsh (0.11%). Intertidal areas along the south-west coastline of Curtis Island in the vicinity of the proposed LNG site are largely undisturbed. The June 2008 intertidal survey confirmed the mapping provided in Danaher *et al*. (2005) showing *Rhizophora* forests dominating the mangrove

World Heritage Criteria and Examples	Impacts and Mitigation Measures
sponge gardens, sandy and muddy bottom communities, continental slopes and deep ocean troughs • The reef bioregions contain one third of the world's soft coral and sea pen species (80 species) • 800 species of echinoderms (for example sea stars) equalling 13 per cent of the world's total species • The location of the world's largest green turtle breeding area, other key breeding areas, regionally important seabird nesting islands, significant spawning ground (for example black marlin) and a significant area for humpback whale calving and rearing.	embayments along the south-west coast of Curtis Island. While mangrove and saltpan communities are in the vicinity of the LNG facility, disturbance to these marine plants will be in accordance with approvals under Qld State legislation for marine plant disturbance (*Fisheries Act 1994).* Habitat types potentially affected by the proposed LNG infrastructure are widely represented within Port Curtis and broader regional areas and it is considered unlikely that any particular intertidal habitat or individual species are restricted to areas that would be directly cleared or modified by the project. In the context of significant historical impacts to intertidal habitats in the Port Curtis area from land reclamation projects, the potential direct habitat loss from the LNG project is likely to be small. In Port Curtis, there was a regional loss of mangrove (1470 ha or 38%) and saltmarsh (1340 ha or 34.8%) habitats between 1941 and 1999 (Duke *et al.* 2003). With environmentally sensitive design objectives and the appropriate environmental management measures in place, the proposed LNG facility will affect 35ha of mangroves, saltpan and saltmarsh Curtis Island. Mitigation measures to avoid indirect impacts from run-off such as the construction of bunds, stormwater controls, upstream treatment and the provision of buffers will minimise sediment loads and increased turbidity to adjacent rocky reef and muddy soft bottom communities such as algal and sponge gardens, soft corals and sea pens that are present at this location. There are no inter-reefal or lagoonal areas within China Bay that may be directly or indirectly impacted by the LNG facility proposal. The nearest significant coral communities are between Curtis and Facing Islands, south of the proposed LNG facility. While parts of Port Curtis may exhibit geological processes linking the various elements of the coastal environment (e.g. estuaries, intertidal flats, mangroves and embayments) the LNG facility will not result in disturbance to these elements.

Table 2-2 National Heritage value for Curtis Island, LNG facility

Outstanding Heritage Value	Examples of value/impacts/mitigation
The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural cultural history.	Curtis Island has a variety of habitats that include tall shrubland, paperbark open forest and woodland, headland grasslands, coastal heath communities, extensive marine plains of saltwater couch and sedges, tidal mud flats and salt pans, large patches of vine thickets, swamp mahogany open forest and a range of eucalypt open forests and woodlands. Algal and sponge gardens, sandy and muddy bottom communities, and rocky reef subtidal communities are present. Impacts to vegetation at the LNG facility site will occur resulting in loss of vegetation and some mangrove, saltmarsh and intertidal communities. The footprint will be kept to a minimum.

Outstanding Heritage Value	Examples of value/impacts/mitigation
The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;	Port Curtis contains 6736 ha of mangroves, 4573 ha of saltmarsh and saltpan communities that are important breeding and nutrient supply areas for the maintenance of fish and crustacean populations. The rocky reef and silted embayments contain soft coral, sponges and sea pen species. No breeding and spawning grounds for unique coral reef associated species are known, however listed species such as turtles and dugong frequent the port. Flatback turtles nest on the eastern side of the island away from the LNG facility site.
The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;	Curtis Island shows a diversity of reef morphologies and ongoing geomorphic processes such as parabolic sand dunes, cliffed coastlines, parallel beach ridges, saltpans, rock platforms, mud flats and marine plain. The island offers the best potential for study due to the accessibility of the island.
The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: • a class of Australia's natural or cultural places; or • a class of Australia's natural or cultural environments	Curtis Island is part of the WHA GBR that is internationally recognised as having a large and significant expanse and diversity of coral reef formations. The GBR is important for its cultural heritage for indigenous populations within Australia in providing habitat for species used as a food source and for culturally significant events. Mitigation measures were consistent in minimising the footprint of the LNG facility and associated infrastructure. In addition Santos will conduct site inspections of the proposed area in consultation with traditional owners or archeologists.
The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics values by a community or cultural group	Curtis Island offers an aesthetically natural environment that is in relatively good condition. The majority of the area is lightly grazed and the eucalypt woodlands are subject to fairly frequent burning. There are small thickets of weeds such as Lantana and rubber vine particularly in the beach ridge systems. Water hyacinth and para grass have localised occurrences within the area. Impacts the outstanding heritage value from the LNG facility are unlikely to impact these values.

2.3.2 Threatened Species and Communities

An assessment of potential impacts to the threatened species listed under the EPBC legislation as potentially occurring within the LNG facility search area is described in Table 2-3.

Table 2-3 EPBC Listed Threatened Species for the LNG facility, Curtis Island

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Birds					
Yellow chat (Dawson)	*Epthianura crocea macgregori*	CE	n/a[2]	Known only from Curtis Island, the Torilla Plain and Fitzroy River delta in central Queensland. On Curtis Island, it occurs in swampy grassland and saline herbland in the northern part of the island.	The requisite habitat for the yellow chat is not found at or near the study site and the proposed action is not expected to impact this species
Red goshawk	*Erythrotriorchis radiatus*	V	Species or species habitat may occur within area	Curtis Island may form part of the range of an individual bird or pair of red goshawks. They are recorded in the central northern part of the island. However, vegetation on the proposed LNG facility site does not form core habitat for this species.	Vegetation on the proposed LNG facility site does not form core habitat for this species. The proposed action is not expected to impact this species.
Squatter pigeon (southern)	*Geophaps scripta scripta*	V	Species or species habitat may occur within area	Populations in the Curtis Coast area represent the southern sub-species of the squatter pigeon, which is distributed throughout inland areas from northern NSW to the Burdekin region of Queensland. It occurs patchily, mainly in grassy eucalypt woodland and gravel ridge habitats, and is a seed eater. The species has declined significantly in the southern parts of its range (NSW), but appears to be stable in Queensland. Identified threats include cattle grazing and predation by foxes (Garnett & Crowley 2000).	The squatter pigeon was not recorded during the survey. However there is suitable habitat present within the proposed LNG facility site. Vegetation of the study area does not form core habitat for the squatter pigeon and the proposed action is not expected to impact this species.
Australian painted snipe	*Rostratula australis*	V	Species or species habitat may occur within area	The Australian painted snipe utilises, amongst other habitats, permanent or temporary shallow inland wetlands. It is found scattered throughout many parts of Australia, although loss and alteration of wetland habitat has contributed to species decline (DEH 2003).	The species' requirement for tall reeds is not fulfilled on the site and at best, the Australian painted snipe may only be an occasional visitor to the LNG facility site. This species is unlikely to occur in areas potentially impacted by the proposed LNG facility.
Southern giant-petrel	*Macronectes giganteus*	E, M	Species or species habitat may occur within area	The southern giant-petrel is the largest of the petrels and breeds in colonies on Antarctic and sub-Antarctic islands and the Antarctic mainland. It feeds at sea, favouring the continental shelf and the edge of the pack-ice (Morecombe 2000). Throughout the colder months, immature birds and most adults disperse widely, travelling as far north as the Tropic of Capricorn (DEWHA 2008a).	Curtis Island does not form part of the breeding or feeding range of the southern giant-petrel. Unlikely to occur in areas potentially impacted by the proposed LNG facility.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Kermadec petrel (western)	*Pterodroma neglecta neglecta*	V	Species or species habitat may occur within area	The Kermadec petrel is a large pelagic bird that breeds on islands across the south west Pacific Ocean. Morecombe (2000) notes that it is an "extremely rare vagrant or accidental visitor to E coast NSW".	Curtis Island does not form part of the Kermadec petrel's feeding or nesting range and it is highly unlikely that it would even be an accidental visitor to the Island. Unlikely to occur in areas potentially impacted by the proposed LNG facility.
Roseate tern	*Sterna dougalli*	TBA	Species or species habitat may occur within area	Qld EPA supported the addition of the Roseate Tern to the Annexes to CAMBA and JAMBA as populations have been documented on the Swain Reefs, with migrations between Australia and Chinese Taipei and Australia and Japan.	These birds are found in sandy caves and areas not frequented by humans. A secure population exists on Swain Reef. Unlikely to utilise the LNG facility area.
Black-breasted button-quail	*Turnix melanogaster*	V	Species or species habitat may occur within area	The black-breasted button-quail is endemic to eastern Australia and is restricted to coastal and near-coastal regions of south-eastern Queensland and north-eastern New South Wales. The main populations occur within south-east Queensland (DEWHA 2008). The black-breasted button-quail has a preference for low canopied forests, including rainforest, monsoon forests, vine forests and Eucalyptus forests with a dense ground and litter cover (Morecombe 2004)/	Small areas of suitable habitat potentially exist in the vicinity of the proposed LNG site. However grazing and other disturbances caused by cattle, horses and feral pigs, as found within the study area, may deter the species from using the site. The proposed action is not expected to impact this species due to superior habitat available on the mainland and/or elsewhere on Curtis Island in conservation reserves.
Mammals					
Large-eared pied bat, large pied bat	*Chalinolobus dwyeri*	V	Species or species habitat may occur within area	It seems this species will occur in most vegetation types provided there are caves or tunnels in which it can roost. Daytime roosts are listed as caves, abandoned mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins (Ayers et al. 1996). Strahan (1995) notes that this species is found in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Isolated records have also been obtained from sub-alpine woodland above 1500m and at the edge of rainforest.	Suitable roosting habitat is not present within the proposed LNG facility site. Individuals may forage across the island. The proposed action is not expected to significantly impact this species.
Northern quoll	*Dasyurus hallucatus*	E	Species or species habitat may occur within area	The northern quoll is found in the savannas of northern Australia. Populations of this quoll have declined across much of its former range, with cane toads thought to be a major factor. They utilise a range of habitats, with rocky areas and eucalypt forests preferred (DEH 2005).	Considering the habitat alteration and disturbance to the proposed LNG facility site, there is a low probability that the northern quoll is present. The proposed action is not expected to significantly impact this species.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Humpback whale	*Megaptera novaeangliae*	V	Breeding known to occur within the area	(Bonn); Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. It is estimated that when the Australian east coast whaling industry ended in 1963, the east coast population of humpbacks had been reduced to a little over 100 individuals. This population has shown steady recovery of around 10 –11% a year, and in 2006 was estimated at around 8,000 (SPRAT Database).	Increased shipping from the operation and construction of the LNG facility is not expected to potentially impact humpback whales as they have not been sighted within Port Curtis. It is unlikely that humpbacks breed in Port Curtis. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.
Water mouse, false water rat	*Xeromys myoides*	V	Species or species habitat may occur within area	Inhabits saline grassland, mangroves and margins of freshwater swamps. Found along Queensland coast from Cooloola to Proserpine, including Stradbroke and Bribie Island. Also found in coastal NT.	There is a low probability of the water mouse being present within or adjacent to the proposed LNG facility site. However, prior to any construction activities it is recommended that further studies be conducted to ascertain presence or absence. If present suitable management as negotiated with government agencies will be undertaken. Given knowledge of the site it is not expected that the proposed activities will significantly impact on this species.
Reptiles					
Loggerhead turtle	*Caretta caretta*	E	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Adult Loggerheads feed on a variety of invertebrate animals such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean. This eastern Australian population has declined by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994) and may not survive the next 100 years (Limpus 1997). Because no interbreeding occurs between breeding units, repopulation would be unlikely (Bowen *et al.* 1994). It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database).	Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact on this species from the proposed LNG facility is considered to be minimal. Potential impacts from increased lighting caused by gas flaring for maintenance purposes will be mitigated using measures such as avoiding, wherever possible, flaring at night and avoiding turtle nesting season, where practicable. Emergency flaring may occur at any time. Potential interactions from increased shipping activities will be mitigated through reduced boat speeds, maintaining watch and adhering to all reporting requirements.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Green turtle	*Chelonia mydas*	V	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds green turtles mainly eat seagrass and seaweed (algae). They also feed on mangrove fruit, jellyfish and sponges. Limpus (2007) reports that the southern GBR stock of green turtles is large by global standards and that, overall, this population is not showing signs of decreasing numbers of breeding females at the nesting beaches over the past four decades.	Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact on this species from the proposed LNG facility is considered minimal. Potential impacts from increased lighting caused by gas flaring for maintenance purposes will be mitigated using measures such as avoiding, wherever possible, flaring at night and avoiding turtle nesting season, where practicable. Emergency flaring may occur at any time. Potential interactions from increased shipping activities will be mitigated through reduced boat speeds, maintaining watch and adhering to all reporting requirements.
Leathery turtle, leatherback turtle	*Dermochelys coriacea*	V	Species or species habitat may occur within area	(Bonn); The diet of Leatherback hatchlings and juveniles is not known. Adult Leatherbacks feed on jellyfish, salps and squid on the ocean surface and down to depths of 200 metres. There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis.	There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis. The impact on this species from the proposed LNG facility is considered negligible. Potential interactions from increased shipping activities will be mitigated through reduced boat speeds, maintaining watch and adhering to all reporting requirements.
Yakka skink	*Egernia rugosa*	V	Species or species habitat may occur within area	Usually found in open dry sclerophyll forest or woodland, often taking refuge among dense ground vegetation, hollow logs, cavities in soil-bound root systems of fallen trees and beneath rocks. Alternatively, skinks may also excavate burrow systems among low vegetation.	Due to historic habitat disturbance there is a low likelihood of the yakka skink being present within the proposed LNG facility site. It is not anticipated that the proposed LNG facility will impact on this species.
Hawksbill turtle	*Eretmochelys imbricata*	V	Species or species habitat may occur within area	(Bonn); Major nesting of hawksbill turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia (Pendoley 2005), and in the northern Great Barrier Reef and Torres Strait (Dobbs et al. 1999; Limpus et al. 1989), Queensland. Hawksbill hatchlings feed on very small (planktonic) plants and animals floating in the ocean. When they grow to between 30 and 40 cm (curved carapace length) they begin feeding among coral and rocky reef habitats on the sea floor. Juvenile and adults hawksbill turtles eat a variety of marine plants and animals, particularly algae, seagrass, sponges and shellfish (SPRAT Database).	It is unlikely that Port Curtis is an important habitat for hawksbill turtles, and thus it is concluded that potential impacts from the proposed LNG facility are unlikely to have a significant impact on this species. Potential interactions from increased shipping activities will be mitigated through reduced boat speeds, maintaining watch and adhering to all reporting requirements

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Pacific Ridley, olive Ridley Turtle	*Lepidochelys olivacea*	E	Species or species habitat may occur within area	(Bonn); In Australia, detailed information on the size of nesting and foraging populations is unknown although the nesting population is estimated between 500 and 1,000 (Limpus 1995a). Little is known about the diet of hatchling olive Ridley turtles. Studies on adult olive Ridley turtles in Australia show that they mainly eat shellfish. Studies in other countries show that olive Ridley turtles also eat crabs, shrimps, jellyfish and algae. This species is classed as the most abundant of the sea turtles. However, in Malaysia the nesting population has declined to 20% in recent years. Many of the large Arribadas such as in Surinam have been reduced to several hundred individuals (Limpus 1995b) (SPRAT Database	While it is possible that olive Ridley turtles occur in the Port Curtis region, no records could be found. The impact on this species from the proposed LNG facility is considered negligible. Potential interactions from increased shipping activities will be mitigated through reduced boat speeds, maintaining watch and adhering to all reporting requirements
Flatback turtle	*Natator depressus*	V	Breeding known to occur within the area	(Bonn); This species is found only in the tropical waters of northern Australia, PNG and Irian Jaya (Spring 1982; Zangerl *et al.* 1988) and is one of only two species of sea turtle without a global distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007). The flatback turtle population utilising these beaches for nesting has remained at approximately 50 females annually throughout the 35 years that monitoring has been conducted (Limpus et al. 2006). Flatback turtle' nesting commences in mid October, reaches a peak in late November – early December and ceases by about late January. Hatchlings emerge from nests between early December and late March, with a peak in February (Limpus 2007). The Australian flatback turtle prefers shallow, turbid, inshore waters and bays where they feed on sea cucumbers and other holothurians, as well as jellyfish, prawns, molluscs, bryzoans, and other invertebrates (Ripple, 1996).Flatback turtles are known to occur within the outer Gladstone harbour and to move north through The Narrows (QDEH 1994). Juvenile flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.	Although flatback turtles are known to breed on the eastern side of Curtis and Facing Island, no turtle nesting occurs on the western side of Curtis Island. It is considered that potential impacts from the construction, operation and decommissioning of the LNG facility is negligible. Potential impacts from increased lighting caused by gas flaring for maintenance purposes will be mitigated using measures such as avoiding, wherever possible, flaring at night and avoiding turtle nesting season, where practicable. Emergency flaring may occur at any time. Potential interactions from increased shipping activities will be mitigated through reduced boat speeds, maintaining watch and adhering to all reporting requirements.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Brigalow scaly-foot	*Paradelma orientalis*	V	Species or species habitat may occur within area	Occurs on sandstone ridges in woodlands and vine thickets, and in open forests. The brigalow scaly-foot has been recorded from Boyne Island.	While the brigalow scaly-foot has been recorded from Boyne Island historic habitat disturbance makes its presence unlikely. The proposed action is not expected to significantly impact this species As it was not sighted on Curtis Island and prefers Brigalow habitat.
Sharks					
Whale shark	*Rhincodon typus*	V	Species or species habitat may occur within area	The Whale Shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and unlikely to occur within Port Curtis.	Increased shipping from the operation and construction of the LNG facility is not expected to potentially impact the whale shark as they have not been sighted within Port Curtis. It is unlikely that they enter Port Curtis as whale sharks prefer offshore clearer waters to turbid estuarine waters. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impacts to this species..
Plants					
Heart-leaved bosistoa	*Bosistoa selwynii*	V	Species or species habitat may occur within area	Grows in rainforests up to 300 m in altitude. From Maryborough in Queensland south to the Tweed River district in north-east NSW.	Unlikely to be present within the proposed LNG facility site. The species was not recorded during field surveys of the site.
Three-leaved bosistoa	*Bosistoa transversa*	V	Species or species habitat may occur within area	Grows in lowland subtropical rainforest up to 300 m in altitude. From Maryborough in Queensland south to the Nightcap Range north of Lismore in north-east NSW.	Unlikely to be present within the proposed LNG facility site. The species was not recorded during field surveys of the site.
Miniature moss-orchid	*Bulbophyllum globuliforme*	V	Species or species habitat may occur within area	Found in the McPherson Range, also Maleny and Noosa areas of the Wide Bay district. Appears to grow only on *Araucaria cunninghamii*.	Unlikely to be present within the proposed LNG facility site. The species was not recorded during field surveys of the site.
Wedge-leaf tuckeroo	*Cupaniopsis shirleyana*	V	Species or species habitat may occur within area	Small tree up to 10 m tall; usually seen as large bushy shrub. Endemic to Queensland, ranging from Carina, Brisbane to Bundaberg. Occurs in dry rainforest.	Unlikely to be present within the proposed LNG facility site. The species was not recorded during field surveys of the site.
Quassia	*Quassia bidwillii*	V	Species or species habitat may occur within area	Shrub or small tree to 6 m that occurs from Gympie to Mackay. Grows in rainforest communities, or on the margins of these communities.	Unlikely to be present within the proposed LNG facility site. The species was not recorded during field surveys of the site.

1 – Type of presence as indicated within the DEWHA MNES database.
2 – These species were not within the DEWHA MNES database for the search area but were identified within other database searches including Queensland EPA Wildflie Online, Birds Australia database, Queensland Museum and Queensland HERBRECS records.

The potential impacts to the threatened vegetation community listed under the EPBC legislation occurring within the LNG facility search area are described in Table 2-4.

Table 2-4 EPBC Listed Communities ground truthed as present for the LNG facility

Common Name	EPBC Status	Type of Presence[1]	Background	Impacts
Littoral Rainforest and Coastal Vine Thicket of Eastern Australia	Critically Endangered	Community likely to occur within the area	Community present at the MOF haul road. Corresponding RE present is 12.2.2.	The proposed actions will clear 0.4 ha of this RE. Approximately 1,562 ha of this RE is present within the Burnett-Curtis Hills sub-region (Accad *et al.*, 2006) and this proposed disturbance represents 0.03 % of the known extent of this community within the sub-region. This relatively small area is not expected to have a significant impact upon the community at a regional scale. Where practicable impacts to this community will be reduced by minimising vegetation clearance.

2.3.3 Migratory Species

The Guidelines provide that an action is likely to have a significant impact on a migratory species if there is a possibility it will:

- Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles) destroy or isolate an area of important habitat for a migratory species; and/or
- Result in invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

An assessment of potential impacts to the migratory species listed under the EPBC legislation as potentially occurring within the LNG facility search area is described in Table 2-5.

A total of thirty-three terrestrial, wetland and marine migratory species were listed on the EPBC Act Protected Matters Report (DEWHA, 2008) with the potential to occur within the LNG facility study area. The list included eight terrestrial migratory species.

The LNG facility study area does not act as core habitat for any of these species as similar vegetation communities and topography is found elsewhere in the region. Similarly, those wetland migratory species that favour freshwater wetland habitats are unlikely to be reliant on the two small water bodies present in the study area. The three listed migratory marine species reliant on marine wetlands are Latham's snipe (*Gallinago hardwickii*), little curlew (*Numenius minutus*) and little tern (*Sterna albifrons*).

Migratory wader bird surveys were undertaken during three independent periods in April (URS), June (URS) and December (BAAM) 2008 (Appendix B). These surveys covered migratory and non-migratory periods to ensure seasonality was considered. The BAAM study was undertaken within the wader bird migration season (BAAM, 2008). Wader and shoreline birds of the Curtis Island LNG facility and surrounds were surveyed over two days between 15 and 17 December 2008. Targeted surveys for wader birds were carried out at 12 coastal sand/mudflat and mangrove sites on the south-west coast of Curtis Island. Study sites were surveyed for waders using binoculars upon arrival at each site. Survey effort at each site was dependent on the height of the tide at the time of arrival. When tides were low, exposed sand and mudflat areas were inspected for feeding waders and mangrove areas were inspected for wader roost habitat. Opportunistic observations of waders (visual or from calls) were also recorded during the concurrent water mouse surveys, as well as from habitat that was adjacent to the target survey area.

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A total of 22 wader and shorebird species were identified within or near the study area during the December 2008 survey. Eleven of these species are considered as migratory species under the EPBC Act and three species are considered to be conservation significant under state legislation. The BAAM (2008) study determined that habitat values for wader birds throughout the study area appeared to be relatively poor. Migratory species such as eastern curlew (*Numenius madagascariensis*), whimbrel (*Numenius phaeopus*) and eastern reef egret (*Egretta sacra*) were observed in the study area in low numbers. Whimbrels were also heard calling from some mangrove areas indicating that whilst this habitat was being used, it was in low usage as roost habitat. Very few wader birds were observed foraging at the study sites at low tide during the field survey period. There was a high abundance and diversity of wader bird species observed foraging on sand/mudflats at low tide on the south-east of the island adjacent to the township of South End (approximately 9 km to the east of the study area). From these observations it is considered that habitat values in the study area are relatively low for wader species. It is likely that the study site is irregularly used at times for foraging/roosting by some wader species in low numbers. The BAAM (2008) study concluded that the south-west coast of Curtis Island contains marine habitat of limited value to wader and shoreline birds.

Table 2-5 EPBC Listed Migratory species for the LNG facility, Curtis Island

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Migratory Terrestrial Birds					
White-bellied sea-eagle	*Haliaeetus leucogaster*	M	Species or species habitat likely to occur within area	(CAMBA); White-bellied Sea-Eagles are a common sight in coastal and near coastal areas of Australia. In addition to Australia, the species is found in New Guinea, Indonesia, China, south-east Asia and India. The White-bellied Sea-Eagle feeds mainly on aquatic animals, such as fish, turtles and sea snakes, but it also eats birds and mammals (Birds Australia). This species was sighted on low tidal mud flats, mangroves and rocky shores habitat during the intertidal survey in June 2008.	Potential impacts from proposed LNG are unlikely to have a significant impact on this species as it is widespread and its preferred habitat is unlikely to be impacted.
White-throated needletail	*Hirundapus caudacutus*	M	Species or species habitat likely to occur within area	Possible occurrence as an overflying species	Possibly found in the area as an overflying species. This species will not be impacted by the proposed activities as the site of the LNG facility does not act as core habitat.
Barn swallow	*Hirundo rustica*	M	Species or species habitat likely to occur within area	Migrant to coastal and sub-coastal districts. Non-breeding in Australia. Possibly present.	Possibly found in the area. This species will not be impacted by the proposed activities as the site of the LNG facility does not act as core habitat.
Rainbow bee-eater	*Merops ornatus*	M	Species or species habitat likely to occur within area	This species was sighted on the hinterland margins of Curtis Island during the intertidal survey in June 2008.	Recorded from the site. Impacts to this species are expected to be minimal from the proposed LNG facility as it does not act as core habitat. There are no suitable sites for nesting at the LNG facility site.
Black-faced monarch	*Monarcha melanopsis*	M	Breeding may occur within area	Occurs in rainforests, mangrove and eucalypt woodlands. Species migrates from north Queensland to south-east Australia.	Possibly found in the area. This species will not be impacted by the proposed activities as the site of the LNG facility does not act as core habitat.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Spectacled monarch	*Monarcha trivirgatus*	M	Breeding may occur within area	Usually occurs in rainforests, mangroves occasionally moist dense wet eucalypt gullies.	Possibly utilises the area. This species will not be impacted by the proposed activities as the site of the LNG facility does not act as core habitat.
Satin flycatcher	*Myiagra cyanoleuca*	M	Species or species habitat likely to occur within area	Species migrates between north Qld and south-east Australia.	Recorded from the site. This species will not be impacted by the proposed activities as the site of the LNG facility does not act as core habitat.
Rufous fantail	*Rhipidura rufifrons*	M	Breeding may occur within area	Species migrates between north Qld and south-east Australia. Would favour moist gullies or semi-evergreen vine thickets.	Possibly utilises the area. Impacts to this species are expected to be minimal from the proposed LNG facility as it does not act as core habitat.
Migratory Wetland Birds					
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008.	Potential impacts from the proposed LNG facility are unlikely to have a significant impact on this species as it is widespread and its preferred habitat is unlikely to be impacted.
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania (Birds Australia).	Potential impacts from the proposed LNG facility are unlikely to have a significant impact on this species as it is widespread and its preferred habitat is unlikely to be impacted.
Latham's snipe, Japanese snipe	*Gallinago hardwickii*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Latham's Snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia (i.e. it travels through northern Australia to reach non-breeding areas located further south). In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977; Naarding 1983; Weston 2006, pers. comm.). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977; Naarding 1983).	Potential impacts from the proposed LNG facility are unlikely to have a significant impact on this species as its preferred habitat is freshwater systems, and it is unlikely to spend any substantial amount of time in intertidal areas.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Australian cotton pygmy-goose	*Nettapus coromandelianus albipennis*	M	Species or species habitat likely to occur within area	Cotton Pygmy-Geese are found on freshwater lakes, swamps and large water impoundments (The Action Plan for Australian Birds 2000).	Unlikely to occur in areas potentially impacted by the proposed LNG facility.
Little Curlew, Little Whimbrel	*Numenius minutus*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Curlew is widespread in the north of Australia and scattered elsewhere (Birds Australia).	Potential impacts from the proposed LNG facility are unlikely to be significant as this species is widespread and its preferred habitat is unlikely to be impacted.
Painted Snipe	*Rostratula benghalensis*	M	Species or species habitat likely to occur within area	(CAMBA); Originally listed based on assumption that *Rostratula australis* was a subspecies of *Rostratula benghalensis* (SPRAT Database). Now known that they are separate species and that *Rostratula benghalensis* is unlikely to occur in Australia. Australia recommended the removal of this species from the CAMBA Annex in 2006. The removal will not lessen the protection of the species due to listing as threatened under the EPBC Act.	Unlikely to occur in areas potentially impacted by the proposed LNG facility.
Migratory Marine Birds					
Fork-tailed swift	*Apus pacificus*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA, ROKAMBA); Could find no reports of it being sighted in Gladstone region. This species has a large range, with an estimated global Extent of Occurrence of 10,000,000 km². The global population size has not been quantified, but it is believed to be large as the species is described as 'common' in at least parts of its range (del Hoyo et al. 1999). Global population trends have not been quantified, but there is evidence of a	Potential impacts from the proposed LNG facility are unlikely to be significant as this species habitat is widespread and unlikely to occur in the Gladstone region. Its preferred habitat is unlikely to be impacted.
				population increase (del Hoyo et al. 1999), and so the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (http://www.iucnredlist.org/).	
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008.	Potential impacts from the proposed LNG facility are unlikely to be significant as this species is widespread and its preferred habitat is unlikely to be impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania (Birds Australia).	Potential impacts from the proposed LNG facility are unlikely to be significant as this species is widespread and its preferred habitat is unlikely to be impacted.
Southern giant-petrel	*Macronectes giganteus*	E, M	Species or species habitat likely to occur within area	(Bonn); The Southern Giant-Petrel breeds on six subantarctic and Antarctic islands in Australian territory. Longline fishing causes two main forms of mortality in the Southern Giant-Petrel; by-catch during line-setting, and ingestion of discarded fishing hooks (SPRAT Database).	Unlikely to occur in areas potentially impacted by the proposed LNG facility.
Little tern	*Sterna albifrons*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Tern is mainly coastal, being found on beaches, sheltered inlets, estuaries, lakes, sewage farms, lagoons, river mouths and deltas. The Little Tern is migratory. Substantial numbers move north from the far south-east after breeding. The Little Tern is extremely sensitive to human disturbance when breeding and is rapidly declining in numbers and range. Nesting sites are usually located where humans swim, walk, exercise dogs, picnic and drive off-road vehicles. The mere presence of people on the beach may cause these terns to desert their eggs and eventually leave the colony altogether. In New South Wales, where they were once quite common, the breeding population of Little Terns has declined to fewer than 50 pairs and of 30 known breeding sites only a handful have been used since 1970 (Birds Australia).	The areas where potential impacts from the proposed LNG facility could occur are impacted from cattle grazing it is unlikely that Little Terns nest in the areas adjacent to site.
Marine Mammals					
Bryde's whale	*Balaenoptera edeni*	M	Species or species habitat likely to occur within area	(Bonn); Bryde's Whales occur in temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40° N and 40° S, or the 20 °C isotherm (Bannister et al. 1996). Bryde's Whales have been recorded from all Australian states except the Northern Territory (Bannister et al. 1996), including one sighting each in Victoria and NSW and 11 reported strandings in South Australia (7), NSW (2), Victoria (1) and Queensland (1) (DEW 2007).	It is considered that potential impacts from the proposed LNG facility are negligible as the Bryde's whale has not been sighted within Port Curtis. LNG carriers will use existing shipping lanes minimising any increased potential impacts to this species.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
				As there are no estimates of the Australian Bryde's Whale population size, the proportion of the global population in Australian waters cannot be estimated. The lack of data for Bryde's Whales in Australian waters leads to an inability to assess whether global threats would affect the Australian population. The offshore form could potentially be subjected to threats from incidental entanglement in fishing gear set, lost or discarded in international or adjacent waters (SPRAT Database). A single record of a stranding was found from 1982, south west of Stewart Island, Great Sandy Strait (National Whale and Dolphin Sightings and Strandings Database – DEWHA).	.
Dugong	*Dugong dugon*	M	Species or species habitat likely to occur within area	The Port of Gladstone region is wholly within the Rodds Bay Dugong Protection Area. Dugongs feed on seagrasses and have distinct preferences, which seem to be based on the nutritional quality of the seagrasses (Lanyon 1991, Preen 1993). Seagrass species of the genera *Halophila* and *Halodule* are favoured (EPA and QPWS 1999). The most significant meadows of *Halophila* and *Halodule* within the port are located at Pelican Banks approximately 10 km to the east.of the LNG facility site, north of Wiggins Island (4 km south west of the LNG facility site) and north of Fisherman's Landing (5 km north west of the LNG facility site). Dugong feeding activity has been observed on the majority of intertidal seagrass meadows surveyed during the 2007 DPI&F long term monitoring program (Rasheed *et. al.*, 2008). The highest density of dugong feeding trails was observed at the *Zostera capricorni* / *Halophila ovalis* meadow at Wiggins Island with feeding trails recorded at 58% of sampling sites. Dugong feeding trails were also recorded at Pelican Banks and the intertidal meadows to the north and south of Fisherman's Landing (Rasheed *et. al.*, 2008).	Potential impacts to dugong may occur from increased numbers of ferries and barges used to transport materials, equipment and staff during the construction phase of the LNG facility. This will extend into the operational phase if the "no bridge" option is adopted. Potential impacts from boat strike will be mitigated through and maintaining regular watch.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Humpback whale	*Megaptera novaeangliae*	M	Breeding known to occur within area	Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. The majority of humpbacks in Australian waters migrate north to tropical calving grounds in the Great Barrier Reef complex between approximately 14°S and 27°S from June to August, and south to the Southern Ocean feeding areas from September to November. Gladstone Harbour is not known as an important migration route. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. It is estimated that when the Australian east coast whaling industry ended in 1963, the east coast population of humpbacks had been reduced to a little over 100 individuals. This population has shown steady recovery of around 10 –11% a year, and in 2006 was estimated at around 8000 (SPRAT Database). No reports of humpback whale sightings or strandings in Gladstone harbour could be found (National Whale and Dolphin Sightings and Strandings Database – DEWHA). While humpbacks are known to occur in the region, they are not known to enter Port Curtis.	Increased shipping from the operation and construction of the LNG facility is not expected to potentially impact humpback whales as they have not been sighted within Port Curtis. It is unlikely that humpbacks breed in Port Curtis. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Irrawaddy dolphin	*Orcaella brevirostris*	M	Species or species habitat likely to occur within area	It should be noted that the Irrawaddy dolphin (*Orcaella brevirostris*) is now generally regarded to not occur in Australian waters. Instead, it is more likely that reports have in fact related to the Snubfin dolphin (*Orcaella heinsohni*) (Beasley et al. 2005). The Snubfin dolphin is not currently listed under the EPBC Act, however, the information that follows shoud be considered to relate to it. The distribution of this species extends from from Broome in Western Australia, along the northern coastline near Darwin and the Gulf of Carpentaria, and off the east coast as far south as the Brisbane River. Irrawaddy dolphins are typically associated with shallow, coastal and estuarine waters, with most sightings recorded within 10 km of the coast, in waters less than 10 m deep, and within 10 km of a river mouth (Parra 2005 – PhD thesis). Since 1968, there have been 36 reported strandings of Irrawaddy dolphins in Queensland, all from around the Townsville region. There have been no reported sightings or strandings from the Gladstone region (National Whale and Dolphin Sightings and Strandings Database – DEWHA). Parra (2005) reports additional strandings, including one from Bundaberg in 1994 and one from the Brisbane River in 1997.	Although Irrawaddy (Snubfin) dolphins do utilise the Port of Gladstone region, the limited number of sightings would indicate that the area is not a significant habitat for them. Potential impacts to this species may occur from increased numbers of ferries and barges during the construction phase of the LNG facility. This will extend into the operational phase if the “no bridge” option is adopted. Potential impacts from boat strike will be mitigated through and maintaining regular watch. Increased shipping from the operation and construction of the LNG facility is not expected to potentially impact this species LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.
Killer whale, orca	*Orcinus orca*	M	Species or species habitat likely to occur within area	(Bonn); The Killer Whale is found in all oceans and seas of the world usually in family groups. They occur in most habitat types from coastal areas to the deep ocean waters, from the tropics to polar regions, although most sightings are in temperate waters. The Killer Whale has never been the target of serious commercial hunting so the species worldwide is secure. Killer whales have not been reported from within Port Curtis.	Unlikely to be found within Port Curtis. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Indo-Pacific humpback dolphin	*Sousa chinensis*	M	Species or species habitat likely to occur within area.	The taxonomy of the Australian population of the Indo-Pacific Humpback dolphin (*Sousa chinensis*) is now undergoing revision, with suggestions that it may in fact be a separate species (Frere et al. 2008). The Qld EPA have records of interactions with these species in the Port Curtis region. Although *Sousa chinensis* is known to occur within the region, it would appear that boat strike and entanglement in fishing gear and the QDPI&F Shark Control nets pose the greatest threats.	Potential impacts to this species may occur from increased numbers of ferry's and barges during the construction phase of the LNG facility. This will extend into the operational phase if the "no bridge" option is adopted. Potential impacts from boat strike will be mitigated through and maintaining regular watch. Increased shipping from the operation and construction of the LNG facility is not expected to potentially impact this species LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.
Marine Reptiles					
Loggerhead turtle	*Caretta caretta*	M	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Adult Loggerheads feed on a variety of invertebrate animals, such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean. This eastern Australian population has declined by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994) and may not survive the next 100 years (Limpus 1997). Because no interbreeding occurs between breeding units, repopulation would be unlikely (Bowen *et al.* 1994). It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database). The Qld EPA have records of interactions with these species.	Due to the occasional nesting on the ocean side of southern Curtis Island and Facing Island, potential impacts to this species from the proposed LNG facility on the western side of the island are considered negligible. Potential interactions from increased shipping activities will be mitigated through maintaining watch and adhering to all reporting requirements

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Green turtle	*Chelonia mydas*	M	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island. Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds green turtles mainly eat seagrass and seaweed (algae). They also feed on mangrove fruit, jellyfish and sponges. Limpus (2007) reports that the southern GBR stock of green turtles is large by global standards and that, overall, this population is not showing signs of decreasing numbers of breeding females at the nesting beaches over the past four decades. The Qld EPA have records of interactions with these species.	Due to the occasional nesting on the ocean side of southern Curtis Island and Facing Island, potential impacts to this species from the proposed LNG facility on the western side of the island are considered negligible. Potential interactions from increased shipping activities will be mitigated through maintaining watch and adhering to all reporting requirements
Estuarine crocodile, salt-water crocodile	*Crocodylus porosus*	M	Species or species habitat may occur within area	(Bonn); Connell Hatch (2006) reported that saltwater crocodiles had been seen within the Calliope and Boyne Rivers prior to 2004, but there have been no reports of their sighting since that time. Significant breeding populations of *C. porosus* do not occur south of the Tropic of Capricorn. Port Curtis is not considered an important habitat for *C. porosus.*	Port Curtis is not considered an important habitat for *C. porosus* and it is concluded that there is little likelihood of the proposed LNG facility impacting this species.
Leathery turtle, leatherback turtle	*Dermochelys coriacea*	M	Species or species habitat may occur within area	(Bonn); The diet of Leatherback hatchlings and juveniles is not known. Adult Leatherbacks feed on jellyfish, salps and squid on the ocean surface and down to depths of 200 metres. There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis.	There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis. The impact on this species from the proposed LNG facility is considered neg ligible. Potential interactions from increased shipping activities will be mitigated through maintaining watch and adhering to all reporting requirements
Hawksbill turtle	*Eretmochelys imbricata*	M	Species or species habitat may occur within area	(Bonn); Major nesting of hawksbill turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia (Pendoley 2005), and in the northern Great Barrier Reef and Torres Strait (Dobbs et al. 1999; Limpus et al. 1989), Queensland. Hawksbill hatchlings feed on very small (planktonic) plants and animals floating in the ocean. When they grow to between 30 and 40 cm (curved carapace length) they begin feeding among coral and rocky reef habitats on the sea floor. Juvenile and adults Hawksbill turtles eat a variety of marine plants and animals, particularly algae, seagrass, sponges and shellfish (SPRAT Database).	It is unlikely that Port Curtis is an important habitat for hawksbill turtles, and thus it is concluded that potential impacts from the proposed LNG facility are unlikely to have a significant impact on this species. Potential interactions from increased shipping activities will be mitigated through maintaining watch and adhering to all reporting requirements

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
Pacific Ridley, olive Ridley	*Lepidochelys olivacea*	M	Species or species habitat may occur within area	(Bonn); In Australia, detailed information on the size of nesting and foraging populations is unknown although the nesting population is estimated between 500 and 1,000 (Limpus 1995a). Over 100 turtles were killed by set netting in Fog Bay, NT, in one incident in 1994 (Guinea & Chatto 1992), which indicates that this species can forage in large aggregations. Little is known about what hatchling olive Ridley turtles eat. Studies on adult olive Ridley turtles in Australia show that they mainly eat shellfish. Studies in other countries show that olive Ridley turtles also eat crabs, shrimps, jellyfish and algae. This species is classed as the most abundant of the sea turtles. However, in Malaysia the nesting population has declined to 20% in recent years. Many of the large Arribadas such as in Surinam have been reduced to several hundred individuals (Limpus 1995b) (SPRAT Database).	While it is possible that Olive Ridley turtles occur in the Port Curtis region, no records could be found. With the implementation of mitigation measures to avoid interactions with this species, the impact on this species from the proposed LNG facility is considered negligible. Potential interactions from increased shipping activities will be mitigated through maintaining watch and adhering to all reporting requirements
Flatback turtle	*Natator depressus*	M	Breeding known to occur within the area	This species is found only in the tropical waters of northern Aust. and PNG and Irian Jaya (Spring 1982; Zangerl et al. 1988) and is one of only two species of sea turtle without a global distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007), with occasional nesting by green and loggerhead turtles (Limpus 1999). The flatback turtle population utilising these beaches for nesting has remained at approximately 50 females annually throughout the 35 years monitoring has been conducted (Limpus et al. 2006). Flatback turtle' nesting commences in mid October, reaches a peak in late November – early December and cease by about late January. Hatchlings emerge from nests between early December and late March, with a peak in February (Limpus 2007).	Although flatback turtles are known to breed on the eastern side of Curtis and Facing Island, no turtle nesting occurs on the western side of Curtis Island. It is considered that potential impacts from the construction, operation and decommissioning of the LNG facility is negligible. Potential interactions from increased shipping activities will be mitigated through maintaining watch and adhering to all reporting requirements

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts
				The Australian flatback turtle prefers shallow, turbid, inshore waters and bays where they feed on sea cucumbers and other holothurians, as well as jellyfish, prawns, molluscs, bryzoans, and other invertebrates (Ripple, 1996). Flatback turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Juvenile Flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.	
Sharks					
Whale shark	*Rhincodon typus*	M	Species or species habitat may occur within area	The Whale Shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis.	As the LNG facility is above mean low water mark it is concluded that potential impacts from the proposed LNG facility are negligible.

Section 3 Marine Facilities- EPBC 2008/4058

3.1 Description of Proposed Action

EPBC Act referral number EPBC 2008/4058 relates to the construction of the project's marine facilities including the product loading facility (PLF), materials off-loading facility (MOF), berthing pockets, and channel dredging

Each component of this referral is described below.

3.1.1 Product Loading Facility

The PLF will include:

- Access trestle – approximately 300 m long piled structure over the water. The pipes on this trestle will connect the onshore plant to the offshore loading platforms;
- Loading platform with four loading arms for loading of LNG onto ships;
- Marine operations platform - for housing the marine terminal, which may be moved to onshore at a later stage in design;
- Building, electrical room, firewater pumps and stand-by generators, which may be moved to onshore at a later stage in design and the firewater supplied from an onshore tank; and
- Six mooring and four breasting dolphins.

LNG will be pumped from the storage tanks to the ships via a pipeline and PLF-mounted retractable loading arms that connect the pipeline to the ships' storage tanks.

LNG tankers will enter Port Curtis and proceed along the main shipping channel to the loading berth. Assuming 155,000 m^3 capacity ships, at the initial single train LNG production rate of 3 - 4 Mtpa, there will be approximately 50 ship loads exported each year, or about one ship per week. This rate will increase to 160 ships per year or about one ship every 2 days when the production rate increases to 10 Mtpa. Using larger ships will involve correspondingly fewer ship movements.

In the 2007/08 financial year (the latest year for which data are available), there were 1,368 ship visits to the port and the tonnage handled at Port of Gladstone was approximately 76 Mt. The Gladstone Ports Corporation's (GPC) projections of trade volumes for the 2011/12 financial year show the tonnage handled at the port increasing to approximately 104 Mt. Assuming a proportional increase in the number of ship movements, the ship movements generated by the initial LNG facility (Train 1) will represent an approximate 3.6% increase in ship movements in the port. Ship movements from Train 3 operations will be approximately 11.7% of 2007/08 ship movements in the port.

3.1.2 Materials Offloading Facility

It is proposed that the MOF will be constructed off Hamilton Point and will be used to support onshore and offshore construction. The MOF design is currently being developed and is expected to include the following components:

- Three separate berths to accommodate a range of vessels for delivery of material, plant modules, construction equipment and workers;
- Wharf structures, mooring and breasting dolphins; and
- Material, equipment and module laydown areas (including vehicle manoeuvring areas).

The MOF will be designed to accommodate up to 2,500 t modules unloaded from a roll-on/roll-off (Ro Ro) barge at the module berth as well as up to 800 t loads of heavy equipment at the general cargo berth. It will also be able to handle bulk construction materials and a range of vehicles and earth moving equipment.

3.1.3 Dredging

To enable LNG vessels to access the PLF it will be necessary for an access channel to be dredged from the existing Targinie Channel in Port Curtis which is currently used to provide shipping access to the RG Tanna Terminal and is to be extended to provide access to the proposed Wiggins Island Terminal. The GLNG access channel will be 200 m wide and approximately 2 km long extending from the Targinie Channel to the LNG product loading facility. It will be dredged to a depth of -13.5 m below lowest astronomical tide (LAT). In addition, a swing basin will be dredged to -13.5 m LAT at the PLF to enable ships to manoeuvre safely.

Approximately 8 million m^3 of material will require dredging for the access channel and swing basin. The material to be dredged consists of a combination of clayey silts and sands together with approximately 240,000 m^3 of rocky material. Due to the characteristics of the material to be dredged and the presence of pockets of rock, the most technically suitable and cost effective dredging plant is a large or medium cutter suction dredge (CSD). It is most likely that a medium sized CSD will be used. The dredged material will be taken to a ploacement facility proposed to be constructed at Laird Point on Curtis Island.

Dredging may be required to ensure suitable barge and ferry access to the MOF. The volume of dredged material will be approximately 100,000 m^3. Based on the assumed likely material, available water depths and the volume of material to be dredged, it is likely that the dredging will be carried out using a medium sized CSD. The CSD will pump dredged material to an onshore reception lagoon and settlement pond. The most suitable location for such works will be adjacent to the MOF haul road where control of the operation and the potential beneficial reuse of the material will be possible. The majority of the dredged material is expected to be suitable for engineering re-use, and thus will be used as fill material for the construction of the MOF and laydown area. Alternatively it may be pumped to the proposed dredge material placement facility at Laird Point.

3.1.4 Dredge Material Placement Facility

In case the dredged material management plan currently being developed by the Queensland Government and the Gladstone Ports Corporation (GPC) for Port Curtis is not sufficiently progressed to meet the timing requirements for the approval and construction of the GLNG Project, a project-specific plan to manage the dredged material is being developed. This plan is to develop a dredge material placement facility south of Laird Point on Curtis Island.

It is proposed to pump the dredged material to the placement facility directly from the dredge. The pipeline between the dredge site and the facility will be in excess of 4 km and a pump booster station will be required. The pump station will be located on shore at Hamilton Point West. From there the material will be pumped to the placement facility. The dredged material will be stored in a retention facility formed by the construction of a rock-fill bund wall across the embayment to the south of Laird Point.

The proposed dredge material placement facility will cover an area of approximately 120 ha and will provide air space for approximately 13.2 million m^3 of dredged material. Bunds (embankments) will be constructed up to a height of 18 m (in two or more stages), with the dredged material being pumped into a series of internal ponds separated by bunds with strategically located weirs to allow the overflowing seawater to flow from one pond to the next. The dredged material will pass slowly through the ponds allowing the solid material (sand, silt etc) to settle out of the seawater. Following a period of controlled settlement and monitoring, the seawater will be discharged back into marine environment.

3.2 Environmental Values - MNES

Port Curtis is a natural deepwater embayment that is protected from the open ocean by Curtis and Facing Islands. Coastal geomorphology in the main study area is characterised by a partially enclosed embayment and shallow estuaries including small, continental rocky islands, intertidal flats and estuarine islands. Port Curtis estuary is a composite estuarine system that includes the Calliope and Boyne rivers, The Narrows, Auckland Creek and several smaller creeks and inlets that merge with deeper waters to form a naturally deep harbour protected by southern Curtis Island and Facing Island.

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Elevated natural turbidity occurs within the shallow marine and estuarine waters with significant input of freshwater and alluvial sediments from the Boyne and Calliope rivers. Seagrasses are generally intertidal (rather than subtidal) due to the naturally elevated turbidity, with the most abundant species being *Zostera capricornia*, *Halophila ovalis* and *Halodule uninervis* (Figure 1-4). Coastal saltflats are mostly bare claypan with lesser areas ranging from saltmarsh species to open and closed grasslands dominated by sand couch (*Sporobolus virginicus*) (EPA website, 2009).

The City of Gladstone has become one of the major industrial centres of Queensland due to its close proximity to the coal fields and deep water access port facilities (McKinnon *et al*. 1995). The area is heavily industrialised along the western shoreline and otherwise surrounded by large tracts of natural intertidal wetlands (Connolly *et al*. 2006). Academic and government research institutions have recently become active in the area resulting in the delivery of current knowledge, however limited, on the values of Port Curtis intertidal wetlands (Connolly *et al.* 2006).

The regional landscape setting of Gladstone is strongly defined by mountain ranges that form the skyline to views to the west from the city and by the tree-covered central ridge of Curtis Island to the north. These visually prominent natural landforms are often seen in the context of the water surface of Gladstone Harbour and Port Curtis, which contributes to the visual quality of many views.

The original landscape character of the Port Curtis area has been significantly changed by development of a number of industrial plants in the area. Structures within these industrial plants are generally geometric in form and include colours that visually contrast with the surrounding remnant woodland vegetation. The industrial plants generally appear as islands of structure set within a tree-covered natural landscape. Views of these plants from public roads are generally limited to the upper portions of structures due to the visual screening effect of vegetation at ground level. Visible emissions from a number of the industrial plant stacks create a dynamic but visually prominent element in the landscape. Views from elevated locations within Gladstone urban areas include the industrial plants, Lighting on the existing industrial plants creates a strong contrast at night with the dark outline of the forest-covered mountains to the west.

While the hills and ridges that define the valley in which the LNG facility site is located are visible from surrounding areas, the centre of the valley itself is generally screened from most surrounding areas. Consequently, the base in the valley in which the facility will be located is only directly visible from boats travelling in Port Curtis.

A “point” search of the DEWHA MNES database for a 10km radius around the Hamilton Point area (-23.800315, 151.214738) was undertaken on 28 February 2008 (project’s marine facilities search area). The project’s marine facilities has the potential to impact on the following matters protected under the EPBC Act:

- World Heritage (Section 12, 15A);
- National Heritage Places (Section 15B, 15C);
- Listed Threatened Species and Communities (Section 18, 18A); and
- Listed Migratory Species (20, 20A).

3.2.1 World Heritage / National Heritage Places

The proposed project’s marine facilities in China Bay, Hamilton Point and Laird Point are within the GBRWHA that is administered by the GBRMPA in association with the EPA.

The GBRMHA is listed as a National Heritage Place and the proposed project’s marine facilities are also located within a National Heritage Place.

Port Curtis has been identified for its extensive range of marine wetlands encompassing seagrass beds, mangrove forests and intertidal mud flats that provide habitat for a range of significant migratory water birds, reptiles and mammals.

3.2.2 Threatened and Migratory Species and Communities

Potential Values

A desktop database search of sources including the DEWHA Protected Matters MNES database, Queensland EPA Wildlife Online, Birds Australia database, Queensland Museum and Queensland Herbarium (HERBRECS) records was conducted. The Protected Matters search of the DEWHA MNES database provides a general guidance on matters of national environmental significance.

A total of 25 threatened species are listed under the EPBC legislation as potentially occurring within the project's marine facilities search area as determined from a desktop database search (Table 3-3). EPBC listed threatened species identified from this search include seven bird species, four mammal species, eight reptile species, one shark species and five species of plants.

A *Semi-evergreen vine thicket of the Brigalow Belt (North and South) and Nandewar Bioregions* was identified within the MNES search area. This community is not found within the LNG Marine Facility study site.

A total of thirty-three listed migratory bird and marine species were identified in the MNES search as potentially being present within the marine facilities search area (Table 3-5).

Surveyed Values

3.2.2.1 Birds

Migratory wader bird surveys were undertaken during three independent periods in April, June and December 2008. These surveys covered migratory and non-migratory periods to ensure seasonality was considered. The BAAM study was undertaken within the wader bird migration season (EIS Appendix DD4)). Wader and shoreline birds of the Curtis Island LNG marine facility and surrounds were surveyed over two days between 15 and 17 December 2008. Targeted surveys for wader birds were carried out at 12 coastal sand/mudflat and mangrove sites on the south-west coast of Curtis Island.

The marine facilities study area does not act as core habitat for any of these species as similar vegetation communities and topography is found elsewhere in the region. Similarly, those wetland migratory species that favour freshwater wetland habitats are unlikely to be reliant on the two small water bodies present in the study area. The three listed migratory marine species reliant on marine wetlands are Latham's snipe (*Gallinago hardwickii*), little curlew (*Numenius minutus*) and little tern (*Sterna albifrons*).

The south-west coast of Curtis Island contains marine habitat of limited value to wader and shoreline birds. The habitat values of these areas, particularly for foraging, have been reduced due to prior and ongoing disturbances in the area. The Gladstone Port and associated operations have, over time, resulted in increased threatening processes such as water and noise pollution. The significance of the habitats for wader birds within the project area is relatively low when compared to other marine/wader habitats in Queensland (e.g. Great Sandy Straights and Moreton Bay). Overall, the subject area is of relatively low significance in the context of the Commonwealth's interests and responsibilities under the EPBC. The potential for significant impacts on wader bird habitat or migratory wader species is low, provided detailed environmental planning for the proposed works and operational phase is prepared.

The rainbow bee-eater (*Merops ornatus*) was sighted on the hinterland margins of Curtis Island during the intertidal survey in June 2008. Potential impacts to this species may occur from removal of the vegetation at the hinterland margin with the development of haul road for the MOF. Significant impacts to this species are not anticipated as this area does not represent core habitat for this species and there is considerable suitable habitat available in other areas within the region.

Suitable habitat for the rufous fantail (*Rhipidura rufifrons*) includes vine thicket as found at the potential haul road for the MOF on Curtis Island. Although no individuals were sighted during field surveys, potential impacts may occur due to loss of this habitat. Significant impacts are however, not anticipated as this vine thicket does not represent core habitat for the species.

The great egret (or white egret) (*Ardea alba*) was sighted on low tidal mudflats adjacent to Curtis Island. Great Egrets are listed in CAMBA and JAMBA agreements. Great Egrets are considered common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008. Potential impacts to this species may occur from some loss of low tidal mudflats in China Bay resulting from the construction and operation of the PLF, berthing pockets and swing basin. However, these impacts are not considered significant due to the extent of mudflats dominating the lower intertidal habitats within Port Curtis. It is unlikely that significant impacts will occur to this species from the construction, operation and decommissioning of the project's marine facilities.

The white-bellied sea eagle (*Haliaeetus leucogaster*) was sighted on low tidal mud flats, mangroves and rocky foreshore habitat of Curtis Island during field surveys conducted in June 2008. Potential impacts to this species from the construction of the MOF, PLF and dredge material placement facility may occur through some loss of mangrove and intertidal habitat for the haul road for, and construction of, the PLF and MOF. The extent of mangrove loss is anticipated to be minimal; however some loss of low tidal mud flats will occur within China Bay. It is considered that the impacts will not be significant due to the availability of suitable habitat regionally.

Surface run-off from the preferred Laird Point dredge material placement facility is not expected to impact on bird communities found within Port Curtis. In the unlikely event of a structural failure resulting in the total or partial collapse of the bund wall, there would be impact to adjacent tidal mudflats and intertidal habitat and communities. Migratory shorebirds may indirectly be impacted through a loss of these mudflats and intertidal habitat. Associated impacts to the quality of mud flats in the adjacent GBRMP may also impact on shorebird feeding grounds although this is expected to be minimal. Given the extent of intertidal mud flats within Port Curtis a direct loss of habitat through such a catastrophic event is likely to have short term impacts on the feeding grounds on migratory marine birds.

3.2.2.2 Reptiles

The beaches on the ocean side of southern Curtis Island and Facing Island support an important, intermediate breeding population of flatback turtles (*Natator depressus*) (Limpus, 2007) and occasional nesting behaviour of the loggerhead turtle (*Caretta caretta*) and the green turtle (*Chelonia mydas*) (Limpus, 1999). Potential impacts to nesting behaviour for these species are considered to be negligible due to the location of the LNG marine facilities on the south-western side of Curtis Island. However, previous reports indicate that these turtle species utilise Port Curtis as habitat for migration and feeding.

The EPA holds records of loggerhead turtles found dead in Gladstone Harbour in 2000 and 2002 during dredging operations. Several green turtles were seen by researchers during the field surveys and it has been reported that The Narrows and the Calliope River mouth are major foraging areas (Connell Hatch, 2006). According to previous research, the loggerhead turtle (*Caretta caretta*) and flatback turtle (*Natator depressus*) utilise habitats in the outer harbour and occasionally move northward through Port Curtis into The Narrows (QDEH, 1994). Although it is possible that the Endangered Pacific Ridley (olive Ridley) turtle (*Lepidochelys olivacea*) inhabits the area, it has not been sighted within Port Curtis and impacts to this species are considered to be unlikely. The leatherback turtle (*Dermochelys coriacea*) has been recorded regionally and although none have been sighted within Port Curtis, the implementation of mitigation measures will reduce any potential interactions that may occur with this species.

Potential impacts from shipping associated with off-loading materials at the MOF during the construction phase of the LNG facility may result in interactions with marine turtles known to occur within the Port. Mitigation measures to avoid interactions will be developed and implemented, through an EMP, for the construction of the LNG marine facilities and all shipping operations associated with the construction and operation of the LNG marine facilities. Mitigation measures will include the use of turtle exclusion devices, reduction in dredge speed and dredge jets (if fitted) left on to minimise the risk of injury to turtles. Other measures such as reducing boat speed and using a spotter to avoid interactions with dredging equipment as well as monitoring and repositioning the dredge as required.

Capital dredging operations associated with the construction of the PLF, berthing pockets, MOF, swing basins and widening of the approach channels will directly impact the benthic and subtidal communities in China Bay and Hamilton Point. Indirect impacts from loss of habitat and increased turbidity to flatback and

other turtles that feed on hydroids, soft corals and other marine invertebrates may occur, however these potential impacts are not expected to be significant due to the availability of suitable habitat regionally and the temporary nature of this habitat loss. Mitigation measures to avoid such interactions will be included into the Dredge Management Plan for all dredging operations as part of the construction and operation of the marine facilities.

Any failure of the dredge material placement facility bund wall is not expected to significantly impact adjacent seagrass meadows or movement of marine turtles. The bund wall will be designed for a 1 in 100,000 catastrophic event and it is unlikely that impacts will occur to neighbouring seagrass meadows. Over-topping of surface waters from the bund wall is also not expected to impact on marine turtles breeding, foraging or migration behaviour.

Loss of biological diversity of marine turtles is not expected as a result of the LNG marine facilities within Port Curtis as these turtle populations are widespread and suitable habitat is available regionally.

3.2.2.3 Mammals

Terrestrial

No terrestrial mammals listed under the EPBC Act were recorded within the LNG marine facility area. Based on the investigation of the area none of these listed mammals would be expected to habit the area. It is concluded that potential impacts to EPBC Act listed terrestrial mammal species from development of the LNG marine facility is negligible.

It is unlikely that the Northern Quoll (*Dasyurus hallucatus*) is present on Curtis Island due to a lack of any suitable habitat and mortality from cane toad ingestion.

There is a low possibility of the water mouse (*Xeromys myoides*) being present within or adjacent to the proposed LNG marine facility sites. Targeted surveys for the water mouse were conducted (EIS Appendix DD4)) within potential mangrove habitat along the west and south coast of Curtis Island. No evidence of the water mouse was found, however prior to any construction activities it is recommended that further studies be conducted to ascertain presence or absence. If present, suitable management would be undertaken. Given knowledge of the site, and appropriate mitigation, it is not expected that the proposed activities will significantly impact on this species.

Marine

No humpback whales (*Megaptera novaeangliae*) have been sighted within Port Curtis. Although one humpback calf was recorded dead on the eastern side of Curtis Island, supporting their presence regionally, impacts from the LNG marine facility are considered to be negligible.

Dugong feeding trails have been reported at the main seagrass meadows in the vicinity of the LNG facility site which are at Pelican Banks (10 km to the east), the intertidal area north of Fishermans Landing and at the Targinie Banks adjacent to Wiggins Island (Figure 8.4.8 of the EIS). A dugong mother and calf was sighted within Port Curtis in the vicinity of southern Curtis Island during field surveys in 2008. Capital dredging operations associated with the construction of the PLF, berthing pockets, MOF, swing basins and widening of the approach channels will increase turbidity within several hundred metres of the dredge. Considering the distance to the nearest major seagrass meadows (approximately 4 km) and with the implementation of mitigation measures, elevated turbidity is anticipated to be kept to a minimum and associated impacts to seagrass meadows are considered to be minimal.

Potential impacts from shipping activities associated with loading and off-loading materials at the MOF during the construction phase of the LNG facility may result in interactions with dugong. Mitigation measures to avoid interactions with dugong will be developed and implemented through an EMP for the construction of the LNG marine facilities and all shipping operations associated with the construction and operation of the LNG marine facilities. Mitigation measures will include maintaining constant watch during all shipping operations, reducing boat speed and avoiding interactions with dredging equipment during dredging operations. Potential impacts to dugong during dredging operations within Port Curtis may ccur

through interactions with the dredger and associated equipment. Mitigation measures to avoid such interactions will be included into the Dredge Management Plan for all dredging operations as part of the construction and operation of the marine facilities.

Although it is possible that Irrawaddy dolphins (see comment in Table 2-5*:* this is likely to relate to the Australian Snubfin dolphin) utilise the Port of Gladstone region, the limited number of sightings indicates that the area is not a significant habitat for them. As such, it is concluded that potential impacts from shipping activities as a result of the proposed LNG marine facilities are unlikely to have a significant impact on this species.

Recent reports recorded by the EPA of dead Snubfin dolphins at the mouth of the Calliope River, Fisherman's Landing and on the seaward beach of Facing Island indicate that this species are found within Port Curtis and utilise the area as a habitat. These reports however, allude to boat strike and entanglement in fishing gear and shark control nets as the most likely causes of death. The implementation of mitigation measures such as maintaining constant watch and reducing boat speed will reduce interactions with dolphins during all shipping and dredging activities.

Dredged material placement at Laird Point is expected to have minimal impact on marine mammal migration. Run-off from the dredge material areas is also expected to have minimal impact to marine mammals.

3.2.2.4 Sharks

The whale shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis. Whale sharks have not previously been recorded within Port Curtis waters; it is considered that potential impacts from the LNG marine facilities are unlikely.

3.2.2.5 Plants

No flora species listed under the EPBC Act were recorded within the LNG marine facilities search area, including the MOF and PLF haul roads. It is concluded that potential impacts to EPBC Act listed flora species from development of the LNG marine facilities is negligible.

3.2.2.6 Threatened Ecological Communities

A semi-evergreen vine thicket of the Brigalow Belt (North and South) and Nandewar Bioregions was identified within the MNES search. However, this community is not found within the LNG marine facilities study area. Potential impacts to this community is considered to be negligible.

The vegetation community of microphyll/notophyll vine forest on beach ridges (RE 12.2.2) found within the MOF haul road is listed as "Littoral Rainforest and Coastal Vine Thicket of Eastern Australia" and Critically Endangered under the EPBC Act. The size of this community to be potentially disturbed is relatively small (0.4 ha) and represents 0.03% of this vegetation community within the sub-region listed under State legislation.

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3.3 Potential Impacts and Mitigation Measures

3.3.1 Referral Actions

3.3.1.1 Dredging

The area of capital dredging is estimated at 125 ha in total. Direct impacts from dredging will include a direct loss of subtidal and soft bottom communities at China Bay and in the approach channel adjacent to Hamilton Point. A loss of mangrove, saltpan and intertidal communities at the haul roads will also be incurred. Santos proposes to dispose of all dredged material at the dredge material placement facility at Laird Point. There will be no anticipated impacts from the dredging to the Great Barrier Reef.

Modelling sediment plumes generated from capital dredging activities indicate that there will be elevated TSS concentrations in and around the area of proposed dredging work covering an area of approximately 150 m by 500 m during neap tides and approximately 200 m by 150 m during spring tides. No impacts to the Great Barrier Reef are expected from dredging operations within Port Curtis.

Previous monitoring studies in Port Curtis and elsewhere of suspended sediment plumes undertaken for typical dredging operations show that the direct disturbance of extraction operations can cause a localised, but short-lived increase in suspended sediment (WBM, 2004). Recorded turbidity plumes are limited in duration and extent (typically less than 200 m) from the disturbed site and the measured turbidity is moderate and within the limits set by licence conditions. Visible plumes can extend for some distance however the suspended sediment concentrations are only slightly elevated above background levels.

Best practice techniques will be adopted for dredging and pipeline construction activities in order to minimise the extent and duration of sediment plumes which may otherwise be generated during the construction phase of the project. The key measures to reduce construction stage impacts primarily relate to the implementation of an approved Dredging Management Plan (DMP) and Environmental Management Plan (EMP). The plans will contain detailed descriptions of the methods to be used, the potential impacts associated with the selected methods, mitigation measures, monitoring and auditing requirements, and approvals required.

Silt curtains work by slowing the flow of water inside the curtain, thereby ensuring the suspended sediment drops to the substrate and reduces the sediment plume in the water column. They are generally effective in minimising sediment plumes and mitigating smothering of seagrass and other marine communities during capital and maintenance dredging and marine construction operations. It is anticipated that maintenance dredging will be required periodically.

There are a number of mitigation measures that minimise impacts to marine megafauna (turtles, dugongs and/or cetaceans) from dredging operations and gear. These include:

- The use of rigid and/or chain deflectors;
- Operational protocols (e.g. no suction when not in contact with seabed and use of draghead jets);
- Maintaining a “look-out” for turtles, dugongs and/or cetaceans on the surface;
- No dredging/dredge material placement if turtles, dugongs and/or cetaceans are within a specified distance (e.g. 500 m);
- Turtle exclusion devices to be fitted to the dredge head in accordance with best practice;
- Reduce pump speed and dredge jets left on;
- Repositioning the dredger to avoid potential interactions;
- Environmental windows (day/night; seasonal); and
- Reporting requirements.

It is expected that these measures would be incorporated into the DMP and/or the EMP.

3.3.1.2 PLF and MOF

The sites for the PLF and MOF as well as the haul road to the facility contain small areas of mangrove and saltmarsh. These areas will be cleared as part of the construction activities. The clearing will include the removal of 0.025 ha of mangrove communities representing 0.0004% of the 6,736ha of mangrove communities estimated within Port Curtis. No impacts to saltmarsh and saltflat communities are anticipated from construction of the haul road.

The extent of mangroves impacted by the construction of the marine facilities and haul roads is not expected to impact world heritage values within Port Curtis.

3.3.1.3 Dredge Material Placement Facility

Ecological Impacts

At Laird Point, bunds (embankments) will be constructed to retain the dredged material which will be pumped into a series of internal ponds separated by bunds with strategically located weirs to allow the seawater to flow from one pond to the next. The dredged material will pass slowly through these structures, allowing the solid material (sand, silt etc) to settle out of the seawater. Following a period of controlled settlement and monitoring, the seawater will be discharged back into the marine environment subject to meeting EPA approved discharge limits.

The construction of the dredge material placement facility will impact an area of approximately 120 ha and the vegetation communities within this area will be removed. The vegetation to be cleared includes mangrove and saltmarsh communities in the intertidal areas as well as terrestrial habitat including grassland dominated by exotic pasture species merging into terrestrial woodland.

No EPBC listed terrestrial communities will be affected by the dredge material placement facility but there are two Queensland listed communities which will be cleared. They are *Eucalyptus crebra*, *Eucalyptus tereticornis* grassy woodland (28 ha - 0.6 % of the community within the sub-region) and *Eucalyptus tereticornis* open forest to woodland on Cainozoic alluvial plains (20 ha – 0.08% of the community in the sub-region). Santos will implement a program to implement biodiversity offsetting of these communities.

The construction of a dredge material placement facility will cover an area of saltmarsh (31 ha) and mangrove (6 ha) habitat. This has been calculated to be approximately 0.09% of the mangrove and 0.68% of the saltmarsh communities that are found within Port Curtis. The disturbance to these marine habitats will result in the displacement of those species directly dependant on these areas.

The dredge material placement facility will be constructed and operated to minimise the potential to increase turbidity concentration in Port Curtis. Most of the construction activities will take place within a bunded area and the facility will be designed to meet agreed discharge standards. The increase in suspended sediment loads in the water column offshore of the dredge material placement facility from both construction and operational activities is considered unlikely to have significant impacts on seagrass meadows as the region has naturally high suspended sediment levels and the nearest significant seagrass meadows are several kilometres away. However, in recognition of potential impacts, suitable mitigation measures and a monitoring program will be developed and included within the approved dredging management plan and discharge levels agreed with the EPA prior to dredging or material placement activities commencing.

The dredging management plan will include a surface water management strategy to provide a basis for the management of discharges from the facility (including dredge effluent from the dewatering process and stormwater runoff) prior to its construction. The strategy will be based on findings from a water quality model and will include several different treatment method options to meet appropriate background water quality guidelines (in Port Curtis) and site-specific water quality objectives (yet to be identified).

Visual Impacts

The development of the dredge material placement facility, which will include a small rock causeway on the shore, will result in elevating the ground surface over the area of the facility by up to 18 m. The construction of the main rockfill bund wall will provide the main visual intrusion, with the majority of activities being undertaken behind this screen once it is constructed.

Views of the facility will be limited to the west, due to the enclosing nature of the surrounding topography. The two main viewing locations are from the mainland (4-5 km south-west) and from shipping on the northern part of Port Curtis.

Visibility of the facility from the mainland will be limited to the Landing Road (north end) foreshore as a result of the long distance across Port Curtis and the screening effect of shoreline vegetation. Viewer sensitivity at this view situation was determined to be low as the majority of viewers are likely to be motorists commuting to and from work, possibly at Fisherman's Landing wharf. The significance of the potential visual impact at the Landing Road (north end) foreshore was therefore determined to be negligible

The view distance from vessels in the north of Port Curtis will vary from long (4 km) to short (less than 200 m) depending on their location. However, it can be assumed that the majority of vessels (and thus viewers) would be in the main shipping channel which is approximately 2 km from the site. The period of viewing will vary depending on the activity, and for tourism and other commercial operations it is assumed that the view period would be 2 hours or less. The number of viewers would be low (100 – 1,000 people per day). The magnitude of visibility would be low. Viewer sensitivity depends on location, expectations and activity and would vary in this case from high sensitivity for tourists sight-seeing in Port Curtis to low for commercial fisherman operating in the area. Based on a high level of sensitivity and low magnitude of visibility, the significance of the potential visual impact to viewers in Port Curtis was determined to be moderate.

3.3.2 World Heritage / National Heritage Places

The construction of the project's marine facilities will involve dredging in China Bay for the PLF and MOF, berthing pockets, swing basin and approach channel. The haul road to the PLF and MOF will impact mangroves and saltmarsh and disturb the immediate surrounding intertidal mud flats. All works will be conducted in accordance with the Queensland Department of Primary Industries and Fisheries operational policy for the removal or disturbance of marine plants and agreed fisheries offsets including obtaining the necessary permits for the removal of marine plants in accordance with the requirements of the Queensland *Fisheries Act 1994*..

Assessment of potential visual impacts from the marine facilities indicates that LNG carriers (LNGC) moored at the PLF at China Bay will be visible from Port Curtis and sections of the Mount Larcom-Gladstone Road. These LNGCs will be visually prominent due to their size and the visual contrast between ship and the natural landscape character of Curtis Island which will form a visual background. When a ship is moored at the PLF it will block views of the land-based components of the LNG facility.

Ships/barges/ferries moored at the MOF at China Bay will also be visible from Port Curtis and sections of the Mount Larcom-Gladstone Road. These ships/barges/ferries will be less visually prominent compared to the LNGCs, but due to their size and the visual contrast between ships/barges/ferries and the natural landscape character of Curtis Island which will form a visual background. As discussed in Section 3.3.1.3, the visual impact of the dredge material placement facility will be negligible to moderate.

Table 3-1 provides an assessment of potential impacts to each of the four World Heritage criteria and provides indicative mitigation measures to be implemented as part of the dredging management plan and environmental management plan.

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Table 3-1 World Heritage Values/National Heritage Places for the Project's Marine Facilities

GBR World Heritage criteria and examples	Impacts/Mitigation Measures
(VII) - Exceptional natural beauty and aesthetic importance • Examples for the Great Barrier Reef WHA values are its vast extent and variety of reefs and islands; coastal mangrove systems of exceptional beauty; rich variety of landscapes and seascapes; spectacular breeding colonies of seabirds and butterflies; and migrating mammals. • Spectacular seascapes and landscapes; for example, Whitehaven Beach, Whitsunday islands, Hinchinbrook Island, mosaic patterns on reefs • Spectacular coral assemblages (hard and soft corals)	Direct impacts to the exceptional natural beauty and aesthetic importance of the WHA values for Curtis Island will include changes to the aesthetic values that the south-western side of Curtis Island currently exhibits. Although Curtis Island has undergone significant anthropogenic changes due to cattle grazing and the introduction of feral animals to the island this is not reflected in the visual aspect of the island. Mangroves, saltmarsh and intertidal communities will be disturbed to construct the haul roads to the PLF and the MOF. Environmental offsets for loss of marine fish habitat may be developed in agreement with the relevant State government agencies. Impacts to the natural beauty and aesthetic importance of Curtis Island will occur during the operation phased of the project with LNG carriers moored at the PLF and will be prominent due to their size and visual contrast between ship and the natural landscape character of Curtis Island. When a ship is moored at the PLF it will block the views of the land based components of the LNG facility. Ships/barges/ferries at the MOF will be less prominent than the LNG carriers. The coastal mangrove communities and saltmarsh at Laird Point will be directly impacted by the placement of dredged material (120ha) and construction of bund walls up to 18m in height. The visual impacts of the dredge material placement facility will be negligible to moderate. Soft coral assemblages adjacent to China Bay and Hamilton Point will incur losses. The nearest hard coral assemblages are between Curtis and Facing Island and unlikely to incur any significant impact from dredging operations. Mitigation to these impacts will be through minimising the footprint of the project's marine facilities and the dredging footprint. Construction of the bund wall will use materials will be comprised of sand, clay, rock and geo-textile lining that minimise the visual impact with the natural background. The area selected for the dredge material placement facility to the south of Laird Point is a low lying valley area, with elevated areas to the north, south and east, with some lower lying sections. It is proposed that all material for the bund will be sourced from the facility footprint.

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GBR World Heritage criteria and examples	Impacts/Mitigation Measures
(VIII) - Significant geomorphic or physiographic features • The world's largest coral reef ecosystem, extending over 14 degrees of latitudinal range about 3000 separate coral reefs, ranging from inshore fringing reefs to mid shelf, exposed outer reefs and deep water reefs and shoals • Deep water features of the adjoining continental shelf including canyons, channels, plateaux and slopes.	Construction of the project's marine facilities will result in physical disturbance to the sediments from dredging. This is not considered significant geomorphic or physiographic features that contribute to the world heritage values of the GBR. Coral reefs will not be impacted by dredging activities as there are no coral reefs or cays in the vicinity. Dredging activities are restricted to soft bottom habitats around China Bay. Deep water features of the adjoining continental shelf will not be impacted.
(IX) - Significant ongoing ecological and biological processes • An extensive diversity of reef morphologies and ongoing geomorphic processes • ~ 900 islands ranging from small coral cays (in various stages of geomorphic development) to large continental islands • Complex cross-shelf, longshore and vertical connectivity facilitated by dynamic current flows, incorporating important ecological processes such as larval dispersal • Breeding and spawning grounds for unique coral reef associated species, including threatened and vulnerable species such as turtles, whales and humphead Maori wrasse.	The project's marine facilities will not interfere with any reefs or islands directly. It is anticipated that indirect impacts will be negligible. Use of the mud flats in China Bay by migratory shorebirds is low. Considering the vast extent of mud flats within Port Curtis it is anticipated that there will be negligible disturbance to breeding colonies of seabirds as a result of the LNG marine facilities. The project's marine facilities are adjacent to the Hamilton Point area. Interactions between migratory marine mammals and shipping operations have been recorded previously in Port Curtis. Interactions with marine fauna will be mitigated through the use of dredge flanges, maintaining regular watch, reduce boat speeds and other measures identified in the dredge management plan and construction and operational EMPs. It is unlikely that impacts would be incurred for humpback whales as they are not known to breed within Port Curtis and have not been sighted. The construction of a dredge material placement facility at Laird Point will cover an area of saltmarsh (31 ha) and mangrove (6 ha) habitat. This has been calculated to be approximately 0.09% of the mangrove and 0.7% of the saltmarsh communities that are found within Port Curtis. Neither of these communities are EPBC listed. Turtles are known to use Port Curtis as habitat and feed on seagrass meadows. Interactions with marine turtles moving through the Port are possible; however breeding cycles are not likely to be impacted. Mitigation measures to avoid interactions with marine turtles will be implemented during all dredging and other shipping activities. It is unlikely that Hamilton Point provides preferred spawning ground habitat for unique coral reef associated species as spawning mostly occurs offshore.

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GBR World Heritage criteria and examples	Impacts/Mitigation Measures
(X) - Significant natural habitat for *in-situ* conservation of biological diversity • Over 2000 km^2 of mangroves including 54 per cent of the world's mangrove diversity • ~ 43 000 km^2 of seagrass meadows in both shallow and deep water areas supporting one of the world's most important dugong populations and six of the world's seven species of marine turtle • 70 bioregions (broad-scale habitats) have been identified comprising 30 reef bioregions and 40 non-reefal bioregions, these include algal and sponge gardens, sandy and muddy bottom communities, continental slopes and deep ocean troughs • The reef bioregions contain one third of the world's soft coral and sea pen species (80 species) • 800 species of echinoderms (for example sea stars) equalling 13 per cent of the world's total species • The location of the world's largest green turtle breeding area, other key breeding areas, regionally important seabird nesting islands, significant spawning ground (for example black marlin) and a significant area for humpback whale calving and rearing.	Port Curtis has 6,736 ha of mangroves and 4,573 ha of saltmarsh and saltpans. There will be direct impacts to mangrove, saltmarsh and intertidal communities for construction of the haul roads to the PLF and MOF and the dredge material placement facility. The dredge material placement facility will impact approximately 37 ha of saltmarsh and mangrove communities representing 0.3% of these habitats within Port Curtis. Impacts to in situ biological diversity will be minimised through developing the 120 ha area sufficient to contain all dredge material from the facility. Impacts to mangroves are estimated to be minimal and will not affect significant natural habitat of intertidal areas at this location. Biological diversity of organisms on rocky shores was considered low from the field survey, possibly due to the extent of silt along the foreshore. Disturbance to mangroves will be kept to a minimum and in accordance with the objectives of ecologically sustainable development under the Qld Fisheries Act 1994. Impacts from dredging for the channel, Marine Off-loading Facility, PLF, berthing pockets and swing basin will result in direct impacts to subtidal communities within the Hamilton Point area through disturbance to algal and sponge gardens, soft corals and sea pens that are present at this location. Impacts will be minimised through the implementation of silt curtains and staged dredging activities and keeping the dredging footprint to a minimum. Negative impacts will be managed through the implementation of sediment limitation devices and other mitigation measures developed as part of the Environmental Management Plan for the construction, operation and decommissioning of the project's marine facilities There are no inter-reefal or lagoonal areas within China Bay that may be directly or indirectly impacted by the LNG Marine Facility proposal. The nearest significant coral communities are between Curtis and Facing Islands, east of the proposed LNG Marine Facilities. While parts of Port Curtis may exhibit geological processes linking the various elements of the coastal environment (e.g. estuaries, intertidal flats, mangroves and embayments) the project's marine facilities will not result in disturbance to these elements.

Table 3-2 provides an assessment of heritage values and potential impacts and mitigation methods for the marine facilities.

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Table 3-2 National Heritage values for Marine Facilities, Port Curtis

Outstanding Heritage Value	Examples of value/impacts/mitigation
The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural cultural history.	Curtis Island has a variety of habitats that include tall shrubland, paperbark open forest and woodland, headland grasslands, coastal heath communities, extensive marine plains of saltwater couch and sedges, tidal mud flats and salt pans, large patches of vine thickets, swamp mahogany open forest and a range of eucalypt open forests and woodlands. Algal and sponge gardens, sandy and muddy bottom communities, and rocky reef subtidal communities are present. Impacts from increased sedimentation to subtidal communities adjacent to Hamilton Point will occur from capital dredging activities for the PLF, MOF, swing basins, berthing pockets and approach channel. Mitigation measures include the use of silt curtains and timing of dredging to minimise impacts. Sub-tidal communities found at this location are represented regionally, therefore impacts to outstanding national heritage values are considered to be minimal.
The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;	The rocky reef and silted embayments contain soft coral, sponges and sea pen species. No breeding and spawning grounds for unique coral reef associated species are known, however listed species such as turtles and dugong frequent the port. Flatback turtles nest on the eastern side of the island. Impacts from dredging to nesting turtles populations are considered negligible. Interactions with marine fauna will be minimised through implementation of Construction EMP and Dredge Management Plan that includes maintaining constant watch during all shipping and dredging operations, using deflectors with dredge gear and minimising boat speed.
The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;	Curtis Island shows a diversity of reef morphologies and ongoing geomorphic processes such as parabolic sand dunes, cliffed coastlines, parallel beach ridges, saltpans, rock platforms, mud flats and marine plain. The island offers the best potential for study due to the accessibility of the island. Impacts to these values from the construction of marine facilities are considered negligible.
The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: • a class of Australia's natural or cultural places; or • a class of Australia's natural or cultural environments	Curtis Island is part of the GBRWHA that is internationally recognised as having the largest and most significant expanse and diversity of coral reef formation in the world. The GBR is important for its cultural heritage for indigenous populations within Australia in providing habitat for species used as a food source and for culturally significant events. Mitigation measures were consistent in minimising the footprint of the marine facilities, dredge material placement facility and associated infrastructure. In addition Santos will conduct site inspections of the

Outstanding Heritage Value	Examples of value/impacts/mitigation
	proposed area in consultation with traditional owners or archaeologists.
The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics values by a community or cultural group	The marine environment at Hamilton Point, China Bay and Laird Point represent highly turbid estuarine waters with minimal flushing during neap tides. Impacts to the aesthetic characteristics will occur from development of the marine facilities and dredge material placement facility. Mitigation measures will include minimising increased sedimentation and increased turbidity through silt curtains and timing of dredging. Impacts the outstanding heritage value from theproject's marine facilities are unlikely to impact these values.

3.3.3 Threatened Species and Communities

An assessment of potential impacts to the threatened species listed under the EPBC legislation as potentially occurring within the project's marine facilities search area is described in Table 3-3.

Table 3-3 EPBC Listed Threatened Species for Project's Marine Facilities, Port Curtis

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Birds					
Red goshawk	*Erythrotriorchis radiatus*	V	Species or species habitat may occur within area	Curtis Island on the whole may form part of the range of an individual bird or pair of red goshawks.	Vegetation on the proposed PLF, MOF and dredge material placement facility site does not form core habitat for this species.
Squatter pigeon (southern)	*Geophaps scripta scripta*	V	Species or species habitat may occur within area	Populations in the Curtis Coast area represent the southern sub-species of the squatter pigeon, which is distributed through inland areas from northern NSW to the Burdekin region of Queensland. It occurs patchily, mainly in grassy eucalypt woodland and gravel ridge habitats, and is a seed eater. The species has declined significantly in the southern parts of its range (NSW), but appears to be stable in Queensland. Identified threats include cattle grazing and predation by foxes (Garnett & Crowley 2000).	The squatter pigeon was not recorded during the survey. However there is suitable habitat present within the proposed PLF, MOF and dredge material placement facility site. Vegetation of the study area does not form core habitat for the squatter pigeon and the proposed action is not expected to impact this species.
Australian painted snipe	*Rostratula australis*	V	Species or species habitat may occur within area	The Australian painted snipe utilises, amongst other habitats, permanent or temporary shallow inland wetlands. It is found scattered throughout many parts of Australia, although loss and alteration of wetland habitat has contributed to species decline (DEH 2003).	The species' requirement for tall reeds is not fulfilled on the site and at best, the Australian painted snipe may only be an occasional visitor to the PLF, MOF and dredge material placement facility. Unlikely to occur in areas potentially impacted by the proposed LNG Marine facilities.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Southern giant-petrel	*Macronectes giganteus*	E, M	Species or species habitat may occur within area	The southern giant-petrel is the largest of the petrels and breeds in colonies on Antarctic and sub-Antarctic islands and Antarctic mainland. It feeds at sea, favouring the continental shelf and the edge of the pack-ice (Morecombe 2000). Throughout the colder months, immature birds and most adults disperse widely, travelling as far north as the Tropic of Capricorn (DEWHA 2008a).	Curtis Island does not form part of the breeding or feeding range of the southern giant-petrel. Unlikely to occur in areas potentially impacted by the proposed PLF, MOF and dredge material placement facility
Kermadec petrel (western)	*Pterodroma neglecta neglecta*	V	Species or species habitat may occur within area	The Kermadec petrel is a large pelagic bird that breeds on islands across the south west Pacific Ocean. Morecombe (2000) notes that it is an "extremely rare vagrant or accidental visitor to E coast NSW".	Curtis Island does not form part of the Kermadec petrel's feeding or nesting range and it is highly unlikely that it would even be an accidental visitor to the Island. Unlikely to occur in areas potentially impacted by the proposed PLF, MOF and dredge material placement facility.
Roseate tern	*Sterna dougalli*	TBA	Species or species habitat may occur within area	Qld EPA supported the addition of the Roseate Tern to the Annexes to CAMBA and JAMBA as populations have been documented on the Swain Reefs with migrations between Australia and Chinese Taipei and Australia and Japan.	These birds are found in sandy caves and areas not frequented by humans. A secure population exists on Swain Reef.
Black-breasted button-quail	*Turnix melanogaster*	V	Species or species habitat may occur within area	The black-breasted button-quail is endemic to eastern Australia and is restricted to coastal and near-coastal regions of south-eastern Queensland and north-eastern New South Wales. The main populations occur within south-east Queensland (DEWHA 2008). The black-breasted button-quail has a preference for low canopied forests, including rainforest, monsoon forests, vine forests and Eucalyptus forests with a dense ground and litter cover (Morecombe 2004).	Small areas of suitable habitat potentially exist in the vicinity of the proposed PLF, MOF and dredge material placement facility. However grazing and other disturbances caused by cattle, horses and feral pigs, as found within the study area, may deter the species from using the site. The proposed action is not expected to impact this species due to superior habitat available on the mainland and/or elsewhere on Curtis Island in conservation reserves.
Mammals					
Northern quoll	*Dasyurus hallucatus*	E	Species or species habitat may occur within area	The northern quoll is found in the savannas of northern Australia. Populations of this quoll have declined across much of its former range, with cane toads thought to be a major factor. They utilise a range of habitats, with rocky areas and eucalypt forests preferred (DEH 2005).	Considering the habitat alteration and disturbance to the proposed PLF, MOF and dredge material placement facility site, there is a low probability that the northern quoll is present.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Large-eared pied bat, large pied bat	*Chalinolobus dwyeri*	V	Species or species habitat may occur within area	It seems this species will occur in most vegetation types provided there are caves or tunnels in which it can roost. Daytime roosts are listed as caves, abandoned mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins (Ayers et al. 1996). Strahan (1995) notes that this species is found in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Isolated records have also been obtained from sub-alpine woodland above 1500m and at the edge of rainforest.	Suitable roosting habitat is not present within the proposed PLF, MOF and dredge material placement facility site. Individuals may forage across the island.
Humpback whale	*Megaptera novaeangliae*	V	Breeding known to occur within the area	(Bonn); Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. It is estimated that when the Australian east coast whaling industry ended in 1963, the east coast population of humpbacks had been reduced to a little over 100 individuals. This population has shown steady recovery of around 10 –11% a year, and in 2006 was estimated at around 8000 (SPRAT Database). The Qld EPA have records of interactions with these species.	No reports of humpback whale sightings or strandings in Gladstone harbour could be found (National Whale and Dolphin Sightings and Strandings Database – DEWHA). While humpbacks are known to occur in the region, they are not known to enter Port Curtis. It is thus concluded that potential impacts from the proposed PLF, MOF and dredge material placement facility are unlikely to have a significant impact on this species.
Water mouse, false water rat	*Xeromys myoides*	V	Species or species habitat may occur within area	Inhabits saline grassland, mangroves and margins of freshwater swamps. Found along Queensland coast from Cooloola to Proserpine, including Stradbroke and Bribie Island. Also found in coastal NT.	There is a low probability of water mouse being present within or adjacent to the proposed PLF, MOF and dredge material placement facility. However, prior to any construction activities it is recommended that further studies be conducted to ascertain presence or absence. If present suitable management as negotiated with government agencies will be undertaken. Given knowledge of the site it is not expected that the proposed activities will significantly impact on this species.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Reptiles					
Loggerhead turtle	*Caretta caretta*	E	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Adult Loggerheads feed on a variety of invertebrate animals, such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean. This eastern Australian population has declined by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994) and may not survive the next 100 years (Limpus 1997). Because no interbreeding occurs between breeding units, repopulation would be unlikely (Bowen *et al.* 1994). It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database). The Qld EPA have records of interactions with these species.	Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact to nesting behaviour of this species from the proposed construction of the PLF, MOF and dredge material placement facility are considered negligible. With the implementation of mitigation measures to avoid potential impacts to this species from capital dredging works, such as the use of silt curtains, timing of dredging with the tidal cycle and turtle exclusion devices interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Green turtle	*Chelonia mydas*	V	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds green turtles mainly eat seagrass and seaweed (algae). They also feed on mangrove fruit, jellyfish and sponges. Limpus (2007) reports that the southern GBR stock of green turtles is large by global standards and that, overall, this population is not showing signs of decreasing numbers of breeding females at the nesting beaches over the past four decades. The Qld EPA have records of interactions with these species.	Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact to nesting behaviour of this species from the proposed construction of the PLF, MOF and dredge material placement facility are considered negligible. With the implementation of mitigation measures to avoid potential impacts to this species from capital dredging works, such as the use of silt curtains, timing of dredging with the tidal cycle and turtle exclusion devices interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Leathery turtle, leatherback turtle	*Dermochelys coriacea*	V	Species or species habitat may occur within area	(Bonn); The diet of Leatherback hatchlings and juveniles is not known. Adult Leatherbacks feed on jellyfish, salps and squid on the ocean surface and down to depths of 200 metres.	There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis. With the implementation of mitigation measures to avoid potential impacts to this species from capital dredging works, such as the use of silt curtains, timing of dredging with the tidal cycle and turtle exclusion devices interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Yakka skink	*Egernia rugosa*	V	Species or species habitat may occur within area	Usually found in open dry sclerophyll forest or woodland, often taking refuge among dense ground vegetation, hollow logs, and cavities in soil-bound root systems of fallen trees and beneath rocks Alternatively, skinks may also excavate burrow systems among low vegetation.	The yakka skink may potentially be present within the proposed PLF, MOF and dredge material placement facility. This site is not core habitat due to the presence of weeds and habitat disturbance and feral predators. Mitigation will be to minimise the footprint of the site.
Hawksbill turtle	*Eretmochelys imbricata*	V	Species or species habitat may occur within area	(Bonn); Major nesting of hawksbill turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia (Pendoley 2005), and in the northern Great Barrier Reef and Torres Strait (Dobbs et al. 1999; Limpus et al. 1989), Queensland. Hawksbill hatchlings feed on very small (planktonic) plants and animals floating in the ocean. When they grow to between 30 and 40 cm (curved carapace length) they begin feeding among coral and rocky reef habitats on the sea floor. Juvenile and adults hawksbill turtles eat a variety of marine plants and animals, particularly algae, seagrass, sponges and shellfish (SPRAT Database).	It is unlikely that Port Curtis is an important habitat for hawksbill turtles, and thus it is concluded that potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikely to impact this species. With the implementation of mitigation measures to avoid potential impacts to this species from capital dredging works, such as the use of silt curtains, timing of dredging with the tidal cycle and turtle exclusion devices interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Pacific Ridley, olive Ridley	*Lepidochelys olivacea*	E	Species or species habitat may occur within area	(Bonn); In Australia, detailed information on the size of nesting and foraging populations is unknown although the nesting population is estimated between 500 and 1,000 (Limpus 1995a). Little is known about the diet of hatchling olive Ridley turtles. Studies on adult olive Ridley turtles in Australia show that they mainly eat shellfish. Studies in other countries show that olive Ridley turtles also eat crabs, shrimps, jellyfish and algae. This species is classed as the most abundant of the sea turtles. However, in Malaysia the nesting population has declined to 20% in recent years. Many of the large Arribadas such as in Surinam have been reduced to several hundred individuals (Limpus 1995b) (SPRAT Database). Over 100 turtles were killed by set netting in Fog Bay, NT, in one incident in 1994 (Guinea & Chatto 1992), which indicates that this species can forage in large aggregations.	While it is possible that olive Ridley turtles occur in the Port Curtis region, no records could be found. With the implementation of mitigation measures to avoid potential impacts to this species from capital dredging works, such as the use of silt curtains, timing of dredging with the tidal cycle and turtle exclusion devices interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Flatback turtle	*Natator depressus*	V	Breeding known to occur within the area	(Bonn); This species is found only in the tropical waters of northern Aust. and PNG and Irian Jaya (Spring 1982; Zangerl *et al.* 1988) and is one of only two species of sea turtle without a global distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007), with occasional nesting by green and loggerhead turtles (Limpus 1999). The flatback turtle population utilising these beaches for nesting has remained at approximately 50 females annually throughout the 35 years monitoring has been conducted (Limpus et al. 2006). Flatback turtle' nesting commences in mid October, reaches a peak in late November – early December and cease by about late January. Hatchlings emerge from nests between early December and late March, with a peak in February (Limpus 2007). Juvenile flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.	Although flatback turtles are known to breed on the eastern side of southern Curtis Island and Facing Island, the impacts to nesting populations from the MOF, PLF and dredge material placement facility is considered negligible. Flatback turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). With the implementation of mitigation measures to avoid potential impacts to this species from capital dredging works, such as the use of silt curtains, timing of dredging with the tidal cycle and turtle exclusion devices interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Brigalow scaly-foot	*Paradelma orientalis*	V	Species or species habitat may occur within area	Occurs on sandstone ridges in woodlands and vine thickets, and in open forests.	The brigalow scaly-foot has been recorded from Boyne Island and may be present within the study site. It is considered that presence is unlikely due to habitat disturbance and feral predators. Lack of micro-habitat features also reduces likelihood of impacts as this species prefers Brigalow forest type not present on Curtis Island.
Sharks					
Whale shark	*Rhincodon typus*	V	Species or species habitat may occur within area	The Whale Shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis.	The Whale Shark is uncommon in Queensland waters, and it is unlikely to occur within Port Curtis. It is unlikely that they enter Port Curtis as whale sharks prefer offshore clearer waters to turbid estuarine waters. It is concluded that the impacts from the proposed MOF, PLF and dredge material placement facility is considered to be negligible. .
Plants					
Heart-leaved bosistoa	*Bosistoa selwynii*	V	Species or species habitat may occur within area	Grows in rainforests up to 300 m in altitude. From Maryborough in Queensland south to the Tweed River district in north-east NSW.	Unlikely to be present within the proposed marine facilities site. The species was not recorded during field surveys of the site.
Three-leaved bosistoa	*Bosistoa transversa*	V	Species or species habitat may occur within area	Grows in lowland subtropical rainforest up to 300 m in altitude. From Maryborough in Queensland south to the Nightcap Range north of Lismore in north-east NSW.	Unlikely to be present within the proposed marine facilities site. The species was not recorded during field surveys of the site.
Miniature moss-orchid	*Bulbophyllum globuliforme*	V	Species or species habitat may occur within area	Found in the McPherson Range, also Maleny and Noosa areas of the Wide Bay district. Appears to grow only on *Araucaria cunninghamii*.	Unlikely to be present within the proposed project's marine facilities site. The species was not recorded during field surveys of the site.
Wedge-leaf tuckeroo	*Cupaniopsis shirleyana*	V	Species or species habitat may occur within area	Small tree up to 10 m tall; usually seen as large bushy shrub. Endemic to Queensland, ranging from Carina, Brisbane to Bundaberg. Occurs in dry rainforest.	Unlikely to be present within the proposed marine facilities site. The species was not recorded during field surveys of the site.
Quassia	*Quassia bidwillii*	V	Species or species habitat may occur within area	Shrub or small tree to 6 m that occurs from Gympie to Mackay. Grows in rainforest communities, or on the margins of these communities.	Unlikely to be present within the proposed marine facilities site. The species was not recorded during field surveys of the site.

1 – Type of presence as indicated within the DEWHA MNES database.
2 – These species were not within the DEWHA MNES database for the search area but were identified within other database searches including Queensland EPA Wildlife Online, Birds Australia database, Queensland Museum and Queensland HERBRECS records.

Table 3-4 provides details of EPBC listed threatened communities.

Table 3-4 EPBC Listed Threatened Communities for the Project's Marine Facilities

Common Name	EPBC Status	Type of Presence[1]	Background	Impacts
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area	Community not found at the LNG Marine Facility.	As this community is not found within the study site potential impacts are considered to be negligible.

3.3.4 Migratory Species

The dugong is a benthic feeder which usually occurs in turbid waters of shallow coastal areas and is considered particularly vulnerable to human impacts (Hodgson 2004). The GBRMPA Position Statement on conservation of dugongs in the Great Barrier Reef Marine Park (GBRMPA 2007) lists boating activity as one of the key pressures of greatest relevance to dugong populations in the Marine Park. Through observations of the response of dugong to passing boats, Hodgson (2004) concluded that the speed of an approaching boat determines the time dugong have to avoid being hit and that speed is the main factor affecting the risk of boat strike.

A pod of at least seven bottlenose dolphins (*Tursiops truncates*) were sighted near Hamilton Point during the May 2008 subtidal survey. The Queensland EPA reported interactions with an Indo-Pacific humpback dolphin (*Sousa chinensis*) at the mouth of the Calliope River, another at Fisherman's Landing and another on the seaward beach of Facing Island in 2005. Interactions with the Indo-Pacific humpback dolphin were recorded on Facing Island with net/rope marks on its body. Seven turtles, one dugong and 30 large fish were also reported. In 2003, and again in 2004, interactions with an Indo-Pacific humpback dolphin were recorded at the mouth of the Calliope River and another on Facing Island. Interactions with a snubfin dolphin (*Orcaella heinsohni*) were recorded at Sea Hill Beach, Curtis Island on 9 August 2007. Although *Sousa chinensis* and *Orcaella heinsohni* are known to occur within the region, it would appear that boat strike and entanglement in fishing gear and the QDPI&F Shark Control nets pose the greatest threats (EPA 2004, 2005, 2006, 2008).

There have been no reported sightings or strandings of Irrawaddy dolphins in the Gladstone Region (National Whale and Dolphin Sightings and Strandings Online Database – DEWHA). It is unlikely that Irrawaddy dolphins utilise the Port of Gladstone region, as they have probably been previously mistaken for Snubfin dolphins.

Gladstone Harbour is not known as part of an important migration route for cetaceans. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. No reports of humpback whale sightings or strandings in Gladstone Harbour could be found on the National Whale and Dolphin Sightings and Strandings Online Database – DEWHA. However, a dead humpback calf was recorded washed ashore on the seaward beach at Curtis Island in 2007 (EPA 2008). While humpbacks are known to occur in the region, they are not known to enter Port Curtis. It is thus concluded that potential impacts from the project's marine facilities are unlikely to have a significant impact on this species.

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Table 3-5 provides details of EPBC listed migratory species.

Table 3-5 EPBC Listed Migratory Species for the Project's Marine Facilities, Curtis Island

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Migratory Terrestrial Species					
White-bellied sea-eagle	*Haliaeetus leucogaster*	M	Species or species habitat likely to occur within area	(CAMBA); White-bellied Sea-Eagles are a common sight in coastal and near coastal areas of Australia. In addition to Australia, the species is found in New Guinea, Indonesia, China, south-east Asia and India. The White-bellied Sea-Eagle feeds mainly off aquatic animals, such as fish, turtles and sea snakes, but it takes birds and mammals as well (Birds Australia). This species was sighted on low tidal mud flats, mangroves and rocky shores habitat during the intertidal survey in June 2008.	Potential impacts from proposed MOF, PLF and dredge material placement facility are unlikely as it is widespread and its preferred habitat is unlikely to be impacted.
White-throated needletail	*Hirundapus caudacutus*	M	Species or species habitat likely to occur within area	Possible occurrence as an overflying species.	Possibly found in the area as an overflying species. This species will not be impacted by the proposed activities as the site of the MOF, PLF and dredge material placement facility does not act as core habitat.
Barn swallow	*Hirundo rustica*	M	Species or species habitat likely to occur within area	Migrant to coastal and sub-coastal districts. Non-breeding in Australia. Possibly present.	Possibly found in the area. This species will not be impacted by the proposed activities as the site of the MOF, PLF and dredge material placement facility does not act as core habitat.
Rainbow bee-eater	*Merops ornatus*	M	Species or species habitat likely to occur within area	This species was sighted on the hinterland margins of Curtis Island during the intertidal survey in June 2008.	Recorded from the site. This species will not be impacted by the proposed activities as the site of the MOF, PLF and dredge material placement facility does not act as core habitat.
Black-faced monarch	*Monarcha melanopsis*	M	Breeding may occur within area	Occurs in rainforests, mangrove and eucalypt woodlands. Species migrates from north Queensland to south-east Australia.	Possibly found in the area. This species will not be impacted by the proposed activities as the site of the MOF, PLF and dredge material placement facility does not act as core habitat.
Spectacled monarch	*Monarcha trivirgatus*	M	Breeding may occur within area	Usually occurs in rainforests, mangroves occasionally moist dense wet eucalypt gullies.	Possibly utilises the area. This species will not be impacted by the proposed activities as the site of the MOF, PLF and dredge material placement facility does not act as core habitat.
Satin flycatcher	*Myiagra cyanoleuca*	M	Species or species habitat likely to occur within area	Species migrates between north Qld and south-east Australia.	Recorded from the site. This species will not be impacted by the proposed activities as the site of the MOF, PLF and dredge material placement facility does not act as core habitat.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Rufous fantail	*Rhipidura rufifrons*	M	Breeding may occur within area	Species migrates between north Qld and south-east Australia. Would favour moist gullies or semi-evergreen vine thickets.	Possibly utilises the area. This species will not be impacted by the proposed activities as the site of the MOF, PLF and dredge material placement facility does not act as core habitat.
Migratory Wetland Birds					
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008.	Potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikelyas it is widespread and its preferred habitat is unlikely to be impacted.
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania (Birds Australia).	Potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikely as it is widespread and its preferred habitat is unlikely to be impacted.
Latham's snipe, Japanese snipe	*Gallinago hardwickii*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Latham's Snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia (i.e. it travels through northern Australia to reach non-breeding areas located further south). In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977; Naarding 1983; Weston 2006, pers. comm.). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977; Naarding 1983).	Potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikely to have a significant impact on this species as its preferred habitat is freshwater systems, and it is unlikely to spend any substantial amount of time in intertidal areas.
Australian cotton pygmy-goose	*Nettapus coromandelianus albipennis*	M	Species or species habitat likely to occur within area	Cotton Pygmy-Geese are found on freshwater lakes, swamps and large water impoundments (The Action Plan for Australian Birds 2000).	Unlikely to occur in areas potentially impacted by the proposed MOF, PLF and dredge material placement facility.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Little curlew, little whimbrel	*Numenius minutus*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Curlew is widespread in the north of Australia and scattered elsewhere (Birds Australia).	Potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikely as this species is widespread and its preferred habitat is unlikely to be impacted.
Painted snipe	*Rostratula benghalensis s. lat.*	M	Species or species habitat likely to occur within area	(CAMBA); Originally listed based on assumption that *Rostratula australis* was a subspecies of *Rostratula benghalensis* (SPRAT Database). Now known that they are separate species and that *Rostratula benghalensis* is unlikely to occur in Australia. Australia recommended the removal of this species from the CAMBA Annex in 2006. The removal will not lessen the protection of the species due to listing as threatened under the EPBC Act.	Unlikely to occur in areas potentially impacted by the proposed MOF, PLF and dredge material placement facility.
Migratory Marine Birds					
Fork-tailed swift	*Apus pacificus*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA, ROKAMBA); Could find no reports of it being sighted in Gladstone region. This species has a large range, with an estimated global Extent of Occurrence of 10,000,000 km². The global population size has not been quantified, but it is believed to be large as the species is described as 'common' in at least parts of its range (del Hoyo et al. 1999). Global population trends have not been quantified, but there is evidence of a population increase (del Hoyo et al. 1999), and so the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (http://www.iucnredlist.org/).	Potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikely as this species habitat is widespread and unlikely to occur in the Gladstone region. Its preferred habitat is unlikely to be impacted.
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008.	Potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikely as this species is widespread and its preferred habitat is unlikely to be impacted.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania (Birds Australia).	Potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikely as this species is widespread and its preferred habitat is unlikely to be impacted.
Southern giant-petrel	*Macronectes giganteus*	E, M	Species or species habitat likely to occur within area	(Bonn); The Southern Giant-Petrel breeds on six subantarctic and Antarctic islands in Australian territory. Longline fishing causes two main forms of mortality in the Southern Giant-Petrel; by-catch during line-setting, and ingestion of discarded fishing hooks (SPRAT Database).	Unlikely to occur in areas potentially impacted by the proposed MOF, PLF and dredge material placement facility.
Little tern	*Sterna albifrons*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Tern is mainly coastal, being found on beaches, sheltered inlets, estuaries, lakes, sewage farms, lagoons, river mouths and deltas. The Little Tern is migratory. Substantial numbers move north from the far south-east after breeding. The Little Tern is extremely sensitive to human disturbance when breeding and is rapidly declining in numbers and range. Nesting sites are usually located where humans swim, walk, exercise dogs, picnic and drive off-road vehicles. The mere presence of people on the beach may cause these terns to desert their eggs and eventually leave the colony altogether. In New South Wales, where they were once quite common, the breeding population of Little Terns has declined to fewer than 50 pairs and of 30 known breeding sites only a handful have been used since 1970 (Birds Australia).	Potential impacts from the proposed MOF, PLF and dredge material placement facility to Little Tern population are considered negligible due to previous disturbance to habitat areas on Curtis Island.
Migratory Marine Mammals					
Bryde's whale	*Balaenoptera edeni*	M	Species or species habitat likely to occur within area	(Bonn); Bryde's Whales occur in temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40° N and 40° S, or the 20 °C isotherm (Bannister et al. 1996). Bryde's Whales have been recorded from all Australian states except the Northern Territory (Bannister et al. 1996), including one sighting each in Victoria and NSW and 11 reported strandings	There have been no reports of sightings within Gladstone harbour. Significant impacts from the proposed project are unlikely. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
				in South Australia (7), NSW (2), Victoria (1) and Queensland (1) (DEW 2007). As there are no estimates of the Australian Bryde's Whale population size, the proportion of the global population in Australian waters cannot be estimated. The lack of data for Bryde's Whales in Australian waters leads to an inability to assess whether global threats would affect the Australian population. The offshore form could potentially be subjected to threats from incidental entanglement in fishing gear set, lost or discarded in international or adjacent waters (SPRAT Database). A single record of a stranding was found from 1982, south west of Stewart Island, Great Sandy Strait (National Whale and Dolphin Sightings and Strandings Database – DEWHA).	
Dugong	*Dugong dugon*	M	Species or species habitat likely to occur within area	The Port of Gladstone region is wholly within the Rodds Bay Dugong Protection Area. The most significant seagrass meadows within the port (significant cover) are located approximately 10 km to the east of the LNG facility site at Pelican Banks. To the west of the site, the foreshore mainland north and south of Fisherman's Landing is covered by isolated patches of seagrass. Dugong feeding activity has been observed on the majority of intertidal seagrass meadows surveyed during the 2007 DPI&F long term monitoring program (Rasheed *et. al.*, 2008). The highest density of dugong feeding trails was observed at the aggregated patches of *Zostera capricorni* / *Halophila ovalis* meadow at Wiggins Island with feeding trails recorded at 58% of sampling sites. Dugong feeding trails were also recorded at Pelican Banks and the intertidal meadows to the north and south of Fishermans Landing (Rasheed *et. al.*, 2008).	Although seagrass meadows suitable for dugong foraging occurs within approximately 2.5km of the proposed MOF, PLF and dredge material placement facility, these meadows are unlikely to be significantly degraded by the project. This is due to their distance from the dredging and spoil placement areas and the limited extent of elevated sediment plumes from the dredging activities (< 500 m). Consequently no significant effects on dugong are expected.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Humpback whale	*Megaptera novaeangliae*	M	Breeding known to occur within area	(Bonn); Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. The majority of humpbacks in Australian waters migrate north to tropical calving grounds in the Great Barrier Reef complex between approximately 14°S and 27°S from June to August, and south to the Southern Ocean feeding areas from September to November. Gladstone Harbour is not known as an important migration route. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. It is estimated that when the Australian east coast whaling industry ended in 1963, the east coast population of humpbacks had been reduced to a little over 100 individuals. This population has shown steady recovery of around 10 –11% a year, and in 2006 was estimated at around 8000 (SPRAT Database).	No reports of humpback whale sightings or strandings in Gladstone harbour could be found (National Whale and Dolphin Sightings and Strandings Database – DEWHA). While humpbacks are known to occur in the region, they are not known to enter Port Curtis. It is concluded that potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikely. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.
Killer whale, orca	*Orcinus orca*	M	Species or species habitat likely to occur within area	(Bonn); The Killer Whale is found in all oceans and seas of the world usually in family groups. They occur in most habitat types from coastal areas to the deep ocean waters, from the tropics to polar regions, although most sightings are in temperate waters. The Killer Whale has never been the target of serious commercial hunting so the species worldwide is secure..	Killer whales have not been reported from within Port Curtis. It is concluded that there is little likelihood of impacts from the proposed MOF, PLF and dredge material placement facility. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Irrawaddy dolphin	*Orcaella brevirostris*	M	Species or species habitat likely to occur within area	It should be noted that the Irrawaddy dolphin (*Orcaella brevirostris*) is now generally regarded to not occur in Australian waters. Instead, it is more likely that reports have in fact related to the Snubfin dolphin (*Orcaella heinsohni*) (Beasley et al. 2005). The Snubfin dolphin is not currently listed under the EPBC Act, however, the information that follows shoud be considered to relate to it. The distribution of this species extends from Broome in Western Australia, along the northern coastline near Darwin and the Gulf of Carpentaria, and off the east coast as far south as the Brisbane River. Irrawaddy dolphins are typically associated with shallow, coastal and estuarine waters, with most sightings recorded within 10 km of the coast, in waters less than 10 m deep, and within 10 km of a river mouth (Parra 2005 – PhD thesis). Since 1968, there have been 36 reported strandings of Irrawaddy dolphins in Queensland, all from around the Townsville region. There have been no reported sightings or strandings from the Gladstone region (National Whale and Dolphin Sightings and Strandings Database – DEWHA). Parra (2005) reports additional strandings, including one from Bundaberg in 1994 and one from the Brisbane River in 1997.	It is unlikely that Irrawaddy dolphins utilise the Port of Gladstone region, however, it is likely that Snubfin dolphins do to a limited extent. The limited number of sightings of Snubfin dolphins indicate that Port Curtis is not a significant habitat for them. As such, it is concluded that potential interactions during the construction of the MOF, PLF and dredge material placement facility are unlikely to have a significant impact on this species. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.
Indo-Pacific humpback dolphin	*Sousa chinensis*	M	Species or species habitat likely to occur within area	The taxonomy of the Australian population of the Indo-Pacific Humpback dolphin (Sousa chinensis) is now undergoing revision, with suggestions that it may in fact be a separate species (Frere et al. 2008). The Qld EPA have records of interactions with these species in the Port Curtis region. Sousa chinensis is known to occur within the region and it would appear that boat strike and entanglement in fishing gear and the QDPI&F shark control nets pose the greatest threats.	The impact on these species from the proposed MOF, PLF and dredge material placement facility is considered to be low. Dredging operations will be accompanied by spotters to check for the presence of marine fauna including dolphins so that mitigation measures can by implemented as necessary. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Migratory Marine Reptiles					
Estuarine crocodile, salt-water crocodile	*Crocodylus porosus*	M	Species or species habitat may occur within area	(Bonn); Connell Hatch (2006) reported that saltwater crocodiles had been seen within the Calliope and Boyne Rivers prior to 2004, but there have been no reports of their sighting since that time. Significant breeding populations of *C. porosus* do not occur south of the Tropic of Capricorn. Port Curtis is not considered an important habitat for *C. porosus.*	Port Curtis is not considered an important habitat for *C. porosus* and It is concluded that there is little likelihood of the proposed MOF, PLF and dredge material placement facility impacting this species.
Loggerhead turtle	*Caretta caretta*	M	Species or species habitat may occur within area	(Bonn) Occasional nesting on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Adult Loggerheads feed on a variety of invertebrate animals, such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean. This eastern Australian population has declined by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994) and may not survive the next 100 years (Limpus 1997). Because no interbreeding occurs between breeding units, repopulation would be unlikely (Bowen *et al.* 1994). It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database). The Qld EPA has records of interactions with these species.	Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact on this species from the proposed MOF, PLF and dredge material placement facility are considered negligible. Potential impacts from dredging the MOF and PLF will be mitigated to avoid interactions. Mitigation measures will include turtle exclusion devices on dredging equipment, reduced dredge pump speed when interactions are likely. Maintaining constant watch and adherence to all reporting requirements for interaction with marine fauna will also be employed. The nearest turtle nesting beaches are located on the eastern side of Curtis Island approximately 8 km from the LNG facility site. The intervening topography is such that there is no direct line of sight from the LNG facility site to these beaches. Hence no light effects from the project on turtle nesting are expected. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Green turtle	*Chelonia mydas*	M	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (see flatback turtle, below). Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds green turtles mainly eat seagrass and seaweed (algae). They also feed on mangrove fruit, jellyfish and sponges. Limpus (2007) reports that the southern GBR stock of green turtles is large by global standards and that, overall, this population is not showing signs of decreasing numbers of breeding females at the nesting beaches over the past four decades. The Qld EPA have records of interactions with these species.	Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact on this species from the proposed MOF, PLF and dredge material placement facility are considered negligible. Potential impacts from dredging the MOF and PLF will be mitigated to avoid interactions. Mitigation measures will include turtle exclusion devices on dredging equipment, reduced dredge pump speed when interactions are likely. Maintaining constant watch and adherence to all reporting requirements for interaction with marine fauna will also be employed. The nearest turtle nesting beaches are located on the eastern side of Curtis Island approximately 8 km from the LNG facility site. The intervening topography is such that there is no direct line of sight from the LNG facility site to these beaches. Hence no light effects from the project on turtle nesting are expected. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Leathery turtle, teatherback turtle	*Dermochelys coriacea*	M	Species or species habitat may occur within area	(Bonn); The diet of Leatherback hatchlings and juveniles is not known. Adult Leatherbacks feed on jellyfish, salps and squid on the ocean surface and down to depths of 200 metres. There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis.	There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis. Potential impacts from dredging the MOF and PLF will be mitigated to avoid interactions. Mitigation measures will include turtle exclusion devices on dredging equipment, reduced dredge pump speed when interactions are likely. Maintaining constant watch and adherence to all reporting requirements for interaction with marine fauna will also be employed. The nearest turtle nesting beaches are located on the eastern side of Curtis Island approximately 8 km from the LNG facility site. The intervening topography is such that there is no direct line of sight from the LNG facility site to these beaches. Hence no light effects from the project on turtle nesting are expected. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Hawksbill turtle	*Eretmochelys imbricata*	M	Species or species habitat may occur within area	(Bonn); Major nesting of hawksbill turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia (Pendoley 2005), and in the northern Great Barrier Reef and Torres Strait (Dobbs et al. 1999; Limpus et al. 1989), Queensland. Hawksbill hatchlings feed on very small (planktonic) plants and animals floating in the ocean. When they grow to between 30 and 40 cm (curved carapace length) they begin feeding among coral and rocky reef habitats on the sea floor. Juvenile and adults hawksbill turtles eat a variety of marine plants and animals, particularly algae, seagrass, sponges and shellfish (SPRAT Database).	It is unlikely that Port Curtis is an important habitat for hawksbill turtles, and thus it is concluded that potential impacts from the proposed MOF, PLF and dredge material placement facility are unlikely to have a significant impact on this species. Potential impacts from dredging the MOF and PLF will be mitigated to avoid interactions. Mitigation measures will include turtle exclusion devices on dredging equipment, reduced dredge pump speed when interactions are likely. Maintaining constant watch and adherence to all reporting requirements for interaction with marine fauna will also be employed. The nearest turtle nesting beaches are located on the eastern side of Curtis Island approximately 8 km from the LNG facility site. The intervening topography is such that there is no direct line of sight from the LNG facility site to these beaches. Hence no light effects from the project on turtle nesting are expected. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Pacific Ridley, olive Ridley Turtle	*Lepidochelys olivacea*	M	Species or species habitat may occur within area	(Bonn); In Australia, detailed information on the size of nesting and foraging populations is unknown although the nesting population is estimated between 500 and 1,000 (Limpus 1995a). Over 100 turtles were killed by set netting in Fog Bay, NT, in one incident in 1994 (Guinea & Chatto 1992), which indicates that this species can forage in large aggregations. Little is known about what hatchling olive Ridley turtles eat. Studies on adult olive Ridley turtles in Australia show that they mainly eat shellfish. Studies in other countries show that olive Ridley turtles also eat crabs, shrimps, jellyfish and algae. This species is classed as the most abundant of the sea turtles. However, in Malaysia the nesting population has declined to 20% in recent years. Many of the large Arribadas such as in Surinam have been reduced to several hundred individuals (Limpus 1995b) (SPRAT Database).	While it is possible that olive Ridley turtles occur in the Port Curtis region, no records could be found. The impact on this species from the proposed MOF, PLF and dredge material placement facility is considered negligible. Potential impacts from dredging the MOF, PLF and dredge material placement facility will be mitigated to avoid interactions. Mitigation measures will include turtle exclusion devices on dredging equipment, reduced dredge pump speed when interactions are likely. Maintaining constant watch and adherence to all reporting requirements for interaction with marine fauna will also be employed. The nearest turtle nesting beaches are located on the eastern side of Curtis Island approximately 8 km from the LNG facility site. The intervening topography is such that there is no direct line of sight from the LNG facility site to these beaches. Hence no light effects from the project on turtle nesting are expected. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.

Section 3 Marine Facilities- EPBC 2008/4058

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts
Flatback turtle	*Natator depressus*	M	Breeding known to occur within the area	(Bonn); This species is found only in the tropical waters of northern Aust. and PNG and Irian Jaya (Spring 1982; Zangerl *et al.* 1988) and is one of only two species of sea turtle without a global distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007), with occasional nesting by green and loggerhead turtles (Limpus 1999). The flatback turtle population utilising these beaches for nesting has remained at approximately 50 females annually throughout the 35 years monitoring has been conducted (Limpus et al. 2006). Flatback turtle' nesting commences in mid October, reaches a peak in late November – early December and cease by about late January. Hatchlings emerge from nests between early December and late March, with a peak in February (Limpus 2007). Juvenile flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.	Although flatback turtles are known to breed on the eastern side of southern Curtis Island and Facing Island, the impacts to nesting populations from the marine facilities is considered negligible. Flatback turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Potential impacts from dredging the MOF, PLF and dredge material placement facility will be mitigated to avoid interactions. Mitigation measures will include turtle exclusion devices on dredging equipment, reduced dredge pump speed when interactions are likely. Maintaining constant watch and adherence to all reporting requirements for interaction with marine fauna will also be employed. The nearest turtle nesting beaches are located on the eastern side of Curtis Island approximately 8 km from the LNG facility site. The intervening topography is such that there is no direct line of sight from the LNG facility site to these beaches. Hence no light effects from the project on turtle nesting are expected. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.
Sharks					
Whale shark	*Rhincodon typus*	M	Species or species habitat may occur within area	The Whale Shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans.	As they are uncommon in Queensland waters and unlikely to occur within Port Curtis, it is concluded that there is little likelihood of the proposed MOF, PLF and dredge material placement facility impacting this species. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts would be similar to those from other ocean going vessels already using the area.

1 – Type of presence as indicated within the DEWHA MNES database.

Section 4 Development of CSG Resources- EPBC 2008/4059

4.1 Description of Proposed Action

EPBC Act referral number EPBC 2008/4059 relates to the development of the coal seam gas fields (CSG) required for the project. The project is located in central Queensland, Australia. The CSG fields extend from south of Roma to north of Rolleston.

4.1.1 Proposed Development Areas

Figure 1-2 shows the extent of the petroleum authorities and names of the CSG fields as they existed in February 2008 which was when the EIS baseline studies commenced. Since that time the boundaries of some petroleum authorities have changed as some of the ATPs have been converted to PLs. Some areas have also been relinquished in accordance with the governing legislation. This is a normal part of managing CSG fields and it is possible that Santos may acquire additional gas acreage in the future.

Projections of future CSG production are difficult to make. Several variables complicate such forecasts, including new exploration or production techniques, increases or decreases in demand for natural gas/LNG, and price increases or decreases that may prompt larger or smaller production programs. For the GLNG Project a reasonably foreseeable development (RFD) scenario has been established to assess the degree of CSG development that can be reasonably expected to occur over a given period of time.

CSG field development to support the initial 3 – 4 Mtpa LNG facility (Train 1) is proposed to be located in the RFD area. The RFD area comprises tenements in the Roma (part), Fairview, Arcadia Valley and part of the Comet Ridge fields. The RFD tenements as they existed in February 2009 are shown on Figure 1-3. Santos proposes to drill and complete enough development wells within the RFD area to supply approximately 5,300 PJ (140 billion m^3) of gas to Train 1. This will likely require up to 1,200 development wells prior to 2015 and up to 1,450 wells after 2015 (excluding exploration wells). The number of wells required to deliver this volume will be influenced by the results of exploration programs, production techniques and other factors. Due to the nature of the CSG industry, exploration results will influence the development plans.

Gas in quantities beyond 5,300 PJ required for the second and third trains of the LNG facility is likely to be supplied by a combination of the following:

- From the development of the wells discussed above.
- From the development of the future development area which includes tenements in the Mahalo, Denison, Scotia, Comet Ridge and Roma Other fields shown on Figure 3.4.2 and listed in Table 3.4.1 of the EIS.
- By utilising Santos' share of gas from tenements in which Santos has an interest but is not the operator. These tenements are listed in Table 3.4.1 in the EIS and are shown in the EIS Figure 3.4.2 as "Other CSG Fields".
- From third parties.

The timing and selection of the source of gas for the subsequent stages of the LNG facility cannot be fully determined at present as it will depend on future exploration activities and development plans. Santos is not seeking approval for the additional CSG development which may be required for the second and third stages of the LNG facility as part of this EIS. Further environmental assessment and approval processes beyond those contemplated in this EIS may apply for the extraction of the additional CSG required depending on the arrangements made for sourcing of the gas.

Although Santos' CSG tenures cover an area of approximately 24,000 km^2, the RFD area is expected to encompass only about 6,900 km^2 which equates to approximately 28% of the total Santos tenure area. The balance consists of future development areas some of which are operated by a Santos entity (12,100 km^2) and some with operators other than a Santos entity (5,100 km^2).

It should be noted that the EPBC Act Referral 2008/4059 incorrectly included PL1(1), PL1(2), PL(3), PL17 and EPC 937. PL1(1), PL1(2) and PL(3) are oil fields. PL17 is not intended to be used by Santos for the

GLNG Project. EPC 937 is an exploration permit for coal. These tenements are not required for the GLNG Project and are not included as part of this assessment.

4.1.2 Assessment Process

Because of the large area of the CSG fields and the ongoing nature of exploration and gas production, the precise number and location of the wells and associated infrastructure, and the locations of the centralised compression and water treatment facilities, is not yet known and will evolve gradually over the life of the project. Consequently, it is not feasible to undertake conventional baseline studies and impact assessment and so, for the CSG fields component of the project, a two-phased approach has been adopted for its impact assessment in accordance with the TOR.

The first phase of impact assessment (Phase 1) which has been reported within this EIS incorporates the following activities:

- Desktop assessment of the CSG fields. This assessment included the GCS fields as shown on Figure 1-2. This included the RFD area as well as the future development area. The purpose of the desktop assessment was to indentify regional environmental constraints over the whole area and to provide a focus for the subsequent reconnaissance field surveys. This desktop assessment included literature reviews, database searches, interpretation of relevant mapping layers and liaison with local community groups.
- Reconnaissance field surveys. The surveys were undertaken in the potentially sensitive locations in the RFD area that were identified from the desktop assessment. The purpose of the reconnaissance field surveys was to identify and characterise the environmental values likely to be affected by development of the RFD area.
- Assessment of likely impacts from typical project elements (e.g. wells, pipelines, nodal compressors, centralised compression and water treatment facilities, accommodation facilities and other related infrastructure). This was based on identified impacts and mitigation measures employed at the existing Santos CSG operations. The purpose of the assessment was to identify the impacts associated with the proposed development and to develop appropriate mitigation measures.
- Development of a Phase 2 protocol for the ongoing biodiversity assessment and impact assessment for project elements undertaken as their specific nature and location becomes known over the life of the project.

The purpose of these assesment protocols is to provide a robust framework for the management of each component of the CSG field in a manner which minimises its impact on the environment. The protocols have been developed to:

- Identify the elements of the CSG fields development which have the potential to impact on the environment;
- Identify the sensitive features of the existing environment;
- Specify the site selection criteria to be applied according to the type and location of the development proposed;
- Outline the proposed timing and scope of field work required to enable the proposed development to be located in accordance with the relevant site selection criteria; and
- Identify mitigation measures which will be employed to minimise impact on the environment.

The protocols are set out in:

- The environmental management plans;
- The mitigation measures in the EIS; and
- The management standards and hazard standards as set out in Santos' Environmental Health and Management System.

The protocols will be managed through the existing Santos impact assessment process and will feed directly into their Environment, Health and Safety Management System.

4.1.3 Development Activities

Development of the CSG fields may include a range of activities from geophysical investigations through to production and processing. Project phases include:

- Exploration - including geophysical surveys and drilling of exploration wells;
- Appraisal - drilling and testing of appraisal wells (also called pilot holes);
- Development, including:
  - drilling and completion of production wells (wells drilled to enable gas production); and
  - construction of centralised compression and water treatment facility, gas and water gathering networks, associated water management facilities and other related infrastructure.
- Production/Operation; and
- Rehabilitation and Decommissioning.

Once the gas reaches the surface, it will be pumped to a centralised compression and water treatment facility through a network of buried pipes. In some cases there may not be adequate pressure for the gas to flow to the centralised facility. If so, nodal compressor stations will be provided to pump the gas to the central facilities. The nodal stations will be low to intermediate rotary screw compressors with either a gas or electric driver. Approximately 150 of them will be required for the development of the RFD area

In order to minimise the disturbance footprint, pipelines will be located along existing roads and tracks or existing fence lines where practical. The current plan for the gas and water pipeline gathering system for the RFD area is that it will require in the order of 2,000 km of pipeline. The gathering system may be longer or shorter depending on ultimate field performance and development plan.

The centralised compression and water treatment facilities will be located throughout the gas fields to minimise the length of the gathering pipelines and pumping requirements. The size and number of centralised compression and water treatment facilities will depend on the nature of the reservoirs, the number of wells and the volume and nature of associated water. It is currently estimated that approximately 12 new centralised compression and water treatment facilities will be required for the RFD area

The volume of associated water produced will vary from well to well and with the duration of well production. The volume of water produced from an individual well will reduce over time. The water will generally have elevated salt concentrations in the range 1,500 to 8,000 mg/L. Nevertheless it has potential for beneficial reuse and a range of management options are being developed that can be adapted to the variability in quality and quantity of the water across the fields and over time. A risk management approach has been used to develop a short list of water management options that will be combined in different proportions across the three fields.

The Queensland Environmental Protection Agency (EPA) has an operational policy for associated water which identifies a preference to re-inject associated water to groundwater, preferably to the coal seams from which the water originated. However, this approach will require the construction of very large areas of temporary water storage ponds, which will have impacts similar to those of evaporation ponds, which are not permitted under current EPA policy.

The risk assessment undertaken by Santos has identified a range of options for associated water management. In order of preference, they include:

- Direct irrigation of salt tolerant crops (e.g. Chinchilla White Gum is already under irrigation at the Fairview field using water with salinity concentrations of up to 3,000 mg/L);
- Some localised stock watering as appropriate;

- Desalination, followed by supply of low salinity water to any of the following:
  - Local landholders, on whose land the CSG fields are located. (Santos expects to supply at least half of its desalinated water to the local pasture industry. Most of this water can be expected to be applied to irrigation of fodder crops).
  - Local industry. (Possibly using rivers to transport desalinated water).
  - Local municipal purposes.
  - Environmental enhancement and/or provide increased public amenity. (For example, maintain water levels in lakes in the region).

4.2 Environmental Values - MNES

A desktop database search of sources including the DEWHA Protected Matters MNES database, Queensland EPA Wildlife Online, Birds Australia database, Queensland Museum and Queensland Herbarium (HERBRECS) records was conducted. The GSG Field MNES search area was an "area search" with a 1km buffer for the following coordinates:

- Northern CSG fields: -23.3956, 148.22961, -23.3956, 150.353164, -26.189102, 150.353164, -26.189102, 148.22961.
- Southern CSG fields: -26.239717, 148.142964, -26.239717, 150.340752, -28.053393, 150.340752, -28.053393, 148.142964.

Desktop analysis of the CSG fields reveals that the northern fields of Arcadia Valley, Comet Ridge, Fairview, Mahalo and the southern part of the Denison Trough have similar landscape characteristics consisting of mountain ranges, scarps and ledges. These areas are primarily densely vegetated and much less amenable to agricultural development. The northern parts of the Denison Trough, Fairview and Scotia have relatively similar landscape characteristics including flat to undulating relief that is largely cleared and developed into agricultural properties. The mountain ranges of Carnarvon and Expedition are very prominent features of the landscape in the north and create defining landscape features that dictate the land use of the region.

The southern gas fields of Roma and Eastern Surat Basin are primarily located in cleared areas of largely flat agricultural land. This land occurs primarily within a single subregion and is fairly uniform in landscape. These areas have been largely modified due to agricultural development and significantly less remnant vegetation remains than is evident in the northern gas fields.

Environmentally sensitive areas (ESAs) include national parks, state forests, world heritage areas, Ramsar wetlands, nationally important wetlands and Essential Habitat. Most of the CSG fields intersect with or wholly contain Environmentally Sensitive Areas (ESAs); which include national parks, state forests, nationally important wetlands and EPA Essential Habitat. These areas are afforded various degrees of protection or management due to their inherent natural and geophysical values.

4.2.1 Threatened Species and Communities

Potential Values

The database searches identified a total of 70 threatened species and 5 threatened communities listed under the EPBC Act as potentially occurring within the within the greater CSG field area (~22 million ha) including the Arcadia Valley, Fairview, Mahalo, Comet, Roma, Roma Other, Denison Trough and Scotia fields (Figure 5-1 and Table 4-1). A total of seventeen protected migratory bird species were identified in the MNES search as potentially being present within the CSG Field search area (Table 4-2).

Surveyed Values

Field surveys for flora census and fauna habitat characterisation were undertaken during four separate field trips over a total of 22 days between September and November 2008. The field investigation

focussed on the reasonably foreseeable development(RFD) area (~1.3 million ha) in the Arcadia Valley, Fairview and Roma CSG fields in locations representative of the overall landscape

One EPBC listed species, the squatter pigeon (*Geophaps scripta scripta*), was identified during the field surveys. Suitable habitat for a number of EPBC listed fauna and flora species (5 birds, 3 mammals, 5 reptiles and 11 plants) was found to be present within RFD area and it is expected that these species will be utilising this habitat.

The following threatened ecological communities were identified from field surveys within RFD area:

- Natural grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin;
- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- Semi-evergreen vine thickets of the Brigalow Belt and the Nandewar Bioregions; and
- The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin.

Reptiles

Five EPBC listed reptile species were identified as potentially present within the CSG Fields. Site scouting and Phase 2 ecological surveys will be undertaken prior to infrastructure development to minimise impacts. With appropriate management it is considered that potential impacts to EPBC listed reptile species from development of the CSG Field will be negligible.

Mammals

Three EPBC listed mammal species are potentially present within the CSG Fields. Site scouting and Phase 2 ecological surveys will be undertaken prior to infrastructure development to minimise impacts. With appropriate management it is considered that potential impacts to EPBC listed mammal species from development of the CSG Field will be negligible.

Birds

Five EPBC listed birds are potentially present within the CSG Fields. One bird species (squatter pigeon) listed under the EPBC Act was recorded from the CSG Field and the four other other species are expected to utilise the area. However, the areas to be impacted by the development of the CSG Field are not considered to provide core habitat for any of these species.

Given that the proposed impacts from the CSG Field will generally be restricted to areas previously cleared of vegetation the proposed action is not expected to significantly impact upon EPBC Act listed bird species. Site scouting and Phase 2 ecological surveys will be undertaken prior to infrastructure development to minimise impacts.

Fish

The Murray cod (*Maccullochella peelii peelii*) is widespread throughout the Murray-Darling system (Native Fish Australia Website, 2009). Recreational fishing has posed the greatest threat to this species in the past, followed by habitat modification such as the installation of dams and weirs, removal of in-stream habitat and changes to the structures of rivers through cattle grazing along river banks. Significant impacts to any population of this species from the CSG Field are unlikely due to their widespread distribution and the stocking of fished impoundments of this species.

Mollusc

The boggomoss snail (*Adclarkia dawsonensis*) is found in the Greater Taroom area of south-eastern Queensland, in the Dawson Valley, north-east of Taroom, on the Dawson River (Stanisic, 1996, 2008). There are two sub-populations of the snail. One is found in boggomoss (artesian spring) habitat on

private property on the Dawson River near Taroom and the other population occurs on a camping and water reserve between Tarom and Theodore, at the Isla-Delusion crossing of the Dawson River (Stanisic, 2008). The extent of the occurrence of the boggomoss snail is estimated to be 0.435km^2. These two habitats are the only two locations at which this species is known to occur. There is a record of a boggomoss snail shell from a recently deceased snail being found at a third site at Cockatoo Creek south of Taroom, however no live snails have been recorded from this site.

The species distribution can be considered highly fragmented as it occurs as only two small and relatively isolated subpopulations. Land clearing and fire are considered the greatest threat to the boggomoss snail. Changes to the hydrology of the area could threaten subpopulations as land snails rely on moist habitat. The boggomoss snail is not known to be under threat from predation. However, land snails are known to be preyed on by rats, birds, beetles, ants and other snails that are present within the known habitat (Stanisic 2008). A National Recovery Plan has been established for the boggomoss snail. It is considered unlikely that the boggomoss snail occurs within the CSG Field area. Likely impacts from the CSG Field development are considered to be negligible.

Plants

No plant species listed under the EPBC Act was recorded from field studies of the CSG Field. However, 11 species are considered to be potentially present within areas of remnant vegetation. Given that the proposed impacts from the CSG Field will generally be restricted to areas previously cleared of vegetation the proposed action is not expected to significantly impact upon EPBC Act listed flora species. Site scouting and Phase 2 ecological surveys will be undertaken prior to infrastructure development to minimise impacts.

Ecological Communities

The following EPBC listed ecological communities were identified from field surveys within the RFD area:

- Natural grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin
- Brigalow (Acacia harpophylla dominant and co-dominant);
- Semi-evergreen vine thickets of the Brigalow Belt and the Nandewar Bioregions; and
- The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin.

4.2.2 Migratory Species

Seventeen protected migratory bird species were identified in the MNES search as potentially being present within the CSG Field search area (Table 4-2).

4.3 Potential Impacts to MNES and Mitigation Measures

4.3.1 Threatened Species and Communities

The potential impacts to the threatened species listed under the EPBC legislation as potentially occurring within the CSG field search area are described in Table 4-1.

Table 4-1 EPBC Listed Threatened Species for the CSG Field

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
Birds					
Red goshawk	*Erythrotriorchis radiatus*	V	Species or species habitat likely to occur within area	Usually found in coastal and sub coastal forests and tropical woodlands, eucalypt woodlands & open forest often near water & with an abundance of prey bird species.	Restricted to suitable core habitat on wooded ranges, proposed activities unlikely to significantly impact this species.
Squatter pigeon (southern)	*Geophaps scripta scripta*	V	Species or species habitat likely to occur within area	Grassy woodlands & open woodlands, particularly near water including artificial sources.	Recorded during field surveys. Will be present in all CSG fields. Adapted to disturbed habitats. Proposed activities unlikely to significantly impact this species due to the abundance of alternative suitable habitat in the region.
Swift parrot	*Lathamus discolor*	E	Species or species habitat may occur within area	Only present in Queensland in autumn / winter months.	CSG field is probably at northern extent of range. May occasionally utilise woodlands in area depending upon resource availability. Proposed activities unlikely to significantly impact this species.
Star Finch (eastern), star finch (southern)	*Neochmia ruficauda ruficauda*	E	Species or species habitat likely to occur within area	Inhabits tall grass besides swamps and rivers, and grassy eucalypt open woodlands near watercourses.	Limited suitable habitat may be present. Proposed activities unlikely to significantly impact this species.
Plains-wanderer	*Pedionomus torquatus*	V	n/a[2]	In Queensland, found in mostly in channel country in the far west; Astrebla Downs National Park, southern reaches of Diamantina Lakes National Park, and Sandringham station. Also scattered through NSW, Victoria and South Australia.	Presence highly unlikely. This species will not be impacted.
black-throated finch (white-rumped subspecies)	*Poephila cincta cincta*	V	n/a[2]	Occupies grassy woodland where there is access to seeding grasses and water. No records of unequivocally wild birds in the last decade in New South Wales. Two records of the species since 1980 in the Inverell district but possibly aviary escapees.	Presence unlikely and low probability of species being impacted.
Superb parrot	*Polytelis swainsonii*	V	Species or species habitat may occur within area	Found in the NSW southwest slopes as well as northern parts of the ACT and north central Victoria.	Presence highly unlikely. This species will not be impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
Paradise parrot	*Psephotus pulcherrimus*	EX	n/a[2]	Presumed extinct, paradise parrots lived in open eucalypt woodland and open forest with a grassy understorey. The presence of termite mounds for nest sites is also an important habitat requirement. .	Presence highly unlikely. This species is listed as presumed extinct and will not be impacted.
Australian painted snipe	*Rostratula australis*	V	Species or species habitat may occur within area	Inhabits marsh, floodplains, swamps, watercourses with adequate cover.	Species may be present in suitable habitat. Unlikely to be significantly impacted.
Black-breasted button-quail	*Turnix melanogaster*	V	Species or species habitat likely to occur within area	Found in rainforests and lantana thickets, and drier scrubby shrub such as hoop pine, belah, brigalow and bottletree thickets. Found in Queensland near Byfield in the north, south to NSW border and west to Palm Grove NP and Barakula State Forest. Main population within south-east Queensland but also in northern NSW.	Presence unlikely and low probability of species being impacted.
Mammals					
Large-eared pied bat, large pied bat	*Chalinolobus dwyeri*	V	Species or species habitat may occur within area	Occur in most vegetation types provided there are caves or tunnels in which it can roost. Daytime roosts are listed as caves, abandoned mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins (Ayers et al. 1996).	Probable occurrence in suitable habitat. Should not be impacted by proposed activities due to the abundance of alternative suitable habitat in the region and planning of CSG facilities to avoid areas of suitable habitat.
Western quoll	*Dasyurus geoffroii geoffroii*	V	n/a[2]	Medium-sized quoll. Formerly present across semi-arid southern Australia from WA to western Queensland and NSW, now confined to wet and dry sclerophyll and mallee remnants in south-west WA.	Presence highly unlikely. This species will not be impacted.
Northern quoll	*Dasyurus hallucatus*	E	Species or species habitat may occur within area	Lives in a range of habitats, but prefer rocky areas and eucalypt forests. The quoll is a good climber but spends most of its time foraging and sleeping on the ground. During the day	Possible occurrence in suitable habitat in the region. CSG facilities are unlikely to be planned for core quoll habitat and thus the species should not be impacted by proposed activities.

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
				it likes to hide in hollow logs, rock crevices, caves and hollow trees.	
Spotted-tailed quoll (southern subspecies)	*Dasyurus maculatus maculatus*	E	n/a[2]	Found in several habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest. Females occupy a home ranges up to about 750 ha and males up to 3500 ha.	Presence unlikely and low probability of species being impacted.
Northern hairy-nosed wombat	*Lasiorhinus krefftii*	E	n/a[2]	Reduced to about 70 animals in 300 ha of sandy grassy woodland in Epping Forest National Park, near Clermont, Qld. Grazes on native perennial grasses.	Presence unlikely and low probability of species being impacted.
Bilby	*Macrotis lagotis*	V	n/a[2]	The bilby remain patchily distributed through the Tanami Desert. They are not present within the CSG fields.	Presence unlikely and low probability of species being impacted.
Eastern long-eared bat	*Nyctophilus timoriensis (South-eastern form)*	V	Species or species habitat may occur within area	Eucalypt & acacia woodlands in the vicinity of suitable roost sites such as tree hollows.	Suitable habitat present within CSG field. Local populations may be impacted if roost trees are removed. No significant impact expected due to the abundance of alternative suitable habitat in the region and planning of CSG facilities to avoid areas of suitable habitat.
Bridled nailtail wallaby	*Onychogalea fraenata*	E	n/a[2]	Confined to acacia-dominated woodland and shrubland in Taunton Scientific Reserve near Dingo.	Presence unlikely and low probability of species being impacted.
Ray-finned fishes					
Murray cod, cod, goodoo	*Maccullochella peelii peelii*	V	Species or species habitat may occur within area	Widespread distribution. May occur in larger permanent waterholes.	May occur in suitable habitat however impacts are unlikely to be significant.
Reptiles					
Five-clawed worm-skink, long-legged wormskink	*Anomalopus mackayi*	V	Species or species habitat may occur within area	Limbed with 3 fingers and two toes. Found in the southern Brigalow Belt and open grasslands on heavy cracking soil in Darling Downs. Normally found in soil under dead grass.	Presence unlikely and low probability of species being impacted.
Collared delma	*Delma torquata*	V	n/a[2]	In general, the species occurs on rocky hillsides on basalt and	Suitable habitat present within CSG field. Local populations may be impacted if suitable habitat is

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
				lateritic soils supporting open eucalypt and Acacia woodland with a sparse understorey of shrubs and tussocks or semi-evergreen vine thicket (Cogger et al. 1993; Davidson 1993; Porter 1998).	affected. Scouting for the species within suitable habitat will be undertaken prior to development of CSG facilities. Given suitable planning it is not expected that this species will be impacted by the proposal.
Ornamental snake	*Denisonia maculata*	V	Species or species habitat likely to occur within area	Endemic. Associated with low-lying seasonally flooded areas of the Brigalow Belt, from Collinsville area south to Rockhampton, and inland to Blackwater.	Suitable habitat present within CSG field. Local populations may be impacted if suitable habitat is affected. Scouting for the species within suitable habitat will be undertaken prior to development of CSG facilities. Given suitable planning it is not expected that this species will be impacted by the proposal.
Yakka Skink	*Egernia rugosa*	V	Species or species habitat likely to occur within area	Occurs near coast and in sub-humid to semi-arid eastern interior of Qld; Found in rocky outcrops, sand plain areas and dense vegetation associated with dry sclerophyll forest or woodland (DEWHA, 2008).	Maybe impacted within suitable habitat by proposed actions. Scouting for the species within suitable habitat will be undertaken prior to development of CSG facilities. Given suitable planning it is not expected that this species will be impacted by the proposal.
Dunmall's snake	*Furina dunmalli*	V	Species or species habitat may occur within area	Eucalypt, callitris & acacia woodlands & open forests.	Suitable habitat present within CSG field. Local populations may be impacted if suitable habitat is affected. Scouting for the species within suitable habitat will be undertaken prior to development of CSG facilities. Given suitable planning it is not expected that this species will be impacted by the proposal.
Brigalow Scaly-foot	*Paradelma orientalis*	V	Species or species habitat may occur within area	Occurs on sandstone ridges in woodlands and vine thickets, and in open forests.	Suitable habitat present within CSG field. Local populations may be impacted if suitable habitat is affected. Scouting for the species within suitable habitat will be undertaken prior to development of CSG facilities. Given suitable planning it is not expected that this species will be impacted by the proposal.
Fitzroy Tortoise	*Rheodytes leukops*	V	Species or species habitat may occur within area	Permanent freshwater riverine reaches and large, isolated permanent waterholes .	Presence unlikely and low probability of species being impacted.
Molluscs					
Boggomoss Snail, dawson valley snail	*Adclarkia dawsonensis*	CE	Species or species habitat likely to occur within area	Two populations of the snail are found in the Dawson Valley, north-east of Taroom, on the Dawson River, south-eastern Queensland. They survive in	Presence unlikely within areas of proposed impact and low probability of species being impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
				riparian habitat at Isla Delusion, and in a 0.5 ha patch of Boggomoss habitat.	
Plants					
No common name	*Acacia chinchillensis*	V	Species or species habitat likely to occur within area	Multi-stemmed, glaucous shrub 0.3-2 m high. Occurs in south-eastern Qld, north of Chinchilla and near Tara.	Presence unlikely and low probability of species being impacted.
Curly-bark wattle	*Acacia curranii*	V	Species or species habitat likely to occur within area	Multistemmed shrub to 3 m high. Disjunct distribution, occurring near Gurulmundi, Darling Downs district, Qld and at Shepherds Hill and Kilparney, NSW.	Presence unlikely and low probability of species being impacted.
No common name	*Acacia grandifolia*	V	n/a[2]	Tree up to 8 m. Endemic to south-east Qld and restricted to a small area around Gayndah, Mundubberra, Coulston Lakes and Proston in the Burnett district.	Presence unlikely and low probability of species being impacted.
No common name	*Acacia wardellii*	V	Species or species habitat may occur within area	Slender shrub or tree 5-7 m high; restricted to south of Roma, south-west of Chinchilla and the Thornby range near Surat. Grows on shallow weathered sandstone in eucalypt woodland.	Presence unlikely and low probability of species being impacted.
No common name	*Amphibromus whitei*	X	n/a[2]	Extinct.	Presence unlikely and low probability of species being impacted.
No common name	*Aristida annua*	V	Species or species habitat likely to occur within area	Restricted to a small area of central Queensland. Black earth and basalt soils. Flowering and fruiting March, May to June. A. annua is distinctive in that it is the only annual species with a convolute lemma and an open panicle.	Suitable habitat present within CSG field. Proposed actions are not expected to impact species.
Hairy-joint grass	*Arthraxon hispidus*	V	Species or species habitat likely to occur within area	Creeping grass that occurs over a wide area in south-east Qld, but is never common. Found in wet eucalypt forest, often near creeks or swamps.	Presence unlikely and low probability of species being impacted.
No common name	*Bertya opponens*	V	n/a[2]	Slender shrub or small tree to 4 m high.	Presence unlikely and low probability of species being

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
				Found in shallow soils on ridges with mallee.	impacted.
No common name	*Bothriochloa biloba*	V	n/a[2]	Endemic. Found only on clay soils of the Darling Downs, Qld and the tablelands and western slopes of the Great Divide in northern NSW extending to Sydney.	Presence unlikely and low probability of species being impacted.
No common name	*Bulbophyllum globuliforme*	V	n/a[2]	This species is epiphytic, favouring subtropical rainforest, warm temperate rainforest, dry rainforest and wet sclerophyll forests. It's favoured (almost exclusive) host is Araucaria cunninghamii.	Presence unlikely and low probability of species being impacted.
Ooline	*Cadellia pentastylis*	V	Species or species habitat likely to occur within area	Occurs on ridges and undulating terrain in pure stands or with brigalow or semi-evergreen vine thicket.	Suitable habitat present within CSG field. Proposed actions are not expected to impact species.
No common name	*Calytrix gurulmundensis*	V	Species or species habitat likely to occur within area	Small to medium shrub between 0.5 and 1.5 m high. Restricted occurrence north west of Toowoomba, Qld.	Presence unlikely and low probability of species being impacted.
No common name	*Commersonia sp. Cadarga (G.P. Guymer 1642)*	V	Species or species habitat likely to occur within area	Restricted to central Queensland.	Presence unlikely and low probability of species being impacted.
No common name	*Cossinia australiana*	E	n/a[2]	Shrub to small tree in dry rainforest and vine thickets. Restricted distribution north from Kingaroy and Gympie to Rockhampton.	Presence unlikely and low probability of species being impacted.
No common name	*Cycas megacarpa*	E	n/a[2]	Scattered and localised on clay-loam soils over several substrates, usually on sloping country in wet eucalypt forests or rainforests. Ranges from near Mount Morgan to near Goomeri in Qld.	Species likely to be present within CSG field however proposed actions are not expected to impact species.
No common name	*Daviesia discolor*	V	n/a[2]	Known from only two isolated locations in Queensland approximately 350km apart: Blackdown Tableland and the Coast Range (approximately 70km west of Maryborough). Grows in very tall open forest on hills and	Presence unlikely and low probability of species being impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
				slopes on well drained sandy loam or clay.	
No common name	*Decaspermum struckoilicum*	E	n/a[2]	Erect, multi-stemmed shrub. Found only in the small town of Struck Oil, 6 km east of Mt Morgan, central Queensland.	Presence unlikely and low probability of species being impacted.
King blue-grass	*Dichanthium queenslandicum*	V	Species or species habitat likely to occur within area	Endemic to Queensland where it occurs mostly on black clay soils around Emerald and more rarely on the Darling Downs.	Suitable habitat present within CSG field. Proposed actions are not expected to impact species.
No common name	*Dichanthium setosum*	V	Species or species habitat likely to occur within area	An upright bluegrass less than 1 m tall. Associated with heavy basaltic black soils.	Suitable habitat present within CSG field. Proposed actions are not expected to impact species.
Finger panic grass	*Digitaria porrecta*	E	Species or species habitat likely to occur within area	Occurs in tropical and subtropical rain forests and tropical and subtropical sub-humid woodlands.	Presence unlikely and low probability of species being impacted.
Tricolour diuris	*Diurus sheaffiana*	V	Species or species habitat likely to occur within area	Grows in sclerophyll forest among native grass; often with native Cypress Pine.	Presence unlikely and low probability of species being impacted.
Salt pipewort, button grass	*Eriocaulon carsonii*	E	Species or species habitat likely to occur within area		Presence unlikely and low probability of species being impacted.
No common name	*Eucalyptus beaniana*	V	Species or species habitat likely to occur within area	Small tree, ironbark to larger branches, small branchlets smooth and white. Very restricted, known only from Isla Gorge National Park in south-central Queensland.	Presence unlikely and low probability of species being impacted
No common name	*Eucalyptus raveretiana*	V	n/a[2]	Small to medium sized tree. Always occurs along creek beds and river banks. Scattered and disjunct in central coastal and subcoastal Queensland.	Presence unlikely and low probability of species being impacted.
No common name	*Eucalyptus virens*	V	Species or species habitat likely to occur within area	Small to medium-sized tree. Ironbark throughout. Known from only four disjunct populations near Inglewood, Tara, Edsvold and Mt Moffat; endemic to Qld.	Presence unlikely and low probability of species being impacted.
No common name	*Homopholis belsonii*	V	Species or species habitat may occur within area	Perennial grass to 0.5 m high. Grows in dry woodland (e.g. Belah) on poor soils. Found in south west Queensland, from near	Presence unlikely and low probability of species being impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
				Gurulmundi and between Miles and Roma.	
No common name	*Homoranthus decumbens*	V	Species or species habitat known to occur within area	Found in two isolated locations in south-west and central-west Qld.	Suitable habitat present within CSG field. Proposed actions are not expected to impact species.
No common name	*Leionema obtusifolium*	V	n/a[2]	Small shrub; endemic. Restricted to one location in south-east Qld.	Presence unlikely and low probability of species being impacted.
No common name	*Leucopogon cuspidatus*	V	n/a[2]	Occurs on off-shore islands in the Great Barrier Reef and adjacent mainland coastal areas.	Presence unlikely and low probability of species being impacted.
No common name	*Logania diffusa*	V	n/a[2]	Found in only one isolated location in Qld.	Presence unlikely and low probability of species being impacted.
No common name	*Macadamia integrifolia*	V	n/a[2]	Small to medium-sized tree to 15 m high; major commercial food crop. Found in rainforests of south-east Queensland.	Presence unlikely and low probability of species being impacted.
No common name	*Macrozamia fearnsidei*	V	Species or species habitat likely to occur within area	Widely scattered, on sandy soil over sandstone in the ranges north and east of Injune.	Species likely to be present within CSG field however proposed actions are not expected to impact species.
No common name	*Macrozamia platyrhachis*	E	Species or species habitat likely to occur within area	Distribution restricted to the Blackdown Tableland/ Planet Downs area of the Dawson range, central Queensland, in eucalypt woodland or open forest on deep sandy soils derived from sandstone (Not of Concern RE's).	Presence unlikely and low probability of species being impacted.
No common name	*Marsdenia brevifolia*	V	Species or species habitat likely to occur within area	Restricted distribution in isolated locations near Marlborough, central Queensland and in northern Queensland.	Presence unlikely and low probability of species being impacted.
No common name	*Phaius australis*	E	n/a[2]	Orchid with flower stems up to 2 m tall. Grows in swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas in south-east Queensland and northern NSW.	Presence unlikely and low probability of species being impacted.
No common name	*Prostanthera sp (Dunmore D.M.Gordon 8A)*	V	n/a[2]	No information available	Presence unlikely and low probability of species being impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
Cobar greenhood orchid	*Pterostylis cobarensis*	V	Species or species habitat likely to occur within area	Terrestrial orchid recorded from the Darling Downs district of Queensland. Grows in eucalypt woodland, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils.	Presence unlikely and low probability of species being impacted.
Quassia	*Quassia bidwillii*	V	Species or species habitat likely to occur within area	Shrub or small tree to 6 m that occurs from Gympie to Mackay. Grows in rainforest communities, or on the margins of these communities.	Presence unlikely and low probability of species being impacted.
No common name	*Rhaphidospora bonneyana*	V	n/a[2]	Shrub to 40 cm high, glabrous or hairy. Grows in gullies or on rocky mesas in ranges.	Suitable habitat present within CSG field. Proposed actions are not expected to impact species.
Slender Darling-pea, slender swainson, Murray Swainson-pea	*Swainsona murrayana*	V	Species or species habitat likely to occur within area	Sparsely-downy forb with greyish, thin or tapered, stiffly leathery pods. Found on clay-based soils and grows in a variety of vegetation types including saltbush, grasslands, floodplains and depressions. Mostly found in NSW, but also a small area in Qld.	Presence unlikely and low probability of species being impacted.
No common name	*Taeniophyllum muelleri*	V	n/a[2]	Epiphytic orchid, favouring littoral rainforest, subtropical rainforest, wet sclerophyll forests and riparian areas.	Presence unlikely and low probability of species being impacted.
No common name	*Thesium australe*	V	n/a[2]	Small strangling herb to 40 cm tall. Found scattered in Queensland, NSW, and Tasmania. Occurs in grassland or grassy woodland and often found in damp sites associated with *Themeda australis* (kangaroo grass).	Presence unlikely and low probability of species being impacted.
No common name	*Tylophora linearis*	E	n/a[2]	Grows in dry scrub and open forest. Found from near Glenmorgan in the western Darling Downs. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa,*	Suitable habitat present within CSG field. Proposed actions are not expected to impact species.

Common Name	Scientific Name	EPBC Status	Type of Presence	Comments	Impacts/Mitigations
				Callitris glaucophylla and *Allocasuarina luehmannii*.	
No common name	*Westringia parvifolia*	V	Species or species habitat likely to occur within area	Spreading shrub 0.3 - 1.5 m high. Grows in mallee, woodland and dry sclerophyll forest, on sandy soils or in deep gravel-rich sands.	Suitable habitat present within CSG field. Proposed actions are not expected to impact species.
No common name	*Xerothamnella herbacea*	E	Species or species habitat likely to occur within area	Grows mainly in shady areas under brigalow trees.	Suitable habitat present within CSG field. Proposed actions are not expected to impact species.

1 – Type of presence as indicated within the DEWHA MNES database.

2 – These species were not within the DEWHA MNES database for the search area but were identified within other database searches including Queensland EPA Wildlife Online, Birds Australia database, Queensland Museum and Queensland HERBRECS records.

Four threatened ecological communities listed under the EPBC Act were recorded from within the CSG Field. As part of the wellfield scoping, Phase 2 involves site field scouting investigation that is undertaken for all proposed well field operation sites. This is undertaken to assess a number of potential sensitivities including cultural heritage, landholder liaison and environmental considerations where desktop evaluation identified these as a requirement.

A number of strategies are investigated at the site scoping stage to determine the appropriate level of impact controls, including but not limited to:

- Avoiding sites of known scientific and natural significance and/or cultural heritage sites;
- Minimising or where possible avoiding clearance of trees and shrubs;
- Minimising disturbance of natural drainage patterns;
- Avoiding inversion of soil profile;
- Avoiding impacts to third party infrastructure and activities e.g. fencing, stock yards
- Minimising risks to wildlife and stock;
- Locating accommodation facilities as close to work areas as possible;
- Minimising the area of impact e.g. lease area, road or pipeline width;
- Using existing roads or tracks where possible (ie. rationalising access);
- Using common or adjacent easements for pipelines, roads or seismic lines;
- Avoiding impact on floodplains, wetlands or permanent waterholes;
- Evaluating need for erosion control measures in vulnerable locations e.g. gibber plain, steep sites to minimise erosion risk;
- Avoiding interference with natural drainage (or restores drainage where required);
- Avoiding introduction of weeds;
- Using a central waste facility whenever possible;

- Facilitating rehabilitation and/or restoration; and
- Considering post-construction land use.

An assessment of the likelihood of presence and potential impacts to threatened ecological communities are listed in Table 4-2

Table 4-2 EPBC Listed Threatened Communities for the CSG Field

Threatened Ecological Community	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin	E	Community known to occur within area	Community present in CSG field. Regional Ecosystems present that correspond to this threatened community include: RE 11.3.21, 11.8.11, 11.8.11a. Figure 5-1 shows extent within CSG field.	Areas of this ecological community within the CSG field will be identified as part of Phase 2 pre-construction surveys and areas will be retained where practicable. No significant impacts are expected to this community.
Brigalow (*Acacia harpophylla* dominant and co-dominant)	E	Community known to occur within area	Community present in CSG field. Regional Ecosystems present that correspond to this threatened community include: 11.3.1, 11.4.3, 11.4.3a, 11.4.7, 11.4.8, 11.4.9, 11.4.9a, 11.9.1. Figure 5-1 shows extent within CSG field.	Areas of this ecological community within the CSG field will be identified prior to development of the field and areas will be retained where practicable. No significant impacts are expected to this community.
Semi-evergreen vine thickets of the Brigalow belt (North and South) and Nandewar Bioregions	E	Community known to occur within area	Community present in CSG field. Regional Ecosystems present that correspond to this threatened community include: RE 11.4.1, 11.5.15, 11.8.3, 11.9.4a, 11.9.4b, 11.9.5. Figure 5-1 shows extent within CSG field.	Areas of this ecological community within the CSG field will be identified prior to development of the field and areas will be retained where practicable. No significant impacts are expected to this community.
The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin	E	Community known to occur within area	Community present in CSG field. Figure 5-1 shows extent within CSG field.	Areas of this ecological community within the CSG field will be identified prior to development of the field and areas will be retained where practicable. No significant impacts are expected to this community
White box-yellow box-Blakely's red gum grassy woodland and derived native grassland	CE	Community may occur within area	This ecological community was not recorded from the CSG field and is considered unlikely to be present.	This ecological community is considered unlikely to be present within the CSG field and no significant impacts are anticipated.

1 – Type of presence as indicated within the DEWHA MNES database.

4.3.2 Migratory Species

Seventeen protected migratory bird species were identified in the MNES searches as potentially being present within the CSG field search areas. The likelihood of presence and potential impacts and mitigation are outlined below in Table 4-3.

Table 4-3 EPBC Listed Migratory Species for CSG Field

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Migratory Terrestrial Species					
White-bellied sea-eagle	*Haliaeetus leucogaster*	M	Species or species habitat likely to occur within area	(CAMBA); White-bellied Sea-Eagles are a common sight in coastal and near coastal areas of Australia. In addition to Australia, the species is found in New Guinea, Indonesia, China, south-east Asia and India. The White-bellied Sea-Eagle feeds mainly off aquatic animals but it takes birds and mammals as well (Birds Australia).	Signifcant impacts are unlikely on this species as it is widespread and its preferred habitat is highly unlikely to be impacted.
White-throated needletail	*Hirundapus caudacutus*	M	Species or species habitat likely to occur within area	Suitable habitat exists within CSG Field. Would overfly site. No impacts to this species are expected from the proposed actions.	No impacts to this species are expected from the proposed actions due to its preference for coastal areas.
Barn swallow	*Hirundo rustica*	M	Species or species habitat likely to occur within area	Migrant to coastal and sub-coastal districts. Non-breeding in Australia. Possibly present. No impacts to this species are expected from the proposed actions.	Impacts to this species are possible but unlikely as this species is migratory and suitable alternative habitat is present over a widespread area.
Rainbow bee-eater	*Merops ornatus*	M	Species or species habitat likely to occur within area	Suitable habitat exists within the CSG Field.	Impacts to this species are possible but unlikely as this species is migratory and suitable alternative habitat is present over a widespread area.
Black-faced monarch	*Monarcha melanopsis*	M	Breeding may occur within area	Occurs in rainforests, mangrove and eucalypt woodlands.	No significant impacts to this species are likely from the proposed actions as this species is migratory and suitable alternative habitat is present over a widespread area in the region.
Spectacled monarch	*Monarcha trivirgatus*	M	Breeding may occur within area	Usually occurs in rainforests, mangroves occasionally moist dense wet eucalypt gullies.	No significant impacts to this species are likely from the proposed actions as this species is migratory and suitable alternative habitat is present over a widespread area in the region..
Satin flycatcher	*Myiagra cyanoleuca*	M	Species or species habitat likely to occur within area	Species migrates between north Qld and south-east Australia. Probable visitor to CSG Field during migration.	No significant impacts to this species are expected from the proposed actions as this species is migratory and suitable alternative habitat is present over a widespread area.
Rufous fantail	*Rhipidura rufifrons*	M	Breeding may occur within area	Species migrates between north Qld and south-east Australia. Probable visitor to CSG Field during migration. Would favour moist gullies or semi-evergreen vine thickets.	No significant impacts to this species are likely from the proposed actions as this species is migratory and suitable alternative habitat is present over a widespread area.
Migratory Wetland Birds					
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are	No significant impacts to this species are likely from the proposed actions as this species is migratory and suitable

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
			within area	common throughout Australia (Birds Australia).	alternative habitat is present over a widespread area.
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania (Birds Australia).	No significant impacts to this species are likely from the proposed actions as this speicies is migratory and suitable alternative habitat is present over a widespread area.
Latham's snipe, Japanese snipe	*Gallinago hardwickii*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Latham's Snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia (i.e. it travels through northern Australia to reach non-breeding areas located further south). In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977; Naarding 1983; Weston 2006, pers. comm.). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977; Naarding 1983).	Potential impacts from the CSG Field are unlikely to have a significant impact on this species as its preferred habitat will not be affected by the proposal.
Australian Cotton Pygmy-goose	*Nettapus coromandelianus albipennis*	M	Species or species habitat likely to occur within area	Cotton Pygmy-Geese are found on freshwater lakes, swamps and large water impoundments (The Action Plan for Australian Birds 2000).	No significant impacts to this species are likely from the proposed actions as this species is migratory and suitable alternative habitat is present over a widespread area.
Little curlew, little whimbrel	*Numenius minutus*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Curlew is widespread in the north of Australia and scattered elsewhere (Birds Australia).	No significant impacts to this species are likely from the proposed actions as this species is migratory and suitable alternative habitat is present over a widespread area.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Painted snipe	*Rostratula benghalensis*	M	Species or species habitat likely to occur within area	(CAMBA); Originally listed based on assumption that *Rostratula australis* was a subspecies of *Rostratula benghalensis* (SPRAT Database). Now known that they are separate species and that *Rostratula benghalensis* is unlikely to occur in Australia. Australia recommended the removal of this species from the CAMBA Annex in 2006. The removal will not lessen the protection of the species due to listing as threatened under the EPBC Act.	No significant impacts to this species are likely from the proposed actions as this species is migratory and suitable alternative habitat is present over a widespread area.
Migratory Marine Birds					
Fork-tailed swift	*Apus pacificus*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA, ROKAMBA); Could find no reports of it being sighted in Gladstone region. This species has a large range, with an estimated global Extent of Occurrence of 10,000,000 km². The global population size has not been quantified, but it is believed to be large as the species is described as 'common' in at least parts of its range (del Hoyo et al. 1999). Global population trends have not been quantified, but there is evidence of a population increase (del Hoyo et al. 1999), and so the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (http://www.iucnredlist.org/).	Potential impacts from the CSG Field are unlikely to be significant as this species habitat is widespread. Its preferred habitat is unlikely to be impacted.
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are common throughout Australia (Birds Australia).	Potential impacts unlikely to be significant as this species is widespread and its preferred habitat is not likely to be impacted from CSG activites
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern	Potential impacts unlikely to be significant as this species is widespread and its preferred habitat is not likely to be impacted from CSG activites.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
				Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg,to Port Augusta, South Australia, including Tasmania (Birds Australia).	
Southern giant-petrel	*Macronectes giganteus*	E, M	Species or species habitat unlikely to occur within area	(Bonn); The Southern Giant-Petrel breeds on six subantarctic and Antarctic islands in Australian territory. Longline fishing causes two main forms of mortality in the Southern Giant-Petrel; by-catch during line-setting, and ingestion of discarded fishing hooks (SPRAT Database).	Unlikely to occur in areas potentially impacted by the CSG Field.
Little tern	*Sterna albifrons*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Tern is mainly coastal, being found on beaches, sheltered inlets, estuaries, lakes, sewage farms, lagoons, river mouths and deltas. The Little Tern is migratory. Substantial numbers move north from the far south-east after breeding. The Little Tern is extremely sensitive to human disturbance when breeding and is rapidly declining in numbers and range. Nesting sites are usually located where humans swim, walk, exercise dogs, picnic and drive off-road vehicles. The mere presence of people on the beach may cause these terns to desert their eggs and eventually leave the colony altogether. In New South Wales, where they were once quite common, the breeding population of Little Terns has declined to fewer than 50 pairs and of 30 known breeding sites only a handful have been used since 1970 (Birds Australia).	Potential impacts from the CSG Field are unlikely as they are primarily coastal.

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Section 5 Bridge, Road and Services Corridor- EPBC 2008/4060

5.1 Description of Proposed Action

EPBC Act referral number EPBC 2008/4060 relates to the construction of the bridge, road and services corridor to Curtis Island to access the LNG plant.

Access to the LNG facility from the mainland will occur by either of the following options:

- The provision of road access to Curtis Island by way of a potential access road and bridge from the mainland crossing Port Curtis between Friend Point and Laird Point. Construction phase access to the site for at least Train 1 will be by barge and ferry as the access road and bridge will not be constructed by that time; or
- Access to the site by barge or ferry for the life of the GLNG Project (for both construction and operation) if the access road and bridge is not constructed.

5.1.1 Bridge and Access Road

5.1.1.1 Bridge

Access to the proposed LNG facility on Curtis Island may be via the potential bridge linking Curtis Island (Laird Point area) with the mainland (Friend Point). A new access road is also proposed to be built on the western side of Curtis Island as well as on the mainland linking the potential bridge with the existing regional road network.

The potential bridge crosses Port Curtis between Friend Point and Laird Point. The eastern end of the bridge would join Curtis Island to the south of Graham Creek, avoiding the need for a major creek crossing on Curtis Island.

A horizontal alignment has been identified between the above two extremes that provides for:

- The road bridge to be provided on a straight horizontal alignment which allows for less complexity and cost in construction of the vertical curves required to achieve the elevated section of the bridge;
- An alignment perpendicular to tidal flows within The Narrows, as currently understood, allowing for non-skewed bridge piers and a more cost effective bridge construction whilst minimising impact on tidal flows; and
- Minimal impact on port planning as currently provided by the Gladstone Ports Corporation Limited (GPC).
- Minimal impact on port development and potential land use on Curtis Island, by aligning the eastern approaches to the north of Laird Point;
- Minimal footprint over seagrass areas by aligning the western approaches as far north as possible and still achieve the following:
  - Straight horizontal alignment for bridge structure.
  - Non-skewed bridge structure, i.e. bridge aligned perpendicular to tidal flow.

The western approach of the access road to the bridge is across the tidal area north of Landing Road to Friend Point. This is consistent with the draft Gladstone Land Port Rail Road Infrastructure Study in that it is aligned to the southern edge of the mudflats to:

- Minimise the length of the road element over the softer ground conditions; and
- Maximise the area of land on the northern side available for future port related activities.

The preferred route alignment for the bridge is to be located in the vicinity of the Great Barrier Reef Coast Marine Park boundary.

5.1.1.2 Access Road

The proposed Curtis Island access road will extend from the northern end of Landing Road at Fisherman's Landing along the coast above the high water mark for a distance of approximately 2.5 km, then north-east across the intertidal area from the mainland to the southern tip of Kangaroo Island (Friend Point) to the western end of the proposed bridge location. From the eastern end of the bridge the road will continue east along the southern side of Graham Creek for approximately 2.5 km then turn south-east to Hamilton Point along the western side of an existing ridgeline. The total length of the road will be approximately 15 km.

The primary function of the road will be to provide access from the mainland to the Curtis Island Industry Precinct for the movement of workers and freight for industry and port activities that may be developed in the Industry Precinct of the GSDA.

The alignment of the western section of the proposed road has taken into consideration the following constraints:

- Avoidance of an existing mining lease;
- Minimising any impact on an existing mining lease application;
- Avoidance of areas proposed for future port development; and
- Minimisation of impacts on existing marine vegetation by using an alignment between two linear mangrove communities.

In crossing the intertidal area the road will be placed on a fill embankment with a minimum development level of 5.5 m Australian Height Datum (AHD) to avoid tidal influences, wave set up, storm surge and possible sea level rises due to climate change. This is higher than the design levels for the Fisherman's Landing port development (4.0 to 4.5 m AHD) and for Landing Road over tidal areas (4.5 to 5.0 m AHD).

The natural surface level of the intertidal area is approximately RL 1.7-1.8 m AHD with a mean high water spring tide level of 1.56 m AHD and a highest astronomical tide level of 2.34 m AHD. Only extremely high tides flood this area and it is inundated from both directions (both from the east and west) at the same time. Investigations to date indicate that there are only negligible flows across this area during extreme high tides and the effect of building a road embankment on tidal flows will be minimal with little need, if any, for drainage through the embankment. This conclusion will be further assessed during the detailed design of the road.

5.1.1.3 Worker/Equipment Access

As the bridge and access road will not be constructed in time, ferries will be used to transfer construction workers from the mainland to Curtis Island during the construction of Train 1.

A number of options exist to provide a ferry service for the project. These include:

- Use of the existing Curtis Ferry Service which operates two 150-passenger capacity ferries from the Gladstone Marina. These ferries have an operating speed of 10 knots.
- Use of a high speed "fast-cat" service using ferries with a passenger capacity of 300-400 and speeds of 15-25 knots. This will require the use of ferries not currently available in Gladstone.
- Placing the buses directly onto barges which will also be used for the transfer of construction equipment. The buses could then be used to transfer the workers directly to the construction workers accommodation facility.
- A combination of the above.

It has been estimated that the Train 1 construction will require 21 ferry trips per 14-day work cycle. This equates to one to two ferry trips per day (1,500 trips in total during the whole construction phase). The preferred site for the ferry terminal on the mainland is Auckland Point. It is proposed that some upgrades

will be undertaken to provide adequate ferry docking and vehicle parking facilities. On Curtis Island, the ferry terminal will be at the MOF.

During Train 1 construction, barges will be used to transport construction materials from the mainland to Curtis Island. This will include aggregate, cement, piping, structural steel, electrical and instrumentation equipment, and machinery. The barges will be loaded at Auckland Point and offloaded at the MOF. There will be approximately 2,500 barge trips for Train 1 construction. The barges will carry trucks loaded with construction materials and a capacity of four trucks per barge has been assumed. Most of the barge traffic will occur during the peak 24 month period of the construction phase. If it was evenly spread over that time it will result in three to four barge trips per day. However there will be periods of peak construction activity when the daily barge traffic will be greater than this.

If pre-assembled modules are used, there will be a significant reduction in the amount of construction materials and equipment that will need to be barged from the mainland. Some of the local barge traffic will be replaced by barges and heavy lift vessels coming from domestic or overseas locations delivering the pre-assembled modules. It has been estimated that there could be approximately 10 heavy lift vessels trips and 30 barges trips required to deliver the pre-assembled modules spread over three years of the construction phase. The modules will be offloaded at the MOF onto self-propelled motorised transporters which will be designed to carry the heavy loads along the haul road to the construction site.

Under Australia's quarantine regulations, the GLNG Project will undertake cleaning of any imported equipment. To avoid the possibility of re-exporting due to contamination, offshore inspection by an appropriate AQIS or equivalent officer may be undertaken at the module construction site prior to shipment.

5.1.2 No Bridge Option

It is possible that the bridge and access road are not built. In this case ferries and barges will be used for worker and equipment access to Curtis Island for the life of the LNG facility.

For Train 1 construction the ferry and barge traffic will be the same as described above for the bridge option. For the construction of Trains 2 and 3, the ferry movements will reduce to approximately one ferry trip per day. Barge movements for the construction of Trains 2 and 3 will reduce to approximately 1,200 movements for each train. This is because the construction of subsequent trains will required less material than the initial construction.

During the operations phase, the workforce will be accommodated on the mainland and will travel to Curtis Island on a daily basis. Maintenance and administration workers will work week days for eight hours with weekends off. The operations workers will work 12-hour shifts which could be on a two-weeks-on/two-weeks-off roster. On this basis there could be up to four ferry trips per day depending on the final roster selection. Due to the smaller workforce, the capacity of the ferries used during operations will be much less than that proposed for the construction phase.

5.2 Environmental Values - MNES

The potential bridge location between Friend Point on the mainland and Laird Point on Curtis Island and is within the Great Barrier Reef World Heritage Area (GBR WHA). The Narrows represent a passage landscape that separates Curtis Island from the mainland and is an important indicator of the geomorphologic processes including Balaclava Island, Kangaroo Island, Targinie Creek, and Graham Creek. The littoral area along the Graham Creek estuary consists of tidal mud flats and saltmarsh with mangrove communities. Graham Creek channels a significant portion of the freshwater run-off from the southern half of Curtis Island into The Narrows (EPA website, 2009).

The intertidal environments of The Narrows are influenced by two different hydrological systems, the Calliope and Boyne Rivers, creating a complex system of intertidal habitats. The mangroves, saltmarsh and mudflats within the area are important to the maintenance of regional fish and crustacean populations.

Section 5

Bridge, Road and Services Corridor- EPBC 2008/4060

A desktop database search of sources including the DEWHA Protected Matters MNES database, Queensland EPA Wildlife Online, Birds Australia database, Queensland Museum and Queensland Herbarium (HERBRECS) records was conducted (the Potential Bridge, Road and Services Corridor Search area). The Protected Matters search of the DEWHA MNES database provides a general guidance on matters of national environmental significance. Following a “line” type search conducted on 31 January 2008, with a 1 km radius of the DEWHA Matters of National Environmental Significance (MNES) database, the proposed location of the bridge and road is approximately within 500 m of a line along the following points:

-23.746145 151.190221
-23.749880 151.175997
-23.749301 151.177041
-23.746648 151.178114
-23.746299 151.178394
-23.745717 151.178497
-23.745275 151.178854
-23.744930 151.179871
-23.744967 151.182618
-23.745553 151.183253
-23.745788 151.183761
-23.745838 151.184473
-23.745537 151.184881
-23.744256 151.185290
-23.744141 151.185722
-23.744317 151.188418
-23.744552 151.188799
-23.745464 151.189332
-23.746483 151.192738
-23.747046 151.193526
-23.747191 151.194467
-23.747520 151.195204
-23.748387 151.196042
-23.750140 151.201889
-23.755551 151.207146
-23.774111 151.216454
-23.777167 151.221817
-23.782351 151.223464
-23.787704 151.220938
-23.785224 151.150542
-23.784664 151.150544
-23.782881 151.149551
-23.780389 151.149336
-23.775853 151.146909
-23.770106 151.143758
-23.765420 151.143920
-23.761611 151.147259
-23.758581 151.147621
-23.757815 151.148208
-23.756214 151.149864
-23.755468 151.149993
-23.753100 151.152210
-23.752823 151.152694
-23.750290 151.154555
-23.749852 151.155726

The bridge is proposed to be located within approximately 200 m of the following coordinates:

-23.749805 151.176035
-23.74999 151.176056
-23.749764 151.155901
-23.74995 151.155895

Variations to this route may be required in some places dependent on topography, land tenure and environmental sensitivities. Note that the bridge will be located in the vicinity of the southern boundary of the Great Barrier Reef Coast Marine Park..

The proposed bridge, road and services corridor has the potential to impact on the following matters protected under the EPBC Act 1999:

- World Heritage (Section 12, 15A);
- National Heritage Places (Section 15B, 15C);
- Listed Threatened Species and Communities (Section 18, 18A); and
- Listed Migratory Species (20, 20A).

5.2.1 World Heritage / National Heritage Places

The potential bridge, road and services corridor is within the GBRWHA that is administered by the GBRMPA. The boundary of the GBRWHA is set at mean low water and the proposed road and service corridor would be adjacent to the GBRWHA.

The GBRWHA is listed as a National Heritage Place and the potential bridge and road on Curtis Island would be located within a National Heritage Place and the proposed road and service corridor on the mainland would be adjacent to it.

The potential bridge is also located within Port Curtis, listed on the Directory of Important Wetlands in Australia.

5.2.2 Threatened and Migratory Species and Communities

Potential Values

The MNES database search for the bridge, road and services corridor searches identified a total of 25 threatened species listed under the EPBC Act as potentially occurring within the potential bridge, road and services corridor including 8 bird species, 4 mammals, 8 reptiles, 1 shark and 5 species of plants (Table 5-3).

A total of 32 liasted migratory bird and marine species were identified in the MNES search as potentially being present within the search area (Table 5-4).

Surveyed Values

Fauna ground truthing survey effort within the service corridor study area included a 10-day full terrestrial vertebrate survey (including trapping and observational programs).

Flora ground truthing survey effort within the service corridor study area included an 8-day 1:25,000 vegetation mapping survey and full floristic census.

No significant EPBC flora or fauna species were identified as being present from surveys. Suitable habitat was identified as being present for use by false water mouse (*Xeromys myiodes*) black-breasted button-quail (*Turnix melanogaster*) and the squatter pigeon (*Geophaps scripta scripta*).

No EPBC significant ecological communities were identified from field surveys along the service corridor.

5.2.2.1 Birds

The great egret (or white egret) (*Ardea alba*) was sighted on low tidal mudflats adjacent to Curtis Island. Great Egrets are listed in CAMBA and JAMBA and are considered common throughout Australia (Birds

Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008. Potential impacts to this species may occur from some loss of low tidal mudflats at Friend Point and Laird Point resulting from the construction the bridge, road and services corridor. However, these impacts are not considered significant due to the extent of mudflats dominating the lower intertidal habitats within Port Curtis. It is unlikely that significant impacts will occur to this species from the construction of the potential bridge, road and services corridor.

The white-bellied sea eagle (*Haliaeetus leucogaster*) was sighted on low tidal mud flats, mangroves and rocky foreshore habitat of Curtis Island during field surveys conducted in June 2008. Potential impacts to this species from the construction of the bridge, road and services corridor may occur through some loss of mangrove, saltmarsh and intertidal habitat at the bridge abutments on Friend Point and Laird Point and along the mainland section of the road proposed on tidal land on the mainland. The extent of mangrove loss is anticipated to be minimal; however some loss of saltmarsh and intertidal habitat will occur adjacent to the seagrass beds north of Fisherman's Landing. It is considered that the impacts to migratory birds will not be significant due to the availability of suitable habitat within Port Curtis.

5.2.2.2 Reptiles

Terrestrial

No terrestrial reptiles listed under the EPBC Act were recorded within the bridge, road and services corridor. Based on the investigation of the area, none of the listed reptiles would be expected to inhabit the area. It is concluded that the potential impacts to EPBC Act listed terrestrial reptile species are negligible.

Marine

Marine turtles are known to migrate northward through Port Curtis between Friend Point and Laird Point and into The Narrows. Several green turtles were observed by researchers during the field surveys and it has been reported that The Narrows and the Calliope River mouth are major foraging areas (Connell Hatch, 2006). According to previous research the loggerhead turtle (*Caretta caretta*) and flatback turtle (*Natator depressus*) utilise habitats in the outer harbour and occasionally move northward through Port Curtis into The Narrows (QDEH, 1994). The EPA has records of loggerhead turtles found dead in Gladstone Harbour in 2000 and 2002 during dredging operations.

Although it is possible that the endangered Pacific Ridley (olive Ridley) turtle (*Lepidochelys olivacea*) inhabits the area, it has not been sighted within Port Curtis and impacts to this species are considered unlikely. The leatherback turtle (*Dermochelys coriacea*) has been recorded regionally and although none have been sighted within Port Curtis, the implementation of mitigation measures will reduce any potential interactions that may occur with this species.

Activities associated with the construction of the bridge will be minimal and possibly restricted to bridge piling activities only. However, construction of the potential bridge will result in some loss of benthic and subtidal communities in the sandy channel between Friend Point and Laird Point. Indirect impacts from elevated turbidity may occur to seagrass meadows north of Fisherman's Landing.

Based on historic information, it is possible that dredging has impacted loggerhead turtles within Port Curtis, indicating that dredging operations may also directly impact turtles through interactions with the dredger and associated equipment. Mitigation measures to avoid such interactions will be included into the Dredge Management Plan for all dredging operations as part of the construction phase. During construction of the potential bridge, road and services corridor, interactions with marine turtles will be minimised through the implementation of mitigation measures such as the installation of turtle exclusion devices, reducing pump speed and reducing boat speed. Loss of biological diversity of marine turtles within Port Curtis is not expected as these turtle populations are widespread and suitable habitat is available regionally.

5.2.2.3 Mammals

Terrestrial

No terrestrial mammals listed under the EPBC Act were recorded within the bridge, road and services corridor. Based on the investigation of the area, it is possible that the water mouse (*Xeromys myoides*) may inhabit intertidal areas. It is likely however, that potential impacts to EPBC Act listed terrestrial mammal species will be negligible.

Marine

No humpback whales (*Megaptera novaeangliae*) have been sighted within Port Curtis. Although one humpback calf was recorded dead on the eastern side of Curtis Island, supporting their presence regionally, impacts from construction of the potential bridge, road and services corridor are considered to be negligible.

Seagrass meadows are found north of Fisherman's Landing adjacent to the potential bridge and proposed road along the mainland. Direct impact from dredging activities such as increased turbidity is considered to be significant for these meadows. Dugong feeding trails have been reported on these meadows north of Fishermans Landing, around Wiggins Island and at Pelican Banks on the southern side of Curtis Island. Changes to foraging behaviour may result from impacts to seagrass meadows at this location. Implementation of mitigation measures such as silt curtains can reduce impacts from elevated turbidity and associated impacts to seagrass meadows. Mitigation measures to avoid interactions with dugong will be developed and implemented through a Dredge Management Plan for the construction of the potential bridge, road and services corridor. Mitigation measures will include maintaining constant watch during all dredging operations, reducing boat speed and avoiding interactions with dredging equipment.

Port Curtis is formally recognised as providing dugong habitat and is a designated dugong protection area under the Queensland *Nature Conservation Act 1992* and *Fisheries Act 1994*. Although dugong and sea turtle frequent the area the grazing potential of Port Curtis has not yet been quantified (Rasheed *et al*, 2003). Previous studies on seagrass following increased sedimentation indicate large scale seagrass mortality (Preen *et al*, 1995) with resulting migration and mortalities of dugong (Preen and Marsh, 1995). Potential impacts to subtidal seagrass beds may change foraging behaviour of dugong as it is considered that as the deep water seagrass species such as *Halophila spp.* are preferred by dugong. Dugongs also eat marine algae and invertebrates such as ascidians but this is believed to occur only when seagrass is scarce (Preen, 1995).

It is unlikely that Irrawaddy dolphins (*Orcaella brevirostris*) utilise the Port of Gladstone region as they have probably been mistaken for Snubfin dolphins. As such, it is concluded that potential impacts from construction of the potential bridge, road and services corridor are unlikely to be significant.

Recent reports recorded by the EPA of dead Snubfin dolphins at the mouth of the Calliope River, Fisherman's Landing and on the seaward beach of Facing Island indicate that this species are found within Port Curtis and utilise the area as a habitat. These reports however, allude to boat strike and entanglement in fishing gear and shark control nets as the most likely causes of death. The implementation of mitigation measures such as maintaining constant watch and reducing boat speed will reduce interactions with dolphins during all dredging activities.

5.2.2.4 Sharks

The whale shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis. Whale sharks have not previously been recorded within Port Curtis waters. It is considered that potential impacts from construction of the potential bridge, road and services corridor are unlikely.

5.2.2.5 Plants

No flora species listed under the EPBC Act were recorded within the bridge, road and services corridor. It is concluded that potential impacts to EPBC Act listed flora species from development of the potential bridge, road and services corridor is negligible.

5.2.2.6 Threatened Ecological Communities

No threatened ecological communities listed under the EPBC Act were recorded from or are expected to occur within the potential bridge, road and services corridor area. It is concluded that potential impacts to EPBC Act listed threatened ecological communities from development of the potential bridge; road and services corridor is negligible.

5.3 Potential Impacts to MNES and Mitigation Measures

It is anticipated that dredging and construction activities for the potential bridge will result in disturbance of the following marine habitats:

- Subtidal, soft bottom communities in Port Curtis between Friend Point and Laird Point; and
- Loss of saltpan, saltmarsh, seagrass, mangrove and intertidal habitat at Friend and Laird Points.

The western approach of the access road to the bridge is across the tidal area north of Landing Road to Friend Point which includes areas of saltpan and saltmarsh.

The disturbance of these habitats would also result in the loss or displacement of those species directly dependant on these areas. The surface layers of the areas to be dredged provides habitats for a range of benthic (bottom dwelling) fauna such as worms and prawns. Some of these fauna are in turn prey species of larger marine fauna and are important ecologically. As the majority of benthic fauna occur in the top 30 cm of the sediment, the dredging operation would be expected to completely remove all benthic fauna within the dredge site; however previous studies indicate rates of re-colonisation by organisms from larval dispersal and active colonisation from adjacent areas are very high (WBM 2004).

Seagrass meadows north of Fisherman's Landing that may be impacted by the construction of the bridge are indicated in Figure 4-1. The construction of the potential bridge between Friend and Laird Point would result in the modification of several marine habitats. The installation of bridge piers between Laird Point and Friend Point and the construction of abutments at Friend and Laird Points would create additional hard substrates and increase habitat complexity. This would increase the available space for a number of species, such as sponges, gorgonians, soft corals, oysters and other species found on hard substrates within Port Curtis, and also provide habitats and food sources for mobile species (e.g. fish, crabs) which would colonise and use these new habitats for shelter and/or food.

Foraging behaviour of dugong and turtles feeding on seagrass meadows south of Friend Point may be impacted during dredging and/or construction activities of the potential bridge. Smothering of seagrass meadows through increased sedimentation and turbidity may be mitigated through measures implemented in the Construction EMP. The fate and extent of time that suspended solids remain in the water column was shown to be impacted by tidal cycle where spring tides provide greater flushing of sediments. Timing of bridge construction in relation to tidal cycles may reduce impacts to seagrass meadows from increased turbidity and associated decreased light penetration. This would have particular benefits for subtidal seagrass species that dugong prefer.

While it is recognised that there is potential for the generation of sediment plumes during construction of the potential bridge, it is highly likely that with appropriate management intervention, such plumes should be far smaller than those which will be developed by the other sources of potential construction impact already assessed. Due to this it is assumed that the potential impacts are largely addressed by the other assessments and it is recommended that a high level of management control be placed over such actions during the construction phase.

Best practice techniques should be adopted for dredging and pipeline construction activities in order to minimise the extent and duration of sediment plumes which may otherwise be generated during the construction phase of the project. The key measures to reduce construction stage impacts are outlined in EIS Section 8.4.5.3 and are primarily related to the implementation of an approved dredging management plan (DMP) and construction environmental management plan (CEMP).

The CEMP will be required for all construction activities which have the potential to impact upon the marine environment. The CEMP will be broadly similar to the DMP and will be developed in detail in consultation with Santos, the selected contractors, the EPA, the DPI&F and the Gladstone Port Corporation. The CEMP will contain detailed descriptions of the methods to be used, the potential impacts those methods could create, mitigation methods, monitoring and auditing requirements, and approvals required.

Silt curtains work by slowing the flow of water inside the curtain, thereby ensuring the sediment drops to the substrate and removing the sediment plume from the waterway. These are effective in minimising sediment plumes and mitigating smothering of seagrass and other marine communities during capital and maintenance dredging, and marine construction operations.

There are a number of mitigation measures available to minimise impacts on marine megafauna (turtles, dugongs and/or cetaceans). These include:

- The use of rigid and/or chain deflectors;
- Operational protocols (e.g. no suction when not in contact with seabed and use of drag head jets);
- Maintaining a “look-out” for turtles, dugongs and/or cetaceans on the surface;
- No dredging/dredge material placement if turtles, dugongs and/or cetaceans within a specified distance (e.g. 500 m);
- Environmental windows (day/night; seasonal); and
- Reporting requirements.

It is expected that these measures would be incorporated into the DMP and/or the CEMP.

5.3.1 World Heritage / National Heritage Places

The construction of the proposed bridge will involve dredging of the substrate at the crossing between Friend Point on the mainland and Laird Point on Curtis Island. The seagrass meadows to the north of Fisherman’s Landing will be impacted from increased turbidity resulting from dredging operations. The construction of the approaches for the bridge will result in direct impacts to mangroves, saltmarsh and intertidal communities at Friend and Laird Point. All works will be conducted in accordance with the DPI&F Operational Policy for the removal or disturbance of marine plants and agreed fisheries offsets. The development of these infrastructure facilities to the east of Friend Point lie within the GBRWHA, a matter of significance under the EPBC Act (Table 5-1).

The potential bridge and access roads would not be visible from most view situations due to screening by vegetation and/or landforms; however it would be highly visible from Port Curtis. The bridge would also be visible from the Auckland and Round Hill public lookouts and from the northern end of Landing Road.

The primary view situation from which the potential Curtis Island bridge would be visible is from vessels travelling along Port Curtis or moored at the Fisherman’s Landing wharf. The likely level of significance of visual impact for crews and passengers on vessels will vary significantly depending on the nature of their activities. Passengers on pleasure craft travelling through Port Curtis are likely to experience a higher level of visual impact than the crew of commercial vessels using the Fisherman’s Landing Wharf. However, for many pleasure craft passengers the visual impact may not necessarily be negative, as the new bridge will form a visual gateway that will clearly mark the northern boundary of Port Curtis. It will form a landmark structure separating the port, with its predominantly industrial character, from the natural landscape character of the state marine park.

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The potential bridge, being a relatively long, well-lit, artificial structure, will act as a barrier to feral animal movement due to its foreign nature and lack of suitable cover. It is considered very unlikely that feral predators such as foxes, cats, pigs or dogs would utilise the bridge to cross from the mainland to Curtis Island. A number of these feral species are currently present on Curtis Island. If in the highly unlikely circumstance that a feral predator did cross, given the current abundance and diversity of feral animals already present, any additional introductions would not create an elevation in risk to natural values and native fauna that has not already been impacted upon by the current feral presence on the island. Additionally it is considered native and feral fauna have historically accessed Curtis Island at the lowest astronomical tide from the mainland and via other means.

Table 5-1 provides an assessment of potential impacts to each of the four World Heritage criteria and indicative mitigation measures to be implemented as part of the EMP.

Table 5-1 World Heritage Values/National Heritage Places for the bridge, road and services corridor

GBR World Heritage criteria and examples	Impacts/Mitigation
(VII) - Exceptional natural beauty and aesthetic importance • Examples for the Great Barrier Reef WHA values are its vast extent and variety of reefs and islands; coastal mangrove systems of exceptional beauty; rich variety of landscapes and seascapes; spectacular breeding colonies of seabirds and butterflies; and migrating mammals. • Spectacular seascapes and landscapes for example, Whitehaven Beach, Whitsunday islands, Hinchinbrook Island, mosaic patterns on reefs • Spectacular coral assemblages (hard/soft corals)	Direct impacts to the exceptional natural beauty and aesthetic importance of the WHA will be low in terms of the uniqueness of Friend Point and Laird Point. The potential bridge and access roads would not be visible from most view situations due to screening by vegetation and/or landforms; however it would be highly visible from Port Curtis. The bridge would also be visible from the Auckland and Round Hill public lookouts even though the views to the potential bridge are from a distance of 13 km and 16 km respectively; and Port Curtis is heavily industrialised, impacting directly on the aesthetic value of the area. Construction of the bridge, road and services corridor will contribute to the anthropogenic impacts within Port Curtis. The extent of mangroves that will be removed from construction of the bridge abutments will be less than negligible in relation to the extent of mangrove communities found within Port Curtis. Construction of the road along tidal land on the mainland will impact on the aesthetic importance of the area and the fisheries values. Mitigation measures to reduce increased sedimentation on adjacent seagrass meadows will be implemented through the Construction EMP.
(VIII) - Significant geomorphic or physiographic features • The world's largest coral reef ecosystem, extending over 14 degrees of latitudinal range, about 3000 separate coral reefs, ranging from inshore fringing reefs to mid shelf, exposed outer reefs and deep water reefs and shoals • Deep water features of the adjoining continental shelf including canyons, channels, plateaux and slopes.	Construction of the bridge will result in physical disturbance to the sediments from dredging, but will not impact on significant geomorphic or physiographic features that contribute to the world heritage values of the GBR. Coral reefs will not be impacted by dredging activities as there are no coral reefs or cays in the vicinity of The Narrows. Construction of the road will not impact on these given world heritage values.
(IX) - Significant ongoing ecological and biological processes • An extensive diversity of reef morphologies and ngoing geomorphic processes	The bridge, road and services corridor will not interfere with any reefs or islands directly. It is anticipated that indirect impacts will be negligible.

GBR World Heritage criteria and examples	Impacts/Mitigation
• ~ 900 islands ranging from small coral cays (in various stages of geomorphic development) to large continental islands • Complex cross-shelf, longshore and vertical connectivity facilitated by dynamic current flows, incorporating important ecological processes such as larval dispersal • Breeding and spawning grounds for unique coral reef associated species, including threatened and vulnerable species such as turtles, whales and humphead Maori wrasse.	Seagrass meadows north of Fisherman's Landing will be impacted through increased turbidity during dredging operations for construction of the bridge. Plume modelling indicates a worst case scenario of a 600m by 150m area of increased turbidity during a neap tide. This will increase turbidity and decrease light penetration compared to typical turbidity levels of the area for temporary periods of time. Use of the mud flats along the mainland north of Fishermans Landing by migratory shorebirds is considered to be low. Considering the vast extent of mud flats within Port Curtis. it is anticipated that there will be negligible disturbance to breeding colonies of seabirds. Interactions with some species of migratory marine mammals such as dolphins and dugong are likely. Interactions with migratory marine mammals will be mitigated through the implementation of flanges, turtle exclusion devices, reduced pump speeds and positioning of the dredger during all dredging operations. Watches will be maintained for all shipping activities within the Port. Whales are not known to breed within Port Curtis and the Humpback has not been sighted there. No impacts are anticipated to the humpback whale. Turtles are known to use Port Curtis as habitat and feed on seagrass meadows within Port Curtis. Interactions with marine turtles moving north through the harbour and into The Narrows have been recorded previously. Breeding is not likely to be impacted. Mitigation measures to avoid interactions with marine turtles will be implemented during all dredging and other shipping activities. It's unlikely that The Narrows provides preferred spawning habitat for unique coral reef associated species.
(X) - Significant natural habitat for *in-situ* conservation of biological diversity • Over 2000 km2 of mangroves including 54 per cent of the world's mangrove diversity • ~ 43 000 km2 of seagrass meadows in both shallow and deep water areas supporting one of the world's most important dugong populations and six of the world's seven species of marine turtle • 70 bioregions (broad-scale habitats) have been identified comprising 30 reef bioregions and 40 non-reefal bioregions, these include algal and sponge gardens, sandy and muddy bottom communities, continental slopes and deep ocean troughs • The reef bioregions contain one third of the world's soft coral and sea pen species (80 species) • 800 species of echinoderms (for example sea stars) equalling 13 per cent of the world's total species • The location of the world's largest green turtle	There may be some direct impacts to mangrove communities, particularly the construction of the bridge approaches. Loss of mangroves will be kept to a minimum and in accordance with the objectives of Qld Fisheries Act 1994. Impacts from dredging and trenching may result in direct impacts to seagrass meadows north of Fishermans Landing through increased turbidity. Some smothering of seagrass may occur resulting in short term impacts to feeding grounds for dugong and turtle from dredging activities. Negative Impacts will be managed through the implementation of sediment limitation devices and other mitigation measures developed as part of the Environmental Management Plan for the bridge, road and services corridor. There any no inter-reefal or lagoonal areas within China Bay that may be directly or indirectly impacted by bridge, road and services corridor. The nearest significant coral communities are between Curtis and Facing Islands, more than 10km south of the proposed bridge.

GBR World Heritage criteria and examples	Impacts/Mitigation
breeding area, other key breeding areas, regionally important seabird nesting islands, significant spawning ground (for example black marlin) and a significant area for humpback whale calving and rearing.	While parts of Port Curtis may exhibit geological processes linking the various elements of the coastal environment (e.g. estuaries, intertidal flats, mangroves and embayments); the bridge, road and services corridor will not result in disturbance to these elements.

Table 5-2 provides an assessment of heritage values and potential impacts and mitigation methods for the potential bridge, access road and services corridor.

Table 5-2 National Heritage values for the proposed bridge location

Outstanding Heritage Value	Examples of value/impacts/mitigation
The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural cultural history.	The Narrows represent an uncommon passage landscape and are one of only five narrow tidal passages separating large continental islands form the mainland in Australia. The Narrows is also an important indicator of past geomorphologic processes, as many of Queensland's headlands and coastal ranges have been joined to the mainland by sedimentation processes identical with those operating within The Narrows. Algal and sponge gardens, sandy and muddy bottom communities, and rocky reef subtidal communities are present. Mitigation measures for any dredging activities during bridge construction will include the use of silt curtains and timing of dredging to minimise impacts. Sub-tidal communities found at this location are represented regionally, therefore impacts to outstanding national heritage values are considered to be minimal. Potential bridge pylons will provide additional suitable substrate for sub-tidal communities to colonise.
The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;	The sandy channel between Friend Point and Laird Point contain soft coral, sponges and sea pen species. Impacts to adjacent intertidal areas is likely from construction of the bridge abutments at Friend Point and Laird Point. These impacts will include some loss of mangroves and saltmarsh, that will not however impact on the outstanding national heritage value of GBR. No breeding and spawning grounds for unique coral reef associated species are known, however listed species such as turtles and dugong frequent the port. Interactions with marine fauna will be minimised through implementation of CEMP and DMP that includes maintaining constant watch during dredging operations, using deflectors and minimising boat speed.
The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;	Curtis Island shows a diversity of reef morphologies and ongoing geomorphic processes such as parabolic sand dunes, cliffed coastlines, parallel beach ridges, saltpans, rock platforms, mud flats and marine plain. The island offers the best potential for study due to the accessibility of the island. Impacts to Friend Point on the mainland will be due to construction of the bridge abutment and some loss of intertidal habitat will result.

Outstanding Heritage Value	Examples of value/impacts/mitigation
	Impacts to these values from the construction of marine facilities are considered negligible.
The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: • a class of Australia's natural or cultural places; or • a class of Australia's natural or cultural environments	Curtis Island is part of the WHA GBR that is internationally recognised as having the largest and most significant expanse and diversity of coral reef formation in the world. The GBR is important for its cultural heritage for indigenous populations within Australia in providing habitat for species used as a food source and for culturally significant events. Mitigation measures were consistent in minimising the footprint of the proposed bridge. In addition Santos will conduct site inspections of the proposed area in consultation with traditional owners or archaeologists.
The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics values by a community or cultural group	The Narrows offers a passage landscape that is one of five narrow tidal passages in Australia. The marine environment between Friend Point and Laird Point consists of highly turbid estuarine waters with minimal flushing during neap tides. Impacts to the aesthetic characteristics will occur from development of the proposed bridge through aesthetic impacts of the passage. Mitigation measures will include minimising increased sedimentation and increased turbidity through silt curtains and timing of dredging.

5.3.2 Threatened Species and Communities

An assessment of potential impacts to the threatened species identified from the MNES database search as potentially present within the bridge, road and services corridor search area is described in Table 5-3.

Table 5-3 Potential EPBC Listed Threatened Species for the Bridge, Road and Services Corridor

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Birds					
Red goshawk	*Erythrotriorchis radiatus*	V	Species or species habitat may occur within area	Curtis Island on the whole may form part of the range of an individual bird or pair of red goshawks. However, vegetation adjacent the potential bridge, road and service corridor does not form core habitat for this species.	Vegetation on the potential bridge, road and service corridor does not form core habitat for this species.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Squatter pigeon (southern)	*Geophaps scripta scripta*	V	Species or species habitat likely to occur within area	Populations in the Curtis Coast area represent the southern sub-species of the squatter pigeon, which is distributed through inland areas from northern NSW to the Burdekin region of Queensland. It occurs patchily, mainly in grassy eucalypt woodland and gravel ridge habitats, and is a seed eater. The species has declined significantly in the southern parts of its range (NSW), but appears to be stable in Queensland. Identified threats include cattle grazing and predation by foxes (Garnett & Crowley 2000).	The squatter pigeon was not recorded during the survey. However there is suitable habitat present within the potential bridge, road and service corridor. Vegetation of the study area does not form core habitat for the squatter pigeon and the proposed action is not expected to impact this species.
Australian painted snipe	*Rostratula australis*	V	Species or species habitat may occur within area	The Australian painted snipe utilises, amongst other habitats, permanent or temporary shallow inland wetlands. It is found scattered throughout many parts of Australia, although loss and alteration of wetland habitat has contributed to species decline (DEH 2003).	The species' requirement for tall reeds is not fulfilled on the site and at best, the Australian painted snipe may only be an occasional visitor to the potential bridge, road and service corridor. Unlikely to occur in areas potentially impacted by the proposed bridge, road and service corridor.
Southern giant-petrel	*Macronectes giganteus*	E, M	Species or species habitat may occur within area	The southern giant-petrel is the largest of the petrels and breeds in colonies on Antarctic and sub-Antarctic islands and Antarctic mainland. It feeds at sea, favouring the continental shelf and the edge of the pack-ice (Morecombe 2000). Throughout the colder months, immature birds and most adults disperse widely, travelling as far north as the Tropic of Capricorn (DEWHA 2008a). Curtis Island does not form part of the breeding or feeding range of the southern giant-petrel.	Curtis Island does not form part of the breeding or feeding range of the southern giant-petrel. Unlikely to occur in areas potentially impacted by the potential bridge, road and service corridor.
Kermadec petrel (western)	*Pterodroma neglecta neglecta*	V	Species or species habitat may occur within area	The Kermadec petrel is a large pelagic bird that breeds on islands across the south west Pacific Ocean. Morecombe (2000) notes that it is an "extremely rare vagrant or accidental visitor to E coast NSW". Curtis Island does not form part of the Kermadec petrel's feeding or nesting range and it is highly unlikely that it would even be an accidental visitor to the Island.	Curtis Island does not form part of the Kermadec petrel's feeding or nesting range and it is highly unlikely that it would even be an accidental visitor to the Island. Unlikely to occur in areas potentially impacted by the potential bridge, road and service corridor.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Roseate tern	*Sterna dougalli*	TBA	Species or species habitat may occur within area	Qld EPA supported the addition of the Roseate Tern to the Annexes to CAMBA and JAMBA as populations have been documented on the Swain Reefs with migrations between Australia and Chinese Taipei and Australia and Japan. These birds are found in sandy caves and areas not frequented by humans. A secure population exists on Swain Reef.	These birds are found in sandy caves and areas not frequented by humans. A secure population exists on Swain Reef.
Black-breasted button-quail	*Turnix melanogaster*	V	Species or species habitat may occur within area	The black-breasted button-quail is endemic to eastern Australia and is restricted to coastal and near-coastal regions of south-eastern Queensland and north-eastern New South Wales. The main populations occur within south-east Queensland (DEWHA 2008). The black-breasted button-quail has a preference for low canopied forests, including rainforest, monsoon forests, vine forests and Eucalyptus forests with a dense ground and litter cover (Morecombe 2004).	Small areas of suitable habitat potentially exist in the vicinity of the potential bridge, road and service corridor. However grazing and other disturbances caused by cattle, horses and feral pigs, as found within the study area, may deter the species from using the site. The proposed action is not expected to impact this species due to superior habitat available on the mainland and/or elsewhere on Curtis Island in conservation reserves.
Mammals					
Large-eared pied bat, large pied bat	*Chalinolobus dwyeri*	V	Species or species habitat may occur within area	It seems this species will occur in most vegetation types provided there are caves or tunnels in which it can roost. Daytime roosts are listed as caves, abandoned mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins (Ayers et al. 1996). Strahan (1995) notes that this species is found in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Isolated records have also been obtained from sub-alpine woodland above 1500m and at the edge of rainforest.	Suitable roosting habitat is not present within the potential bridge, road and service corridor. Individuals may forage across the island. The proposed action is not expected to significantly impact this species.
Northern quoll	*Dasyurus hallucatus*	E	Species or species habitat may occur within area	The northern quoll is found in the savannas of northern Australia. Populations of this quoll have declined across much of its former range, with cane toads thought to be a major factor. They utilise a range of habitats, with rocky areas and eucalypt forests preferred (DEH 2005).	Considering the habitat alteration and disturbance to the potential bridge, road and service corridor site, there is a low probability that the northern quoll is present.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Humpback whale	*Megaptera novaeangliae*	V	Breeding known to occur within the area	(Bonn); Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. It is estimated that when the Australian east coast whaling industry ended in 1963, the east coast population of humpbacks had been reduced to a little over 100 individuals. This population has shown steady recovery of around 10 –11% a year, and in 2006 was estimated at around 8000 (SPRAT Database). No reports of humpback whale sightings or strandings in Gladstone harbour could be found (National Whale and Dolphin Sightings and Strandings Database – DEWHA). While humpbacks are known to occur in the region, they are not known to enter Port Curtis.	While humpbacks are known to occur in the region, they are not known to enter Port Curtis. It is thus concluded that potential impacts from the potential bridge, road and service corridor are unlikely to have a significant impact on this species.
Water mouse, false water rat	*Xeromys myoides*	V	Species or species habitat may occur within area	Inhabits saline grassland, mangroves and margins of freshwater swamps. Found along Queensland coast from Cooloola to Proserpine, including Stradbroke and Bribie Island. Also found in coastal NT.	There is a low probability of water mouse being present within or adjacent to the potential bridge, road and service corridor. However, prior to any construction activities it is recommended that further studies be conducted to ascertain presence or absence. If present suitable management as negotiated with government agencies will be undertaken. Given knowledge of the site it is not expected that the proposed activities will significantly impact on this species.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Reptiles					
Loggerhead turtle	*Caretta caretta*	E	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (see flatback turtle, below). Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Adult Loggerheads feed on a variety of invertebrate animals, such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean. This eastern Australian population has declined by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994) and may not survive the next 100 years (Limpus 1997). Because no interbreeding occurs between breeding units, repopulation would be unlikely (Bowen *et al.* 1994). It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database). The Qld EPA have records of interactions with these species.	Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact to nesting behaviour of this species from the potential bridge, road and service corridor is considered negligible. With the implementation of mitigation measures to avoid potential impacts to this species from dredging, trenching and piling works such as the use of silt curtains, timing of works with the tidal cycle and turtle exclusion devices interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Green turtle	*Chelonia mydas*	V	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (see flatback turtle). Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds. Green turtles mainly eat seagrass and seaweed (algae). They also feed on mangrove fruit, jellyfish and sponges. Limpus (2007) reports that the southern GBR stock of green turtles is large by global standards and that, overall, this population is not showing signs of decreasing numbers of breeding females at the nesting beaches over the past four decades.	Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact to nesting behaviour of this species from the potential bridge, road and service corridor is considered negligible. With the implementation of mitigation measures to avoid potential impacts to this species from dredging, trenching and piling works such as the use of silt curtains, timing of works with the tidal cycle and turtle exclusion devices interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Leathery turtle, leatherback turtle	*Dermochelys coriacea*	V	Species or species habitat may occur within area	(Bonn); The diet of Leatherback hatchlings and juveniles is not known. Adult Leatherbacks feed on jellyfish, salps and squid on the ocean surface and down to depths of 200 metres. There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis.	The impact on this species from the potential bridge, road and service corridor is considered negligible.
Yakka skink	*Egernia rugosa*	V	Species or species habitat may occur within area	Usually found in open dry sclerophyll forest or woodland, often taking refuge among dense ground vegetation, hollow logs, and cavities in soil-bound root systems of fallen trees and beneath rocks Alternatively, skinks may also excavate burrow systems among low vegetation.	Due to historic habitat disturbance there is a low likelihood of the yakka skink being present within the proposed site. It is not anticipated that the potential bridge, road and services corridor will impact on this species.
Hawksbill turtle	*Eretmochelys imbricata*	V	Species or species habitat may occur within area	(Bonn); Major nesting of hawksbill turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia (Pendoley 2005), and in the northern Great Barrier Reef and Torres Strait (Dobbs et al. 1999; Limpus et al. 1989), Queensland. Hawksbill hatchlings feed on very small (planktonic) plants and animals floating in the ocean. When they grow to between 30 and 40 cm (curved carapace length) they begin feeding among coral and rocky reef habitats on the sea floor. Juvenile and adults hawksbill turtles eat a variety of marine plants and animals, particularly algae, seagrass, sponges and shellfish (SPRAT Database).	It is unlikely that Port Curtis is an important habitat for hawksbill turtles, and thus it is concluded that potential impacts from the potential bridge, road and service corridor are unlikely to potentially impact this species.
Pacific Ridley, olive Ridley turtle	*Lepidochelys olivacea*	E	Species or species habitat may occur within area	(Bonn); In Australia, detailed information on the size of nesting and foraging populations is unknown although the nesting population is estimated between 500 and 1,000 (Limpus 1995a). Little is known about the diet of hatchling olive Ridley turtles. Studies on adult olive Ridley turtles in Australia show that they mainly eat shellfish. Studies in other countries show that olive Ridley turtles also eat crabs, shrimps, jellyfish and algae. This species is classed as the most abundant of the sea turtles. However, in Malaysia the nesting population has declined to 20% in recent years. Many of the large Arribadas such as in Surinam have been reduced to several hundred individuals (Limpus 1995b) (SPRAT Database).	While it is possible that olive Ridley turtles occur in the Port Curtis region, no records could be found. The impact on this species from the potential bridge, road and service corridor is considered negligible.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Flatback turtle	*Natator depressus*	V	Breeding known to occur within the area	(Bonn); This species is found only in the tropical waters of northern Aust. and PNG and Irian Jaya (Spring 1982; Zangerl *et al.* 1988) and is one of only two species of sea turtle without a global distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007), with occasional nesting by Green and loggerhead turtles (Limpus 1999). The flatback turtle population utilising these beaches for nesting has remained at approximately 50 females annually throughout the 35 years monitoring has been conducted (Limpus et al. 2006). Flatback turtle' nesting commences in mid October, reaches a peak in late November – early December and cease by about late January. Hatchlings emerge from nests between early December and late March, with a peak in February (Limpus 2007). Flatback turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Juvenile flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.	Due to the nesting location on the ocean side of southern Curtis Island and Facing Island, the impact to nesting behaviour of this species from the potential bridge, road and service corridor is considered negligible. With the implementation of mitigation measures to avoid potential impacts to this species from dredging, trenching and piling works such as the use of silt curtains, timing of works with the tidal cycle and turtle exclusion devices interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch. .
Brigalow scaly-foot	*Paradelma orientalis*	V	Species or species habitat may occur within area	Occurs on sandstone ridges in woodlands and vine thickets, and in open forests. The brigalow scaly-foot has been recorded from Boyne Island and may be present within the study site.	While the brigalow scaly-foot has been recorded from Boyne Island historic habitat disturbance makes its presence unlikely. The proposed action is not expected to significantly impact this species.
Sharks					
Whale shark	*Rhincodon typus*	V	Species or species habitat may occur within area	The Whale Shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis.	The Whale Shark is uncommon in Queensland waters, and it is unlikely to occur within Port Curtis. It is concluded that the impacts from the potential bridge, road and service corridor is considered to be negligible.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Plants					
Heart-leaved bosistoa	*Bosistoa selwynii*	V	Species or species habitat may occur within area	Grows in rainforests up to 300 m in altitude. From Maryborough in Queensland south to the Tweed River district in north-east NSW.	Unlikely to be present within the potential bridge, road and service corridor. The species was not recorded during field surveys of the site.
Three-leaved bosistoa	*Bosistoa transversa*	V	Species or species habitat may occur within area	Grows in lowland subtropical rainforest up to 300 m in altitude. From Maryborough in Queensland south to the Nightcap Range north of Lismore in north-east NSW.	Unlikely to be present within the potential bridge, road and service corridor site. The species was not recorded during field surveys of the site.
Miniature moss-orchid	*Bulbophyllum globuliforme*	V	Species or species habitat may occur within area	Found in the McPherson Range, also Maleny and Noosa areas of the Wide Bay district. Appears to grow only on *Araucaria cunninghamii*.	Unlikely to be present within the potential bridge, road and service corridor. The species was not recorded during field surveys of the site.
Wedge-leaf tuckeroo	*Cupaniopsis shirleyana*	V	Species or species habitat may occur within area	Small tree up to 10 m tall; usually seen as large bushy shrub. Endemic to Queensland, ranging from Carina, Brisbane to Bundaberg. Occurs in dry rainforest.	Unlikely to be present within the potential bridge, road and service corridor site. The species was not recorded during field surveys of the site.
Quassia	*Quassia bidwillii*	V	Species or species habitat may occur within area	Shrub or small tree to 6 m that occurs from Gympie to Mackay. Grows in rainforest communities, or on the margins of these communities.	Unlikely to be present within the potential bridge, road and service corridor. The species was not recorded during field surveys of the site.

1 – Type of presence as indicated within the DEWHA MNES database.

5.3.3 Migratory Species

The Guidelines provide that an action is likely to have a significant impact on a migratory species if there is a possibility it will:

- Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles) destroy or isolate an area of important habitat for a migratory species; and/or
- Result in invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Migratory species were identified in the MNES searches as potentially being present within the bridge, road and services corridor search area (Table 5-4).

Table 5-4 EPBC Listed Migratory Species for the Bridge, Road and Services Corridor

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Migratory Terrestrial Species					
White-bellied sea-eagle	*Haliaeetus leucogaster*	M	Species or species habitat likely to occur within area	(CAMBA); White-bellied Sea-Eagles are a common sight in coastal and near coastal areas of Australia. In addition to Australia, the species is found in New Guinea, Indonesia, China, south-east Asia and India. The White-bellied Sea-Eagle feeds mainly off aquatic animals, such as fish, turtles and sea snakes, but it takes birds and mammals as well (Birds Australia). This species was sighted on low tidal mud flats, mangroves and rocky shores habitat during the intertidal survey in June 2008.	Potential impacts from proposed bridge, road and service corridor are unlikely as the species is widespread and its preferred habitat is unlikely to be impacted.
White-throated needletail	*Hirundapus caudacutus*	M	Species or species habitat likely to occur within area	Possible occurrence as an overflying species.	Possibly found in the area as an overflying species. This species will not be impacted by the proposed activities as the site of the bridge, road and services corridor does not act as core habitat.
Barn swallow	*Hirundo rustica*	M	Species or species habitat likely to occur within area	Migrant to coastal and sub-coastal districts. Non-breeding in Australia. Possibly present.	Possibly found in the area. This species will not be impacted by the proposed activities as the site of the bridge, road and services corridor does not act as core habitat.
Rainbow bee-eater	*Merops ornatus*	M	Species or species habitat likely to occur within area	This species was sighted on the hinterland margins of Curtis Island during the intertidal survey in June 2008.	Recorded from the site. This species will not be impacted by the proposed activities as the site of the bridge, road and services corridor does not act as core habitat.
Black-faced monarch	*Monarcha melanopsis*	M	Breeding may occur within area	Occurs in rainforests, mangrove and eucalypt woodlands. Species migrates from north Queensland to south-east Australia.	Possibly found in the area. This species will not be impacted by the proposed activities as the site of the bridge, road and services corridor does not act as core habitat.
Spectacled monarch	*Monarcha trivirgatus*	M	Breeding may occur within area	Usually occurs in rainforests, mangroves occasionally moist dense wet eucalypt gullies.	Possibly utilises the area. This species will not be impacted by the proposed activities as the site of the bridge, road and services corridor does not act as core habitat.
Satin flycatcher	*Myiagra cyanoleuca*	M	Species or species habitat likely to occur within area	Species migrates between north Qld and south-east Australia.	Recorded from the site. This species will not be impacted by the proposed activities as the site of the bridge, road and services corridor does not act as core habitat.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Rufous fantail	*Rhipidura rufifrons*	M	Breeding may occur within area	Species migrates between north Qld and south-east Australia. Would favour moist gullies or semi-evergreen vine thickets.	Possibly utilises the area. This species will not be impacted by the proposed activities as the site of the bridge, road and services corridor does not act as core habitat.
Migratory Wetland Birds					
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008.	Potential impacts from the proposed bridge, road and service corridor are unlikely as this species is widespread and its preferred habitat is unlikely to be impacted.
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania (Birds Australia).	Potential impacts from the proposed bridge, road and service corridor are as this species is widespread and its preferred habitat is unlikely to be impacted.
Latham's snipe, Japanese snipe	*Gallinago hardwickii*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Latham's Snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia (i.e. it travels through northern Australia to reach non-breeding areas located further south). In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977; Naarding 1983; Weston 2006, pers. comm.). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977; Naarding 1983).	Potential impacts from the proposed bridge, road and service corridor are unlikely as this species' preferred habitat is freshwater systems, and it is unlikely to spend any substantial amount of time in intertidal areas.
Australian cotton pygmy-goose	*Nettapus coromandelianus albipennis*	M	Species or species habitat likely to occur within area	Cotton Pygmy-Geese are found on freshwater lakes, swamps and large water impoundments (The Action Plan for Australian Birds 2000).	Unlikely to occur in areas potentially impacted by the proposed bridge, road and service corridor.
Little curlew, little whimbrel	*Numenius minutus*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Curlew is widespread in the north of Australia and scattered elsewhere (Birds Australia).	Potential impacts from the proposed bridge, road and service corridor are unlikely as this species is widespread and its preferred habitat is unlikely to be impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Painted snipe	*Rostratula benghalensis*	M	Species or species habitat likely to occur within area	(CAMBA); Originally listed based on assumption that *Rostratula australis* was a subspecies of *Rostratula benghalensis* (SPRAT Database). Now known that they are separate species and that *Rostratula benghalensis* is unlikely to occur in Australia. Australia recommended the removal of this species from the CAMBA Annex in 2006. The removal will not lessen the protection of the species due to listing as threatened under the EPBC Act.	Unlikely to occur in areas potentially impacted by the proposed bridge, road and service corridor.
Migratory Marine Birds					
Fork-tailed swift	*Apus pacificus*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA, ROKAMBA); Could find no reports of it being sighted in Gladstone region. This species has a large range, with an estimated global Extent of Occurrence of 10,000,000 km². The global population size has not been quantified, but it is believed to be large as the species is described as 'common' in at least parts of its range (del Hoyo et al. 1999). Global population trends have not been quantified, but there is evidence of a population increase (del Hoyo et al. 1999), and so the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (http://www.iucnredlist.org/).	Potential impacts from proposed bridge, road and service corridor are as this species' habitat is widespread and unlikely to occur in the Gladstone region. Its preferred habitat is unlikely to be impacted.
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008.	Potential impacts from proposed bridge, road and service corridor are as this species is widespread and its preferred habitat is unlikely to be impacted.
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania (Birds Australia).	Potential impacts from the proposed bridge, road and service corridor are unlikely as this species is widespread and its preferred habitat is unlikely to be impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Southern giant-petrel	*Macronectes giganteus*	E, M	Species or species habitat likely to occur within area	(Bonn); The Southern Giant-Petrel breeds on six subantarctic and Antarctic islands in Australian territory. Longline fishing causes two main forms of mortality in the Southern Giant-Petrel; by-catch during line-setting, and ingestion of discarded fishing hooks (SPRAT Database).	Unlikely to occur in areas potentially impacted by proposed bridge, road and service corridor
Little tern	*Sterna albifrons*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Tern is mainly coastal, being found on beaches, sheltered inlets, estuaries, lakes, sewage farms, lagoons, river mouths and deltas. The Little Tern is migratory. Substantial numbers move north from the far south-east after breeding. The Little Tern is extremely sensitive to human disturbance when breeding and is rapidly declining in numbers and range. Nesting sites are usually located where humans swim, walk, exercise dogs, picnic and drive off-road vehicles. The mere presence of people on the beach may cause these terns to desert their eggs and eventually leave the colony altogether. In New South Wales, where they were once quite common, the breeding population of Little Terns has declined to fewer than 50 pairs and of 30 known breeding sites only a handful have been used since 1970 (Birds Australia).	Potential impacts from the proposed bridge, road and services corridor to Little Tern population are considered negligible.
Migratory Marine Mammals					
Bryde's whale	*Balaenoptera edeni*	M	Species or species habitat likely to occur within area	(Bonn); Bryde's Whales occur in temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40° N and 40° S, or the 20 °C isotherm (Bannister et al. 1996). Bryde's Whales have been recorded from all Australian states except the Northern Territory (Bannister et al. 1996), including one sighting each in Victoria and NSW and 11 reported strandings in South Australia (7), NSW (2), Victoria (1) and Queensland (1) (DEW 2007). As there are no estimates of the Australian Bryde's Whale population size, the proportion of the global population in Australian waters	There have been no reports of sightings within Gladstone harbour. It is concluded that potential impacts from the proposed bridge, road and service corridor are unlikely.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
				cannot be estimated. The lack of data for Bryde's Whales in Australian waters leads to an inability to assess whether global threats would affect the Australian population. The offshore form could potentially be subjected to threats from incidental entanglement in fishing gear set, lost or discarded in international or adjacent waters (SPRAT Database). A single record of a stranding was found from 1982, south west of Stewart Island, Great Sandy Strait (National Whale and Dolphin Sightings and Strandings Database – DEWHA).	
Dugong	*Dugong dugon*	M	Species or species habitat likely to occur within area	The Port of Gladstone region is wholly within the Rodds Bay Dugong Protection Area. The most significant seagrass meadows within the port (significant cover) are located approximately 10 km to the east of the LNG facility site at Pelican Banks. To the west of the site, the foreshore mainland north and south of Fisherman's Landing is covered by isolated patches of seagrass. Dugong feeding activity has been observed on the majority of intertidal seagrass meadows surveyed during the 2007 DPI&F long term monitoring program (Rasheed *et. al.*, 2008). The highest density of dugong feeding trails was observed at the aggregated patches of *Zostera capricorni* / *Halophila ovalis* meadow at Wiggins Island with feeding trails recorded at 58% of sampling sites. Dugong feeding trails were also recorded at Pelican Banks and the intertidal meadows to the north and south of Fishermans Landing (Rasheed *et. al.*, 2008).	The seagrass meadows adjacent to the proposed bridge, road and service corridor north of Fisherman's Landing are likely to incur short term impacts from increased sedimentation and turbidity levels. It is considered that potential impacts from proposed bridge; road and services corridor will be mitigated through the use of silt curtains, timing of piling and dredging to avoid neap tides and minimising the footprint of the bridge abutments. The seagrass meadows adjacent to Friend Point are ephemeral and patchy. Dugong foraging behaviour may alter during the construction phase with a preference to forage on seagrass meadows of greater area and biomass at Pelican Banks and Targinie Banks. Changes to foraging behaviour in relation to loss of seagrass has been observed previously in Moreton Bay.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Humpback whale	*Megaptera novaeangliae*	M	Breeding known to occur within area	(Bonn); Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. The majority of humpbacks in Australian waters migrate north to tropical calving grounds in the Great Barrier Reef complex between approximately 14°S and 27°S from June to August, and south to the Southern Ocean feeding areas from September to November. Gladstone Harbour is not known as an important migration route. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. It is estimated that when the Australian east coast whaling industry ended in 1963, the east coast population of humpbacks had been reduced to a little over 100 individuals. This population has shown steady recovery of around 10 –11% a year, and in 2006 was estimated at around 8000 (SPRAT Database). No reports of humpback whale sightings or strandings in Gladstone harbour could be found (National Whale and Dolphin Sightings and Strandings Database – DEWHA). While humpbacks are known to occur in the region, they are not known to enter Port Curtis. The Qld EPA have records of interactions with these species.	While humpbacks are known to occur in the region, they are not known to enter Port Curtis. It is concluded that potential impacts from the proposed bridge, road and service corridor are unlikely.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Irrawaddy dolphin	*Orcaella brevirostris*	M	Species or species habitat likely to occur within area	It should be noted that the Irrawaddy dolphin (*Orcaella brevirostris*) is now generally regarded to not occur in Australian waters. Instead, it is more likely that reports have in fact related to the Snubfin dolphin (*Orcaella heinsohni*) (Beasley et al. 2005). The Snubfin dolphin is not currently listed under the EPBC Act, however, the information that follows shoud be considered to relate to it. The distribution of this species extends from from Broome in Western Australia, along the northern coastline near Darwin and the Gulf of Carpentaria, and off the east coast as far south as the Brisbane River. Irrawaddy dolphins are typically associated with shallow, coastal and estuarine waters, with most sightings recorded within 10 km of the coast, in waters less than 10 m deep, and within 10 km of a river mouth (Parra 2005 – PhD thesis). Since 1968, there have been 36 reported strandings of Irrawaddy dolphins in Queensland, all from around the Townsville region. There have been no reported sightings or strandings from the Gladstone region (National Whale and Dolphin Sightings and Strandings Database – DEWHA). Parra (2005) reports additional strandings, including one from Bundaberg in 1994 and one from the Brisbane River in 1997.	It is unliklet that Irrawaddy dolphins utilise the Port of Gladstone region, however, it is likely that Snubfin dolphins do to a limited extent. The limited number of sightings of Snubfin dolphins indicate that Port Curtis is not a significant habitat for them. As such, it is thus concluded that potential interactions during the construction of the MOF, PLF and dredge material placement facility are unlikely to have a significant impact on this species. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts are unlikely.
Killer whale, orca	*Orcinus orca*	M	Species or species habitat likely to occur within area	(Bonn); The Killer Whale is found in all oceans and seas of the world usually in family groups. They occur in most habitat types from coastal areas to the deep ocean waters, from the tropics to polar regions, although most sightings are in temperate waters. The Killer Whale has never been the target of serious commercial hunting so the species worldwide is secure. Killer whales have not been reported from within Port Curtis.	Killer whales have not been reported from within Port Curtis. It is concluded that there is little likelihood of impacts from the proposed bridge, road and service corridor.
Indo-Pacific humpback dolphin	*Sousa chinensis*	M	Species or species habitat likely to occur within area	The taxonomy of the Australian population of the Indo-Pacific Humpback dolphin (Sousa chinensis) is now undergoing revision, with suggestions that it may in fact be a separate species (Frere et al. 2008). The Qld EPA have records of interactions with these species in the Port Curtis region. Although Sousa chinensis is known to occur within the region, it would appear that boat strike and entanglement in fishing gear and the QDPI&F Shark Control nets pose the greatest threats.	Although *Sousa chinensis* and *Orcaella heinsohni* are known to occur within the region, it would appear that boat strike and entanglement in fishing gear and the QDPI&F Shark Control nets pose the greatest threats. The impact on these species from the proposed MOF, PLF and dredge material placement facility is considered to be low. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts are unlikely.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Migratory Marine Reptiles					
Loggerhead turtle	*Caretta caretta*	M	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (see flatback turtle, below). Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Adult Loggerheads feed on a variety of invertebrate animals, such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean. This eastern Australian population has declined by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994) and may not survive the next 100 years (Limpus 1997). Because no interbreeding occurs between breeding units, repopulation would be unlikely (Bowen *et al.* 1994). It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database). The Qld EPA have records of interactions with these species.	Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). With the implementation of mitigation measures to avoid interactions with this species, such as maintaining constant watch and adherence to reporting requirements for all interactions, the impact on this species from the proposed bridge, road and service corridor is considered to be low.
Green turtle	*Chelonia mydas*	M	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (see flatback turtle, below). Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds green turtles mainly eat seagrass and seaweed (algae). They also feed on mangrove fruit, jellyfish and sponges. Limpus (2007) reports that the southern GBR stock of green turtles is large by global standards and that, overall, this population is not showing signs of decreasing numbers of breeding females at the nesting beaches over the past four decades. The Qld EPA have records of interactions with these species.	With the implementation of mitigation measures to avoid interactions with this species, such as maintaining constant watch and adherence to reporting requirements for all interactions, the impact on this species from the proposed bridge, road and service corridor is considered to be low.
Estuarine crocodile, salt-water crocodile	*Crocodylus porosus*	M	Species or species habitat may occur within area	(Bonn); Connell Hatch (2006) reported that saltwater crocodiles had been seen within the Calliope and Boyne Rivers prior to 2004, but there have been no reports of their sighting since that time. Significant breeding populations of *C. porosus* do not occur south of the Tropic of Capricorn. Port Curtis is not considered an important habitat for *C. porosus.*	Port Curtis is not considered an important habitat for *C. porosus* and It is concluded that there is little likelihood of proposed bridge, road and service corridor site impacting this species.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Leathery turtle, leatherback turtle	*Dermochelys coriacea*	M	Species or species habitat may occur within area	(Bonn); The diet of Leatherback hatchlings and juveniles is not known. Adult Leatherbacks feed on jellyfish, salps and squid on the ocean surface and down to depths of 200 metres.	There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis. The impact on this species from the proposed bridge, road and service corridor site is considered negligible.
Hawksbill turtle	*Eretmochelys imbricata*	M	Species or species habitat may occur within area	(Bonn); Major nesting of Hawksbill Turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia (Pendoley 2005), and in the northern Great Barrier Reef and Torres Strait (Dobbs et al. 1999; Limpus et al. 1989), Queensland. Hawksbill hatchlings feed on very small (planktonic) plants and animals floating in the ocean. When they grow to between 30 and 40 cm (curved carapace length) they begin feeding among coral and rocky reef habitats on the sea floor. Juvenile and adults Hawksbill turtles eat a variety of marine plants and animals, particularly algae, seagrass, sponges and shellfish (SPRAT Database).	It is unlikely that Port Curtis is an important habitat for hawksbill turtles, and thus it is concluded that potential impacts from the proposed bridge, road and service corridor site are unlikely.
Pacific Ridley, olive Ridley Turtle	*Lepidochelys olivacea*	M	Species or species habitat may occur within area	(Bonn); In Australia, detailed information on the size of nesting and foraging populations is unknown although the nesting population is estimated between 500 and 1,000 (Limpus 1995a). Over 100 turtles were killed by set netting in Fog Bay, NT, in one incident in 1994 (Guinea & Chatto 1992), which indicates that this species can forage in large aggregations. Little is known about what hatchling olive Ridley turtles eat. Studies on adult olive Ridley turtles in Australia show that they mainly eat shellfish. Studies in other countries show that olive Ridley turtles also eat crabs, shrimps, jellyfish and algae. This species is classed as the most abundant of the sea turtles. However, in Malaysia the nesting population has declined to 20% in recent years. Many of the large Arribadas such as in Surinam have been reduced to several hundred individuals (Limpus 1995b) (SPRAT Database).	While it is possible that olive Ridley turtles occur in the Port Curtis region, no records could be found. With the implementation of mitigation measures to avoid interactions with this species, the impact on this species from the proposed bridge, road and service corridor site is considered negligible.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Flatback turtle	*Natator depressus*	M	Breeding known to occur within the area	(Bonn); This species is found only in the tropical waters of northern Aust. and PNG and Irian Jaya (Spring 1982; Zangerl *et al.* 1988) and is one of only two species of sea turtle without a global distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007), with occasional nesting by green and loggerhead turtles (Limpus 1999). The flatback turtle population utilising these beaches for nesting has remained at approximately 50 females annually throughout the 35 years monitoring has been conducted (Limpus et al. 2006). Flatback turtle' nesting commences in mid October, reaches a peak in late November – early December and cease by about late January. Hatchlings emerge from nests between early December and late March, with a peak in February (Limpus 2007). Flatback turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Juvenile flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.	With the implementation of mitigation measures to avoid interactions with this species, such as maintaining constant watch and adherence to reporting requirements for all interaction, the impact on this species from the proposed bridge, road and service corridor site is considered to be low.
Sharks					
Whale shark	*Rhincodon typus*	M	Species or species habitat may occur within area	The Whale Shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis.	There is little likelihood of proposed bridge, road and service corridor site impacting this species

1 – Type of presence as indicated within the DEWHA MNES database.

Section 6 Gas Transmission Pipeline- EPBC 2008/4096

6.1 Description of Proposed Action

EPBC Act referral number EPBC 2008/4096 relates to the construction of the gas transmission pipeline.

The proposed gas transmission pipeline corridor is closely aligned with the existing Queensland Gas Pipeline (QGP) for much of its length with the exception of the section north of Injune where the corridor will run up the eastern side of the Arcadia Valley. The pipeline will approach Gladstone from the south-west, entering the Gladstone State Development Area (GSDA) and crossing Port Curtis between Friend Point and Laird Point to Curtis Island. The proposed alignment is shown on Figure 3.4.3 in the EIS. The length of this route is 435 km. There will be no linkages to any existing gas pipelines along the route.

The gas transmission pipeline will be a buried, high pressure steel pipeline. Its diametre will be up to 1070 mm. It will be designed in accordance with the requirements of *AS 2885 Pipelines – Gas and Liquid Petroleum* and constructed in accordance with the Australian Pipeline Industry Association's *Code of Environmental Practice* (APIA, 2005).

The pipeline will be buried for its entire length and will be deep enough so that current land use activities will be able to continue after the pipe has been installed.

A summary of the typical construction procedures and activities is provided below.

- Survey of the pipeline route.
- Provision of access tracks and temporary facilities. Existing roads will be utilised as far as practicable to minimise disturbance to the surrounding areas. Access tracks will be positioned and constructed in consultation with landholders.
- Clear and grade the 30 m wide right of way (ROW). The gas transmission pipeline route will be marked, vegetation and other obstacles removed from the ROW, topsoil will be stripped stockpiled at the edge of the ROW. Temporary fencing and gates will also be installed to allow easy access between properties.
- Pipe delivery. Lengths of pipe are transported from Gladstone to specially constructed laydown locations at strategic points along the pipeline route.
- Pipe stringing and bending. The pipe will be laid out in preparation for welding and pipes bent as required by route and terrain.
- Pipe welding. The pipe will be welded into long lengths, typically up to 1000 m, called pipe strings.
- Tie-ins. The individual pipe strings will be welded together to form a continuous pipeline. Tie-ins will be carried out either above ground or 'in-the-trench'.
- Trenching. A pipeline trench will be excavated, with the subsoil stockpiled adjacent to the trench.
- Pipe placement in the trench (lowering in and laying). The trench spoil, where suitable, will be used as bedding and backfill for the pipeline. The pipe will then be lowered into the trench using side boom tractors and the trench backfilled and compacted. In addition, marker tape will be laid in the trench at designated areas.
- Fibre optic cable (FOC). Duct for a FOC to be used for communications along the pipeline will most probably be installed in the pipeline trench during the backfilling operation. Marker tape will be placed over the top of the duct. The actual FOC will be 'blown' through the duct at a later stage.
- Hydrotesting. The gas transmission pipeline will be cleaned and gauged prior to being hydrostatically tested for strength and leaks.
- Rehabilitation. Once construction is complete, rehabilitation will involve removal of construction material, surface re-contouring, fence repair/replacement, respreading of topsoil and vegetation and seeding/revegetation.

Section 6 Gas Transmission Pipeline- EPBC 2008/4096

The ROW width of 30 m allows the pipeline to be constructed safely, pipeline traffic and impacts to be restricted to the ROW, and to provide adequate area to store topsoil. The easement will be narrowed in some areas where necessary (e.g. to minimise impacts on sensitive vegetation). The feasibility of narrowing the ROW is dependent on site-specific conditions, such as slope, soil type, sensitive ecosystems, construction requirements, presence of alternative access past the site, and safety considerations. In some areas extra workspace may be required in addition to the 30 m easement (e.g. for truck turnarounds or to accommodate spoil and vegetation stockpiles adjacent to constrained workspaces such as watercourse crossings).

Three alternative methods will be used for watercourse crossings by the gas transmission pipeline. These alternatives are as follows:

- Open Trench. The majority of watercourse crossings are expected to be constructed using standard open trenching construction. This technique is most suited to the dry or low flow conditions which will be preferred for the construction phase;
- Open Trench with Flow Diversion. Flow diversion is a modification to the standard open trench method employed where higher water volumes and flows are present (typically up to 1,000 litres per second). In this way the risk of erosion and interference with construction activities is reduced; and
- Horizontal Directional Drilling (HDD). HDD is generally used to cross major watercourses where standard open cut methods are not feasible or to avoid environmentally sensitive features. The feasibility of using HDD is limited by site conditions such as soil stability, slope, access, available workspace and the nature of subsurface strata. The Dawson and Calliope Rivers will be crossed by HDD methods.

The gas transmission pipeline will cross Port Curtis between Friend Point and Laird Point. The preferred design for the crossing is for the gas transmission pipeline to be laid in a trench below the sea bed and backfilled with rock for protection. A trench will be dug to a depth of approximately 3 m with the excavated material loaded onto a barge for transfer to the proposed dredge material placement facility at Laird Point. Construction techniques to install the pipeline may include the following, however the final design will not be made until the FEED stage:

- Lay barge – progressively constructing / laying the pipeline; or
- Floatation – fabrication of the pipe string onshore and floating it to the crossing location before sinking it into position.

The layer of rocks placed over the top of the pipe will act:

- As additional buoyancy protection;
- As mechanical protection from vessels (e.g. anchors, hulls); and
- To limit scouring due to tidal flows.

The design of the Port Curtis crossing will include an allowance for the planned/possible installation of other similar pipelines in the immediate vicinity so that the integrity of the GLNG pipeline is not jeopardised by these other pipelines. The sizes and other details of these pipelines are currently unknown.

6.2 Environmental Values – MNES

Following a search of the DEWHA MNES database, the gas transmission pipeline has the potential to impact on the following matters protected under the EPBC Act 1999:

- World Heritage (Section 12, 15A);
- National Heritage Places (Section 15B, 15C);
- Listed Threatened Species and Communities (Section 18, 18A); and
- Listed Migratory Species (20, 20A).

Section 6 Gas Transmission Pipeline- EPBC 2008/4096

A desktop database search of sources including the DEWHA Protected Matters MNES database, The Protected Matters search provides a general guidance on matters of national environmental significance. Following a "line" type search conducted on 31 January 2008, with a 1 km radius of the DEWHA MNES database (the Gas Transmission Pipeline Search area), the proposed location of the bridge and road is approximately within 1 km of a line along the following points:

25.616146 148.923332

-25.623718 148.673805

-25.433726 148.622077

-25.381309 148.625997

-25.33752 148.658599

-25.296862 148.667942

-25.275116 148.660298

-25.235581 148.696558

-25.14233 148.720079

-25.08223 148.72034

-24.710971 148.842702

-24.686866 148.945588

-24.650621 149.031983

-24.621882 149.213846

-24.554222 149.398572

-24.454288 149.744509

-24.419429 149.848529

-24.405215 149.968894

-24.369024 150.037215

-24.365521 150.145432

-24.29175 150.373552

-24.266373 150.516303

-24.131365 150.739077

-24.086432 150.869771

-24.038989 150.956671

-23.988606 150.973413

-23.966573 150.964483

-23.882852 151.013477

-23.8663 151.037476

-23.856813 151.072647

-23.848568 151.101317

-23.83979 151.116883

-23.827378 151.132298

-23.826047 151.138772

-23.812744 151.147483

-23.785166 151.150647

-23.765577 151.143985

-23.770145 151.14394

-23.750506 151.155339

-23.75061 151.176997

-23.745699 151.178948

-23.744664 151.188314

-23.750362 151.201656

-23.755681 151.206858

-23.774218 151.216269

-23.777369 151.221668

-23.78756 151.220838

Variations to this route may be required in some places (e.g. Carnarvon, Expedition, Callide and Calliope Ranges, Calliope River) dependent on topography, land tenure and environmental sensitivities.

The marine section of the gas transmission pipeline lies between Friend Point on the mainland and Laird Point on Curtis Island and is wholly within the GBR WHA. The Narrows represents a passage landscape that separates Curtis Island from the mainland and is an important indicator of the geomorphologic processes including Balaclava Island, Kangaroo Island, Targinie Creek, and Graham Creek. The littoral area along the Graham Creek estuary consists of tidal mud flats and saltmarsh with mangrove communities. Graham Creek channels a significant portion of the freshwater run-off from the southern half of Curtis Island into The Narrows (EPA website, 2009).

The intertidal environments of The Narrows are influenced by two different hydrological systems, the Calliope and Boyne Rivers, creating a complex system of intertidal habitats. The mangroves, saltmarsh and mudflats within the area are important to the maintenance of regional fish and crustacean populations.

Following searches of the Department of the Environment, Water, Heritage and Arts (DEWHA) Matters of National Environmental Significance (MNES) database, the gas transmission pipeline corridor appears to have the potential to impact on matters protected under the *Environment Protection and Biodiversity Conservation Act 1999*. .

The MNES search indicates that approximately 1.5km will be in the GBRWHA at the eastern portion of the proposed corridor and part of the transmission corridor will be located within a National Heritage Place.

There are no Ramsar wetlands present within close proximity to the proposed gas transmission corridor. Part of the corridor route is located within the catchment of the Shoalwater and Corio Bays Ramsar Wetland; however the wetland is over 80km to the north of the proposed pipeline.

6.2.1 World Heritage / National Heritage Places

The proposed marine pipeline crossing is within the GBRWHA that is administered by the GBRMPA in association with the EPA. As stated previously, the boundary of the GBRWHA is set at mean low water,

The GBRWHA is listed as a National Heritage Place and the proposed marine pipeline crossing would be located within a National Heritage Place.

The proposed marine pipeline crossing is also within Port Curtis, listed on the Directory of Important Wetlands in Australia.

6.2.2 Threatened Species and Communities

The database searches identified 57 threatened species listed under the EPBC Act as potentially occurring within the gas transmission pipeline corridor search area.. EPBC listed threatened species identified from this search included 11 bird species, 7 mammal species, 11 reptile species, 1 shark species and 27 species of plants. Four EPBC listed threatened ecological communities were identified as potentially being present from the desktop searches.

Field surveys for 1:25,000 vegetation mapping, flora census and fauna habitat characterisation were undertaken over a 25-day period along the extent of the ROW. One EPBC listed species (the squatter pigeon (Geophaps scripta scripta)) was identified within from the field survey. Suitable habitat for a number of EPBC significant fauna and flora species (5 birds, 4 mammals, 4 reptiles and 3 plants) was identified within the gas transmission pipeline corridor.

Three ecological communities were identified as present in the study area during field surveys including:

- Natural grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin;
- Brigalow (Acacia harpophylla dominant and co-dominant); and
- Semi-evergreen vine thickets of the Brigalow Belt and the Nandewar Bioregions

6.2.2.1 Birds

Terrestrial

One bird species (squatter pigeon) listed under the EPBC Act was recorded from the gas transmission pipeline corridor and a number of other species are expected to utilise the area. However, the areas to be impacted by the development of the gas transmission pipeline are not considered to provide core habitat for any of these species. It is concluded that potential impacts to EPBC Act listed bird species from development of the gas transmission pipeline is negligible.

Migratory/ Marine

The potential impacts to migratory/ marine birds from construction of the gas transmission pipeline including trenching of the marine component are considered negligible.

6.2.2.2 Reptiles

Terrestrial

Four terrestrial reptiles have been identified as possibly present in portions of the gas transmission pipeline. The habitat requirements of each species (ornamental snake, Dunmall's snake, brigalow scaly-foot and yakka skink) are quite specific and restricted in light of the disturbed nature of the pipeline corridor. As pipeline route selection has already taken into account significant habitat, there is unlikely to be impacts on these species from construction of the gas transmission pipeline.

Marine

Marine turtles are known to migrate northward through Port Curtis between Friend Point and Laird Point and into The Narrows. Several green turtles were seen by researchers during the field surveys and it has been reported that The Narrows and the Calliope River mouth are major foraging areas (Connell Hatch, 2006). According to previous research the loggerhead turtle (*Caretta caretta*) and flatback turtle (*Natator depressus*) utilise habitats in the outer harbour and occasionally move northward through Port Curtis into The Narrows (QDEH, 1994). The EPA has records of loggerhead turtles found dead in Gladstone Harbour in 2000 and 2002 during dredging operations.

Although it is possible that the Endangered Pacific Ridley (olive Ridley) turtle (*Lepidochelys olivacea*) inhabits the area, it has not been sighted within Port Curtis and impacts to this species are considered to be unlikely. The leatherback turtle (*Dermochelys coriacea*) has been recorded regionally and although none have been sighted within Port Curtis, the implementation of mitigation measures will reduce any potential interactions that may occur with this species.

Trenching the gas transmission pipeline will result in direct loss of benthic and subtidal communities along the marine crossing route in the sandy channel between Friend Point and Laird Point. Impacts to the seagrass meadows north of Fisherman's Landing will also occur from elevated turbidity from trenching activities.

The loggerhead turtle has been impacted during previous dredging operations within Port Curtis indicating that dredging operations may also directly impact turtles through interactions with the dredger and associated equipment. Mitigation measures to avoid such interactions will be included into the EMP for all operations. During trenching operations, interactions with marine turtles will be minimised through the implementation of mitigation measures such as maintaining constant watch during all operations and

reducing boat speed. Loss of biological diversity of marine turtles within Port Curtis is not expected as these turtle populations are widespread and suitable habitat is available regionally.

6.2.2.3 Mammals

Terrestrial

Three mammal species listed under the EPBC Act are possibly present within the areas to be disturbed for the development of the gas transmission pipeline (large-eared pied bat, grey-headed flying fox and Semon's leaf-nosed bat). These species are unlikely to rely significantly upon resources within the proposed pipeline corridor and thus potential impacts to EPBC Act listed mammal species from development of the gas transmission pipeline is negligible.

Marine

No humpback whales (*Megaptera novaeangliae*) have been sighted within Port Curtis. Although one humpback calf was recorded dead on the eastern side of Curtis Island, supporting their presence regionally, impacts from trenching of the gas transmission pipeline are considered to be negligible.

Seagrass meadows are found north of Fisherman's Landing adjacent to the proposed marine crossing of the gas transmission pipeline at Friend Point. Direct impact from trenching of the gas transmission pipeline such as increased turbidity is considered to be significant for these meadows. Dugong feeding trails have been reported on these meadows north of Fishermans Landing and changes to foraging behaviour may result from expected impacts. Implementation of mitigation measures such as silt curtains can reduce impacts from elevated turbidity and associated impacts to seagrass meadows. Mitigation measures to avoid interactions with dugong will be developed and implemented through an EMP for the trenching of the gas transmission pipeline. Mitigation measures will include maintaining constant watch during all trenching operations, reducing boat speed and avoiding interactions with equipment.

Port Curtis is formally recognised as providing dugong habitat and is a designated dugong protection area under the Queensland *Nature Conservation Act 1992* and *Fisheries Act 1994* and seagrass is a major contributor to dugong and sea turtle diets (Rasheed *et al*, 2003). Although dugong and sea turtle frequent the area the grazing potential of Port Curtis has not yet been quantified (Rasheed *et al*, 2003). Previous studies on seagrass following increased sedimentation indicate large scale seagrass mortality (Preen *et al*, 1995) with resulting migration and mortalities of dugong (Preen and Marsh, 1995). Any loss of subtidal seagrass beds in particular has significance as the deep water seagrass species such as *Halophila spp.* are preferred by dugong. Dugongs also eat marine algae and invertebrates such as ascidians but this is believed to occur only when seagrass is scarce (Preen, 1995).

This is yet to be reflected in the EPBC database. Recent reports recorded by the EPA of dead snubfin dolphins at the mouth of the Calliope River, Fisherman's Landing and on the seaward beach of Facing Island indicate that this species are found within Port Curtis and utilise the area as a habitat. These reports however, allude to boat strike and entanglement in fishing gear and shark control nets as the most likely causes of death. The implementation of mitigation measures such as maintaining constant watch and reducing boat speed will reduce interactions with dolphins during all trenching activities.

6.2.2.4 Sharks

The whale shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis. Whale sharks have not previously been recorded within Port Curtis waters. It is considered that potential impacts from trenching of the gas transmission pipeline are unlikely.

6.2.2.5 Plants

One plant species, *Cycas megacarpa*, listed under the EPBC Act was recorded from field studies of the gas transmission pipeline and a number of other species are expected to be present within areas of remnant vegetation.

The gas transmission pipeline corridor avoids the core populations of this *Cycas megacarpa* within the range crossings, and intersects the margins of the populations where plant densities are lower. Some individuals are likely to require translocation as part of vegetation clearing during construction; however, the low numbers to be impacted indicate there will not be a significant impact to the species.

It is concluded that the proposed action is not expected to significantly impact upon EPBC Act listed flora species.

6.2.2.6 Threatened Ecological Communities

Three threatened ecological communities listed under the EPBC Act were recorded from within the gas transmission pipeline corridor (Table 6-3). Areas of these ecological communities along the gas transmission pipeline will be identified prior to clearing and will be retained where practicable. Only minor clearing is expected to be required within these communities and no significant impacts are anticipated.

6.2.3 Migratory Species

Thirty-two protected migratory bird and marine species were identified in the MNES search as potentially being present within the gas transmission pipeline corridor search area (Table).

6.3 Potential Impacts and Mitigation Measures

It is anticipated that trenching of the gas transmission pipeline will result in some loss of the following marine habitats:

- Subtidal, soft bottom communities in Port Curtis between Friend Point and Laird Point; and
- Loss of saltpan, saltmarsh, seagrass, mangrove and intertidal habitat at Friend and Laird Points.

The loss of these habitats would also result in the loss or displacement of those species directly dependant on these areas. The surface layers provides habitats for a range of benthic (bottom dwelling) fauna such as worms and prawns. Some of these fauna are in turn prey species of larger marine fauna and are important ecologically. As the majority of benthic fauna occur in the top 30 cm of the sediment, the trenching operation would be expected to completely remove all benthic fauna within the site, however previous studies indicate rates of re-colonisation by organisms from larval dispersal and active colonisation from adjacent areas are very high (WBM 2004).

Results of trenching impacts of the gas transmission pipeline indicate that sediments will be entrained into the water column during trenching by the release from the clamshell dredge of excess water, containing high concentrations of fine sediments. A sediment entrainment rate of 50 kg per bulk m^3 of material excavated was conservatively assumed, based on typical published values for clamshell dredging operations. The results show that for this case there are elevated TSS levels in and around the area of proposed dredging work, with this region occupying an area of approximately 600 m by 200 m during neap tides and approximately 150 m by 150 m during spring tides. Outside these areas, maximum levels of increase of the order of 14-16 mg/L are predicted. When compared with typical background levels in this region of Port Curtis it is apparent that these TSS levels, while high, are comparable to the existing levels of variability in TSS present in the region. Unlike the case of capital dredging, these TSS levels extend much further afield; both upstream and downstream of the proposed bridge, due to the much higher water velocities in this region.

Best practice techniques should be adopted for dredging and pipeline construction activities in order to minimise the extent and duration of sediment plumes which may otherwise be generated during the construction phase of the project. The key measures to reduce construction stage impacts are primarily related to the implementation of an approved dredge management plan (DMP) and construction environmental management plan (CEMP). The CEMP is required for all construction activities that have the potential to impact upon the marine environment. The CEMP will be broadly similar to the DMP and will be developed in detail in consultation with Santos, the selected contractors, the EPA, the DPI&F and the Gladstone Port Corporation. The CEMP will contain detailed descriptions of the methods to be used,

the potential impacts those methods could create, mitigation methods, monitoring and auditing requirements, and approvals required.

Silt curtains work by slowing the flow of water inside the curtain, thereby ensuring the sediment drops to the substrate and removing the sediment plume from the waterway. These are effective in minimising sediment plumes and mitigating smothering of seagrass and other marine communities during capital and maintenance dredging and marine construction operations.

There are a number of other mitigation measures available to minimise impacts on marine megafauna (turtles, dugongs and/or cetaceans). These include:

- The use of rigid and/or chain deflectors;
- Operational protocols (e.g. no suction when not in contact with seabed and use of draghead jets);
- Maintaining a "look-out" for turtles, dugongs and/or cetaceans on the surface;
- No dredging/dredge material placement if turtles, dugongs and/or cetaceans within a specified distance (e.g. 500 m);
- Environmental windows (day/night; seasonal); and
- Reporting requirements.

It is expected that these measures would be incorporated into the DMP and/or the CEMP.

6.3.1 World Heritage / National Heritage Places

The construction of the marine component of the gas transmission pipeline will involve dredging in Port Curtis between Friend Point on the mainland and Laird Point on Curtis Island, resulting in direct impacts to soft bottom communities and indirect impacts to seagrass north of Fishermans Landing on the mainland.

Impacts from the trenching of the marine component of the gas transmission pipeline are similar to that of the potential bridge construction. Dredging will result in direct loss of benthic habitat and communities and possible loss or displacement of those species directly dependant on these areas. The surface layers of the areas to be dredged are provides habitats for a range of benthic (bottom dwelling) fauna such as worms and prawns. Some of these fauna are in turn prey species of fish and are important for environmental and commercial reasons. As the majority of benthic fauna occur in the top 30 cm of the sediment, the dredging operation would be expected to completely remove all benthic fauna within the dredge site. However, previous studies indicate rates of re-colonisation by organisms from larval dispersal and active colonisation from adjacent areas are very high (WBM, 2004).

The resultant subtidal environmental impact will be limited to the following:

- Disturbance to the silt/mud substrate with some rubble near Friend Point and Laird Point and to the coarse sand substrate with some shell grit in the deeper water near the middle of the crossing;
- Loss of subtidal, soft bottom communities across The Narrows. No subtidal species or communities of conservation significance are located in this area;
- Introduction of a new habitat on the sand/rock backfill hard substrates and increase in habitat complexity. This would increase the available space for a number of species, such as sponges, gorgonians, soft corals, oysters and other species found on hard substrates within Port Curtis, and also provide habitat and food sources for mobile species (e.g. fish, crabs) which would use these new habitat for shelter and/or food; and

- Temporary increase in total suspended solids (TSS) concentrations in the vicinity of the pipeline crossing during construction to levels of the order of 12-14 mg/L which are comparable to the existing levels of variability in TSS present in the region. Further afield, both upstream and downstream of the pipeline, the additional TSS levels are predicted to nearly always be less than 5 mg/L, which will be effectively undetectable.

Construction of the pipeline crossing of Port Curtis will also result in disturbance to the intertidal areas at both Friend Point and Laird Point.

Table 6-1 provides an assessment of potential impacts to each of the four World Heritage criteria and indicative mitigation measures to be implemented as part of the EMP.

Table 6-1 GBR World Heritage Values for the Gas Transmission Pipeline

GBR World Heritage criteria and examples	Impacts/Mitigation
(VII) - Exceptional natural beauty and aesthetic importance • Examples for the Great Barrier Reef WHA values are its vast extent and variety of reefs and islands; coastal mangrove systems of exceptional beauty; rich variety of landscapes and seascapes; spectacular breeding colonies of seabirds and butterflies; and migrating mammals. • Spectacular seascapes and landscapes for example, Whitehaven Beach, Whitsunday islands, Hinchinbrook Island, mosaic patterns on reefs • Spectacular coral assemblages (hard and soft corals)	Direct impacts to the exceptional natural beauty and aesthetic importance of the WHA will be low in terms of the uniqueness of Friend Point and Laird Point; however some impact to the exceptional natural beauty and aesthetic importance of The Narrows will be incurred. Port Curtis is heavily industrialised impacting directly on the aesthetic value of the area. Construction of the pipeline will contribute to the anthropogenic impacts within Port Curtis. Subtidal soft bottom communities will be disturbed during the trenching of the pipeline. This will not impact on the WHA value of exceptional natural beauty and aesthetic importance.
(VIII) - Significant geomorphic or physiographic features • The world's largest coral reef ecosystem, extending over 14 degrees of latitudinal range about 3000 separate coral reefs, ranging from inshore fringing reefs to mid shelf, exposed outer reefs and deep water reefs and shoals • Deep water features of the adjoining continental shelf including canyons, channels, plateaux and slopes.	Trenching of the pipeline will result in physical disturbance to the sediments from dredging, but will not impact on significant geomorphic or physiographic features that contribute to the world heritage values of the GBR. Coral reefs will not be impacted by dredging activities as there are no coral reefs or cays in the vicinity of The Narrows.

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GBR World Heritage criteria and examples	Impacts/Mitigation
(IX) - Significant ongoing ecological and biological processes • An extensive diversity of reef morphologies and ongoing geomorphic processes; • ~ 900 islands ranging from small coral cays (in various stages of geomorphic development) to large continental islands; • Complex cross-shelf, longshore and vertical connectivity facilitated by dynamic current flows, incorporating important ecological processes such as larval dispersal; and • Breeding and spawning grounds for unique coral reef associated species, including threatened and vulnerable species such as turtles, whales and humphead Maori wrasse.	The pipeline will not interfere with coral reefs or islands directly. It is anticipated that indirect impacts will be negligible. Use of the mud flats along the mainland north of Fishermans Landing by migratory shorebirds is considered to be low. Considering the vast extent of mud flats within Port Curtis. It is anticipated that there will be negligible disturbance to breeding colonies of seabirds. Interactions with some species of migratory marine mammals such as dolphins and dugong are likely. Interactions with migratory marine mammals will be mitigated through the implementation of watches during all dredging and shipping activities. Whales are not known to breed within Port Curtis and the Humpback has not been sighted within Port Curtis. No impacts are anticipated to the Humpback Whale. Turtles are known to use Port Curtis as habitat and feed on seagrass meadows within Port Curtis. Observations of marine turtles moving north through the harbour and into The Narrows have been recorded previously. Interactions with marine turtles during trenching of the pipeline are likely however, turtle breeding is not likely to be impacted. Mitigation measures to avoid interactions with marine turtles will be implemented during all dredging and other shipping activities. It is unlikely that The Narrows provides preferred spawning ground habitat for unique coral reef associated species.
(X) - Significant natural habitat for *in-situ* conservation of biological diversity • Over 2000 km2 of mangroves including 54 per cent of the world's mangrove diversity • ~ 43 000 km2 of seagrass meadows in both shallow and deep water areas supporting one of the world's most important dugong populations and six of the world's seven species of marine turtle • 70 bioregions (broad-scale habitats) have been identified comprising 30 reef bioregions and 40 non-reefal bioregions, these include algal and sponge gardens, sandy and muddy bottom communities, continental slopes and deep ocean troughs • The reef bioregions contain one third of the world's soft coral and sea pen species (80 species) • 800 species of echinoderms (for example sea stars) equalling 13 per cent of the world's total species • The location of the world's largest green turtle breeding area, other key breeding areas, regionally important seabird nesting islands, significant spawning ground (for example black marlin) and a significant area for humpback whale calving and rearing.	There may be some direct impacts to mangrove communities particularly the trenching of the pipeline at Friend and Laird Point. Loss of mangroves will be kept to a minimum and in accordance with the objectives of Qld Fisheries Act 1994. Impacts from dredging and trenching may result in direct impacts to seagrass meadows north of Fishermans Landing through increased turbidity. Some smothering of seagrass will occur resulting in short term impacts to feeding grounds for dugong and turtle from dredging activities. Negative Impacts will be managed through the implementation of sediment limitation devices and other mitigation measures developed as part of the Environmental Management Plan for the marine component of the gas transmission pipeline. There any no inter-reefal or lagoonal areas adjacent to The Narrows that may be directly or indirectly impacted. The nearest significant coral communities are between Curtis and Facing Islands, more than 10 km south of the proposed marine pipeline crossing. While parts of Port Curtis may exhibit geological processes linking the various elements of the coastal environment (e.g. estuaries, intertidal flats, mangroves and embayments) the bridge, road and services corridor will not result in disturbance to these elements.

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Table 6-2 provides an assessment of heritage values and potential impacts and mitigation methods for the gas transmission pipeline.

Table 6-2 National Heritage Values for the Gas Transmission Pipeline

Outstanding Heritage Value	Examples of value/impacts/mitigation
The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural cultural history.	The Narrows represent an uncommon passage landscape and are one of only five narrow tidal passages separating large continental islands form the mainland in Australia. The Narrows is also an important indicator of past geomorphologic processes, as many of Queensland's headlands and coastal ranges have been joined to the mainland by sedimentation processes identical with those operating within the Narrows. Algal and sponge gardens, sandy and muddy bottom communities, and rocky reef subtidal communities are present. Mitigation measures for any trenching activities during construction of the marine component of the gas transmission pipeline will include the use of silt curtains and timing of trenching to minimise impacts. Sub-tidal communities found at this location are represented regionally, therefore impacts to outstanding national heritage values are considered to be minimal. The rock fill will provide additional substrate for colonisation of marine fauna and flora.
The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;	The sandy channel between Friend Point and Laird Point contain soft coral, sponges and sea pen species. Impacts to adjacent intertidal areas are likely from construction of the gas transmission pipeline at the marine crossing. These impacts will include some loss of mangroves and saltmarsh that will not however impact on the outstanding national heritage value of GBR. No breeding and spawning grounds for unique coral reef associated species are known, however threatened and vulnerable species such as turtles and dugong frequent the port. Interactions with marine fauna will be minimised through implementation of Construction EMP and Dredge Management Plan that includes maintaining constant watch during all shipping and dredging operations, using deflectors with dredge gear and minimising boat speed.
The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;	Curtis Island shows a diversity of reef morphologies and ongoing geomorphic processes such as parabolic sand dunes, cliffed coastlines, parallel beach ridges, saltpans, rock platforms, mud flats and marine plain. The island offers the best potential for study due to the accessibility of the island. Impacts to Friend Point on the mainland will be due to construction of the bridge abutment and some loss of intertidal habitat will result. Impacts to these values from the construction of marine facilities are considered negligible.
The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: • a class of Australia's natural or cultural places; or	Curtis Island is part of the WHA GBR that is internationally recognised as having the largest and most significant expanse and diversity of coral reef formation in the world. The GBR is important for its cultural heritage for

Outstanding Heritage Value	Examples of value/impacts/mitigation
• a class of Australia's natural or cultural environments	indigenous populations within Australia in providing habitat for species used as a food source and for culturally significant events. Mitigation measures were consistent in minimising the footprint of the proposed bridge. In addition Santos will conduct site inspections of the proposed area in consultation with traditional owners or archaeologists.
The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics values by a community or cultural group	The Narrows offers a passage landscape that is one of five narrow tidal passages in Australia. The marine environment between Friend Point and Laird Point consists of highly turbid estuarine waters with minimal flushing during neap tides. Impacts to the aesthetic characteristics will be negligible. Sub-tidal communities may increase with the availability of increased substrate. Mitigation measures will include minimising increased sedimentation and increased turbidity through silt curtains and timing of dredging.

6.3.2 Threatened Species and Communities

Approximately 4.7 ha of Brigalow (*Acacia harpophylla* dominant and co-dominant) and 2.1 ha of Semi-evergreen vine thickets of the Brigalow Belt (North and South) and the Nandewar Bioregions will be cleared in range lands where topography does not accommodate relocation of the ROW. Measures for the minimisation of impacts from vegetation clearing and construction include:

- Adjustment of ROW alignment to avoid significant impacts to sensitive environmental values;
- Adequate erosion and sedimentation controls;
- Staged clearing for fauna dispersal;
- Retention of habitat hollows and other habitat features wherever practicable;
- Pre-clearing surveys for potential significant species;
- Use of fauna spotters during clearing; and
- Development and use of a biodiversity offset management plan in keeping with the objectives of both the Commonwealth biodiversity offsetting policy and the Qld offsetting policy under the *Vegetation Management Act 1999.*

An assessment of potential impacts to the threatened species listed under the EPBC legislation as potentially occurring within the gas transmission pipeline corridor is described in Table 6-3.

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Table 6-3 EPBC Listed Threatened Species for Gas Transmission Pipeline

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Birds					
Red goshawk	*Erythrotriorchis radiatus*	V	Species or species habitat may occur within area	It is known to utilise a very large home range (50 to 220 square km) including a mix of tall open forest, woodland, lightly treed savannah and the edge of rainforest (EPA 2005a). Favoured areas contain permanent water and have large populations of birds of other species. Red goshawks generally avoid very dense or very open habitats, preferring to hunt along ecotones (NSW NPWS 2002).	Vegetation on the proposed pipeline route generally does not form core habitat for this species. However, opportunities may exist in densely vegetated gullies as found within the range crossings. The proposed pipeline is unlikely to significantly impact this species.
Squatter pigeon (southern)	*Geophaps scripta scripta*	V	Species or species habitat may occur within area	Populations in the Curtis Coast area represent the southern sub-species of the squatter pigeon, which is distributed through inland areas from northern NSW to the Burdekin region of Queensland. It occurs patchily, mainly in grassy eucalypt woodland and gravel ridge habitats, and is a seed eater. The species has declined significantly in the southern parts of its range (NSW), but appears to be stable in Queensland. Identified threats include cattle grazing and predation by foxes (Garnett & Crowley 2000).	The squatter pigeon was observed at various locations along the pipeline route on the mainland. Suitable habitat is present in many areas of the route. The proposed pipeline is unlikely to significantly impact this species due to the abundance of alternative suitable habitat in the region.
Swift parrot	*Lathamus discolor*	E	n/a[2]	Inhabits forests and woodlands with flowering trees. Often found in association with lorikeets (Morcombe 2004). It breeds only in Tasmania but overwinters on the mainland. In Qld, prefers *E. crebra* and *E. tereticornis* woodlands (DEWHA, 2008c).	Gas transmission pipeline is probably at northern extent of range. May occasionally utilise woodlands in area depending upon resource availability. The proposed pipeline is unlikely to significantly impact this species.
black-throated finch (white-rumped subspecies)	*Peophila cincta cincta*	E	n/a[2]	Forages on ground for seed in small flocks. Inhabits open woodlands and grasslands with scattered tree cover never far from water (Morcombe, 2004).	May be present in areas along the pipeline. The proposed pipeline is unlikely to significantly impact this species due to the abundance of alternative suitable habitat in the region.
Australian painted snipe	Rostratula australis	V	Species or species habitat may occur within area	The Australian painted snipe utilises, amongst other habitats, permanent or temporary shallow inland wetlands. It is found scattered throughout many parts of Australia, although loss and alteration of wetland habitat has contributed to species decline (DEH 2003).	The species' requirement for tall reeds is not fulfilled on the site and at best, the Australian painted snipe may only be an occasional visitor to the gas transmission pipeline site. The proposed pipeline is unlikely to significantly impact this species.
Southern giant-petrel	*Macronectes giganteus*	E, M	Species or species habitat may occur within area	The southern giant-petrel is the largest of the petrels and breeds in colonies on Antarctic and sub-Antarctic islands and Antarctic	This species is not expected anywhere along the pipeline route. The proposed pipeline is unlikely to significantly

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
				mainland. It feeds at sea, favouring the continental shelf and the edge of the pack-ice (Morecombe 2000). Throughout the colder months, immature birds and most adults disperse widely, travelling as far north as the Tropic of Capricorn (DEWHA 2008a). Curtis Island does not form part of the breeding or feeding range of the southern giant-petrel.	impact this species.
Star Finch (eastern), star finch (southern)	*Neochmia ruficauda ruficauda*	E	Species or species habitat may occur within area	Inhabits tall grass besides swamps and rivers, and grassy eucalypt open woodlands near watercourses.	Limited suitable habitat may be present. The proposed pipeline is unlikely to significantly impact this species.
Kermadec petrel (western)	*Pterodroma neglecta neglecta*	V	Species or species habitat may occur within area	The Kermadec petrel is a large pelagic bird that breeds on islands across the south west Pacific Ocean. Morecombe (2000) notes that it is an "extremely rare vagrant or accidental visitor to E coast NSW". Curtis Island does not form part of the Kermadec petrel's feeding or nesting range and it is highly unlikely that it would even be an accidental visitor to Curtis Island.	Is not expected anywhere along the pipeline route. The proposed pipeline is unlikely to significantly impact this species.
Roseate tern	*Sterna dougalli*	TBA	Species or species habitat may occur within area	Qld EPA supported the addition of the Roseate Tern to the Annexes to CAMBA and JAMBA as populations have been documented on the Swain Reefs with migrations between Australia and Chinese Taipei and Australia and Japan. These birds are found in sandy caves and areas not frequented by humans. A secure population exists on Swain Reef.	Limited suitable habitat may be present. The proposed pipeline is unlikely to significantly impact this species.
Black-breasted button-quail	*Turnix melanogaster*	V	Species or species habitat may occur within area	The black-breasted button-quail is endemic to eastern Australia and is restricted to coastal and near-coastal regions of south-eastern Queensland and north-eastern New South Wales. The main populations occur within south-east Queensland (DEWHA 2008). The black-breasted button-quail has a preference for low canopied forests, including rainforest, monsoon forests, vine forests and Eucalyptus forests with a dense ground and litter cover (Morecombe 2004).	Small areas of suitable habitat potentially exist in the vicinity of the proposed pipeline route near the Curtis coast. However grazing and other disturbances caused by cattle, horses and feral pigs, as found within the study area, may deter the species from using the site. The proposed action is not expected to impact this species due to superior habitat available elsewhere throughout the region.
Mammals					
Large-eared pied bat, Large pied bat	*Chalinolobus dwyeri*	V	Species or species habitat may occur within area	It seems this species will occur in most vegetation types provided there are caves or tunnels in which it can roost. Daytime roosts are listed as caves, abandoned mine tunnels and the abandoned,	The pipeline may traverse suitable habitat for the large-eared pied bat. Should not be impacted by proposed activities due to the abundance of alternative

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
				bottle-shaped mud nests of Fairy Martins (Ayers et al. 1996). Strahan (1995) notes that this species is found in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Isolated records have also been obtained from sub-alpine woodland above 1500m and at the edge of rainforest.	suitable habitat in the region.
Northern quoll	*Dasyurus hallucatus*	E	Species or species habitat may occur within area	The northern quoll is found in the savannas of northern Australia. Populations of this quoll have declined across much of its former range, with cane toads thought to be a major factor. They utilise a range of habitats, with rocky areas and eucalypt forests preferred (DEH 2005).	Unlikely to be present along the pipeline given the disturbed nature of most habitats surveyed. The proposed pipeline is unlikely to significantly impact this species.
Humpback whale	*Megaptera novaeangliae*	V	Breeding known to occur within the area	(Bonn); Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. It is estimated that when the Australian east coast whaling industry ended in 1963, the east coast population of humpbacks had been reduced to a little over 100 individuals. This population has shown steady recovery of around 10 –11% a year, and in 2006 was estimated at around 8000 (SPRAT Database). No reports of humpback whale sightings or strandings in Gladstone harbour could be found (National Whale and Dolphin Sightings and Strandings Database – DEWHA). While humpbacks are known to occur in the region, they are not known to enter Port Curtis. The Qld EPA has records of interactions with these species.	While humpbacks are known to occur in the region, they are not known to enter Port Curtis and potential impacts are considered negligible.
Grey-headed flying fox	*Pteropus poliocephalus*	V	n/a[2]	Australia's second-largest bat. Feeds on blossoms, fruit and leaves of many plants. It is an important pollinator and disperser of seed.	May be present on the coastal fringe near Gladstone. The proposed action is unlikely to significantly impact this species due to availability of alternative habitat and the relatively small amount of proposed habitat disturbance.
Semon's leaf-nosed bat,	*Hipposideros*	E	Species or species habitat	Semon's Leaf-nosed Bat is found in tropical rainforest, monsoon	Removal of arboreal hollows along the proposed gas

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
greater wart-nosed horseshoe-bat	*semoni*		may occur within area	forest, wet sclerophyll forest and open savannah woodland. It utilises tree hollows, deserted buildings in rainforest, road culverts and shallow caves amongst granite boulders or in fissures (DEWHA, 2008e).	transmission pipeline route may potentially impact this species in localised areas. However it is unlikely to impact significantly as fragmentation of the habitat is not expected to have long term impacts on populations.
Water mouse, false water rat	*Xeromys myoides*	V	Species or species habitat may occur within area	Inhabits saline grassland, mangroves and margins of freshwater swamps. Found along Queensland coast from Cooloola to Proserpine, including Stradbroke and Bribie Island. Also found in coastal NT.	Unlikely that this species is present on the mainland coast near Gladstone due to industrial and recreational impact.
Eastern long-eared Bat	*Nyctophilus timoriensis (South-eastern form)*	V	Species or species habitat may occur within area	This species inhabits Eucalypt & acacia woodlands in the vicinity of suitable roost sites such as tree hollows.	The pipeline may traverse suitable habitat for the species. Should not be impacted by proposed activities due to the abundance of alternative suitable habitat in the region.
Reptiles					
Loggerhead turtle	*Caretta caretta*	E	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Adult Loggerheads feed on a variety of invertebrate animals, such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean. This eastern Australian population has declined by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994) and may not survive the next 100 years (Limpus 1997). Because no interbreeding occurs between breeding units, repopulation would be unlikely (Bowen *et al.* 1994). It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database). The Qld EPA have records of interactions with these species.	Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Potential interactions with loggerhead turtles during trenching of the marine crossing component of the gas transmission pipeline are possible. Mitigation measures to avoid interactions with this species from trenching activities include maintaining watch, interactions, ceasing work if interactions are considered probable and reporting any interactions that may occur. The use of silt curtains and timing works in accordance with the appropriate tidal cycle and will ensure that potential impacts are mitigated. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Green turtle	*Chelonia mydas*	V	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds green turtles mainly eat seagrass and seaweed (algae). They also feed on mangrove fruit, jellyfish and sponges. Limpus (2007) reports that the southern GBR stock of	Potential impacts from trenching the marine crossing of the gas transmission pipeline may be likely although previous interactions with green turtles have been reported as resulting from fishing activities Mitigation measures to avoid interactions with this species

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
				green turtles is large by global standards and that, overall, this population is not showing signs of decreasing numbers of breeding females at the nesting beaches over the past four decades. The Qld EPA have records of interactions with these species.	from trenching activities include maintaining watch, interactions, ceasing work if interactions are considered probable and reporting any interactions that may occur. The use of silt curtains and timing works in accordance with the appropriate tidal cycle and will ensure that potential impacts are mitigated. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Leathery turtle, Leatherback turtle	*Dermochelys coriacea*	V	Species or species habitat may occur within area	(Bonn); The diet of Leatherback hatchlings and juveniles is not known. Adult Leatherbacks feed on jellyfish, salps and squid on the ocean surface and down to depths of 200 metres. There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis.	There are no records of this species recorded within Port Curtis. Mitigation measures to avoid interactions with this species from trenching activities include maintaining watch, interactions, ceasing work if interactions are considered probable and reporting any interactions that may occur. The use of silt curtains and timing works in accordance with the appropriate tidal cycle and will ensure that potential impacts are mitigated. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Ornamental snake	*Denisonia maculata*	V	Species or species habitat may occur within area	Occurs in *Acacia harpophylla* woodland growing on clay and sandy soils, riverine woodland, and open forest growing on natural levees. Shows a preference for moist areas. Known only from the Brigalow Belt (DEWHA 2008h).	Suitable habitat present within pipeline corridor. Local populations may be impacted if suitable habitat is affected. Scouting for the species within suitable habitat will be undertaken prior to pipeline construction. Given suitable planning it is not expected that this species will be impacted by the proposal.
Yakka skink	*Egernia rugosa*	V	Species or species habitat may occur within area	Usually found in open dry sclerophyll forest or woodland, often taking refuge among dense ground vegetation, hollow logs, and cavities in soil-bound root systems of fallen trees and beneath rocks. Alternatively, skinks may also excavate burrow systems among low vegetation. It has been collected from the Arcadia Valley, Banana and near Biloela (DEWHA 2008f).	Suitable habitat present within pipeline corridor. Local populations may be impacted if suitable habitat is affected. Scouting for the species within suitable habitat will be undertaken prior to pipeline construction. Given suitable planning it is not expected that this species will be impacted by the proposal.
Hawksbill turtle	*Eretmochelys imbricata*	V	Species or habitat may occur within area	(Bonn); Major nesting of hawksbill turtles in Australia occurs at Varanus Island and Rosemary	Port Curtis is not preferred habitat for this species. Potential impacts are

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
				Island in Western Australia (Pendoley 2005), and in the northern Great Barrier Reef and Torres Strait (Dobbs et al. 1999; Limpus et al. 1989), Queensland. Hawksbill hatchlings feed on very small (planktonic) plants and animals floating in the ocean. When they grow to between 30 and 40 cm (curved carapace length) they begin feeding among coral and rocky reef habitats on the sea floor. Juvenile and adults hawksbill turtles eat a variety of marine plants and animals, particularly algae, seagrass, sponges and shellfish (SPRAT Database).	considered negligible, Mitigation measures to avoid interactions with this species from trenching activities include maintaining watch, ceasing work if interactions are considered probable and reporting any interactions that may occur. The timing works in accordance with the appropriate tidal cycle and will ensure that potential impacts are mitigated. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Pacific Ridley, olive Ridley Turtle	*Lepidochelys olivacea*	E	Species or species habitat may occur within area	(Bonn); In Australia, detailed information on the size of nesting and foraging populations is unknown although the nesting population is estimated between 500 and 1,000 (Limpus 1995a). Little is known about the diet of hatchling olive Ridley turtles. Studies on adult olive Ridley turtles in Australia show that they mainly eat shellfish. Studies in other countries show that olive Ridley turtles also eat crabs, shrimps, jellyfish and algae. This species is classed as the most abundant of the sea turtles. However, in Malaysia the nesting population has declined to 20% in recent years. Many of the large Arribadas such as in Surinam have been reduced to several hundred individuals (Limpus 1995b) (SPRAT Database). Over 100 turtles were killed by set netting in Fog Bay, NT, in one incident in 1994 (Guinea & Chatto 1992), which indicates that this species can forage in large aggregations.	Port Curtis is not preferred habitat for this species. Potential impacts are considered negligible. Mitigation measures to avoid interactions with this species from trenching activities include maintaining watch, interactions, ceasing work if interactions are considered probable and reporting any interactions that may occur. The use of silt curtains and timing works in accordance with the appropriate tidal cycle and will ensure that potential impacts are mitigated. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Dunmall's snake	*Furina dunmalli*	V	Species or species habitat may occur within area	Preferred habitat is *Acacia harpophylla* forest and woodland growing on cracking black clay and clay loam soils. Shows a preference for moist areas. Known only from the Brigalow Belt (DEWHA 2008h).	Suitable habitat present within pipeline corridor. Local populations may be impacted if suitable habitat is affected. Scouting for the species within suitable habitat will be undertaken prior to pipeline construction. Given suitable planning it is not expected that this species will be impacted by the proposal.
Flatback turtle	*Natator depressus*	V	Breeding known to occur within the area	(Bonn); This species is found only in the tropical waters of northern Aust. and PNG and Irian Jaya (Spring 1982; Zangerl *et al.* 1988) and is one of only two species of sea turtle without a global	Flatback turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Mitigation measures to avoid

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
				distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007), with occasional nesting by green and loggerhead turtles (Limpus 1999). The flatback turtle population utilising these beaches for nesting has remained at approximately 50 females annually throughout the 35 years monitoring has been conducted (Limpus et al. 2006). Flatback turtle' nesting commences in mid October, reaches a peak in late November – early December and cease by about late January. Hatchlings emerge from nests between early December and late March, with a peak in February (Limpus 2007). Juvenile flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.	interactions with this species from trenching activities include maintaining watch, interactions, ceasing work if interactions are considered probable and reporting any interactions that may occur. The use of silt curtains and timing works in accordance with the appropriate tidal cycle and will ensure that potential impacts are mitigated. Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch.
Brigalow scaly-foot	*Paradelma orientalis*	V	Species or species habitat may occur within area	Occurs on sandstone ridges in woodlands and vine thickets, and in open forests. Found within the Brigalow Belt (DEWHA 2008g).	Suitable habitat present within pipeline corridor. Local populations may be impacted if suitable habitat is affected. Scouting for the species within suitable habitat will be undertaken prior to pipeline construction. Given suitable planning it is not expected that this species will be impacted by the proposal.
Fitzroy tortoise	*Rhoedytes leukops*	V	Species or species habitat may occur within area	This species is found only in the drainage of the Fitzroy River, Qld. Found in rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity, and are often associated with *Vallisneria* spp. beds. Common riparian vegetation includes *Eucalyptus tereticornis*, *Casuarina cunninghamiana*, *Callistemon viminalis* and *Melaleuca linariifolia.* It is thought that the turtles have an affinity for well-oxygenated riffle zones, moving into deeper pools as the riffle zones cease to flow.	This species is found only in the drainage of the Fitzroy River, Qld. Potential impacts to this species are considered unlikely.
Sharks					
Whale shark	*Rhincodon typus*	V	Species or species habitat may occur within area	The Whale Shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are	Whale sharks are uncommon in Queensland waters, and it is considered unlikely to occur within Port Curtis. Potential impacts to this

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
				uncommon in Queensland waters, and it is unlikely to occur within Port Curtis.	species are considered unlikely.
Plants					
No common name	*Acacia grandifolia*	V	n/a[2]	Tree up to 8 m. Endemic to south-east Qld and restricted to a small area around Gayndah, Mundubberra, Coulston Lakes and Proston in the Burnett district.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Asplenium pellucidum*	V	n/a[2]	Lithophytic or epiphytic fern which grows on mossy branches and rocks near in damp areas.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Atalaya collina*	E	Species or species habitat likely to occur within area	Grows on hillsides in remnant dry scrubs, and is associated with *A. salicifolia*.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Bertya opponens*	V	n/a[2]	Slender shrub or small tree to 4 m high. Found in shallow soils on ridges with mallee.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
Heart-leaved bosistoa	*Bosistoa selwynii*	V	Species or species habitat likely to occur within area	Grows in rainforests up to 300 m in altitude. From Maryborough in Queensland south to the Tweed River district in north-east NSW.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
Three-leaved bosistoa	*Bosistoa transversa*	V	Species or species habitat likely to occur within area	Grows in lowland subtropical rainforest up to 300 m in altitude. From Maryborough in Queensland south to the Nightcap Range north of Lismore in north-east NSW.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
Miniature Moss-orchid	*Bulbophyllum globuliforme*	V	Species or species habitat likely to occur within area	Found in the McPherson Range, also Maleny and Noosa areas of the Wide Bay district. Appears to grow only on *Araucaria cunninghamii*.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
Ooline	*Cadellia pentastylis*	V	Species or species habitat likely to occur within area	Occurs on ridges and undulating terrain in pure stands or with brigalow or semi-evergreen vine thicket.	Species known to occur within area of gas transmission pipeline. Unlikely that any individuals will be cleared during pipeline construction and no impact to species anticipated.
Wedge-leaf tuckeroo	*Cupaniopsis shirleyana*	V	Species or species habitat likely to occur within area	Small tree up to 10 m tall; usually seen as large bushy shrub. Endemic to Queensland, ranging from Carina, Brisbane to Bundaberg. Occurs in dry rainforest.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
No common name	*Commersonia sp.Cadarga (G.P. Guymer 1642)*	V	Species or species habitat likely to occur within area	Restricted to central Queensland.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
Cossinia	*Cossinia australiana*	E	Species or species habitat likely to occur within area	Shrub to small tree in dry rainforest and vine thickets. Restricted distribution north from Kingaroy and Gympie to Rockhampton.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Cupaniopsis shirleyana*	V	n/a[2]	Small tree up to 10 m tall; usually seen as large bushy shrub. Endemic to Queensland, ranging from Carina, Brisbane to Bundaberg. Occurs in dry rainforest.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Cycas megacarpa*	E	n/a[2]	Scattered and localised on clay-loam soils over several substrates, usually on sloping country in wet eucalypt forests or rainforests. Ranges from near Mount Morgan to near Goomeri in Qld. *Cycas megacarpa* was recorded from several locations within the Callide and Calliope Ranges (Figure 7-1).	Based upon incidental observations of the species as part of this survey and mapping presented within the Central Queensland University investigation (CQU, 2007) the gas transmission pipeline corridor avoids the core populations of this species within the ranges, and intersects the margins of the populations where plant densities are lower. Some individuals are likely to require translocation however the low number to be impacted indicate there will not be a significant impact to the species.
No common name	*Denhamia parvifolia*	V	n/a[2]	Grows in brown or brownish-red loams and clay-loams in vine thickets and softwood scrubs on hillslopes and crests.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
King blue-grass	*Dichanthium queenslandicum*	V	Species or species habitat likely to occur within area	Endemic to Queensland where it occurs mostly on black clay soils around Emerald and more rarely on the Darling Downs.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
Finger panic grass	*Digitaria porrecta*	E	Species or species habitat likely to occur within area	Occurs in tropical and subtropical rain forests and tropical and subtropical sub-humid woodlands.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
Tricolour diuris	*Diuris sheaffiana*	V	Species or species habitat likely to occur within area	Grows in sclerophyll forest among native grass; often with native Cypress Pine.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
No common name	*Eucalyptus raveretiana*	V	n/a[2]	Small to medium sized tree. Always occurs along creek beds and river banks. Scattered and disjunct in central coastal and subcoastal Queensland.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Leionema obtusifolium*	V	n/a[2]	Small shrub; endemic. Restricted to one location in south-east Qld.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Leucopogon cuspidatus*	V	Species or species habitat likely to occur within area	Occurs on off-shore islands in the Great Barrier Reef and adjacent mainland coastal areas.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Macadamia integrifolia*	V	n/a[2]	Small to medium-sized tree to 15 m high; major commercial food crop. Found in rainforests of south-east Queensland.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Macrozamia fearnsidei*	V	n/a[2]	Widely scattered, on sandy soil over sandstone in the ranges north and east of Injune.	Species is potentially present within gas transmission pipeline area. No major populations of this species are expected to be impacted upon by the pipeline and no significant impact to this species is anticipated.
No common name	*Macrozamia platyrhachis*	E	n/a[2]	Distribution restricted to the Blackdown Tableland/ Planet Downs area of the Dawson Range, central Queensland. Grows in eucalypt woodland or open forest on deep sandy soils derived from sandstone.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
No common name	*Parsonia larcomensis*	V	Species or species habitat likely to occur within area	Occurs in open heathland and shrubland at or near the summits of mountain peaks from 350 to 750 m elevations and is restricted to central east and south-east Qld.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
Quassia	*Quassia bidwillii*	V	Species or species habitat likely to occur within area	Shrub or small tree to 6 m that occurs from Gympie to Mackay. Grows in rainforest communities, or on the margins of these communities.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.
Minute orchid, ribbon-root orchid	*Taeniophyllum muelleri*	V	Species or species habitat may occur within area	Epiphytic orchid, favouring littoral rainforest, subtropical rainforest, wet sclerophyll forests and riparian areas.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
No common name	*Trymalium minutiflorum*	V	Species or species habitat likely to occur within area	No information available.	Presence within proposed impact area of gas transmission pipeline unlikely and low probability of species being impacted.

1 – Type of presence as indicated within the DEWHA MNES database.
2 – These species were not within the DEWHA MNES database for the search area but were identified within other database searches including Queensland EPA Wildlife Online, Birds Australia database, Queensland Museum and Queensland HERBRECS records.

An assessment of potential impacts to threatened ecological communities is listed in Table 6-4.

Table 6-4 EPBC Listed Threatened Communities for the Gas Transmission Pipeline

Threatened Ecological Community	EPBC Status	Type of Presence[1]	Background	Impacts/Mitigation
Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin	E	Community known to occur within area	Community present within the gas transmission pipeline corridor. Regional Ecosystems present that correspond to this threatened community include: RE 11.8.11. Figure 7-1 shows extent along the gas transmission pipeline.	Areas of this ecological community along the gas transmission pipeline will be identified prior to clearing and will be retained where practicable. No significant impacts are expected to this community.
Brigalow (*Acacia harpophylla* dominant and co-dominant)	E	Community known to occur within area	Community present within the gas transmission pipeline corridor. Regional Ecosystems present that correspond to this threatened community include: 11.3.7, 11.4.8, 11.4.9, 11.4.9a, 11.4.9b, 11.9.5. Figure 7-1 shows extent along the gas transmission pipeline.	Areas of this ecological community along the gas transmission pipeline will be identified prior to clearing and will be retained where practicable. No significant impacts are expected to this community.
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	E	Community likely to occur within area	Community is likely to be present within the gas transmission pipeline corridor. Regional Ecosystems present that correspond to this threatened community include: RE 11.11.18.	Areas of this ecological community along the gas transmission pipeline will be identified prior to clearing and will be retained where practicable. No significant impacts are expected to this community.

1 – Type of presence as indicated within the DEWHA MNES database.
2 – These species were not within the DEWHA MNES database for the search area but were identified within other database searches including Queensland EPA Wildlife Online, Birds Australia database, Queensland Museum and Queensland HERBRECS records.

6.3.3 Migratory Species

The Guidelines provide that an action is likely to have a significant impact on a migratory species if there is a possibility it will:

- Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles) destroy or isolate an area of important habitat for a migratory species; and/or
- Result in invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Dugongs and turtles feed on seagrasses which may be impacted during dredging and/or construction activities. Management of the seagrass communities will have to be considered or adverse impacts to dugong populations are possible. Figure 4.1 indicates the proximity of one of the options for the pipeline and its location to existing seagrass beds. Potential impacts to seagrass meadows are considered to be temporary and isolated to the meadows north of Fisherman's Landing. These meadows have been assessed by the DPI&F as being patchy and ephemeral (Rasheed *et al.* 2003). Temporary impacts to these meadows from smothering and reduced photosynthesis may result in changes to foraging behaviour by dugong and turtles. Significant seagrass meadows are located at Pelican Banks and Targinie Banks with feeding trails observed during monitoring studies conducted by DPI&F (Rasheed *et al,* 2003). Temporary disturbance of the seagrass meadow to the north of Fisherman's Landing is not expected to impact dugong populations within the GBRWHA. These meadows were observed to reduce in area and biomass between 2002 and 2005 and observations of changes to foraging behaviour was not recorded. Mitigation measures to minimise impacts to these meadows will be implemented through the development of Dredge Management Plans and Construction and Operational EMP's.

Migratory species were identified in the MNES searches as potentially being present within the gas transmission pipeline corridor search area (Table 6-5).

Table 6-5 EPBC Listed Migratory Species for the Gas Transmission Pipeline

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Migratory Terrestrial Species					
White-bellied sea-eagle	*Haliaeetus leucogaster*	M	Species or species habitat likely to occur within area	(CAMBA); White-bellied Sea-Eagles are a common sight in coastal and near coastal areas of Australia. In addition to Australia, the species is found in New Guinea, Indonesia, China, south-east Asia and India. The White-bellied Sea-Eagle feeds mainly off aquatic animals, such as fish, turtles and sea snakes, but it takes birds and mammals as well (Birds Australia). This species was sighted on low tidal mud flats, mangroves and rocky shores habitat during the intertidal survey in June 2008.	Potential impacts from the proposed gas transmission pipeline are unlikely as it is widespread and its preferred habitat is unlikely to be impacted.
White-throated needletail	*Hirundapus caudacutus*	M	Species or species habitat likely to occur within area	Suitable habitat exists within gas transmission pipeline corridor. Would overfly site. No impacts to this species are expected from the proposed actions.	No impacts to this species are expected from the proposed actions.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Barn swallow	*Hirundo rustica*	M	Species or species habitat likely to occur within area	Migrant to coastal and sub-coastal districts. Non-breeding in Australia. Possibly present. No impacts to this species are expected from the proposed actions.	No impacts to this species are expected from the proposed actions.
Rainbow bee-eater	*Merops ornatus*	M	Species or species habitat likely to occur within area	Suitable habitat exists within gas transmission pipeline corridor. Impacts to this species are possible but unlikely. This species was sighted on the hinterland margins of Curtis Island during the intertidal survey in June 2008.	No impacts to this species are expected from the proposed actions.
Black-faced monarch	*Monarcha melanopsis*	M	Breeding may occur within area	Occurs in rainforests, mangrove and eucalypt woodlands.	No impacts to this species are expected from the proposed actions.
Spectacled monarch	*Monarcha trivirgatus*	M	Breeding may occur within area	Usually occurs in rainforests, mangroves occasionally moist dense wet eucalypt gullies.	No impacts to this species are expected from the proposed actions.
Satin flycatcher	*Myiagra cyanoleuca*	M	Species or species habitat likely to occur within area	Species migrates between north Qld and south-east Australia. Probable visitor to gas transmission pipeline corridor during migration.	No impacts to this species are expected from the proposed actions.
Rufous fantail	*Rhipidura rufifrons*	M	Breeding may occur within area	Species migrates between north Qld and south-east Australia. Probable visitor to gas transmission pipeline corridor during migration. Would favour moist gullies or semi-evergreen vine thickets.	No impacts to this species are expected from the proposed actions.
Migratory Wetland Birds					
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008.	Potential impacts from the proposed gas transmission are unlikely as it is widespread and its preferred habitat is unlikely to be impacted.
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania (Birds Australia).	Potential impacts from the proposed gas transmission pipeline are unlikely as it is widespread and its preferred habitat is unlikely to be impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Latham's snipe, Japanese snipe	*Gallinago hardwickii*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Latham's Snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia (i.e. it travels through northern Australia to reach non-breeding areas located further south). In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977; Naarding 1983; Weston 2006, pers. comm.). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977; Naarding 1983).	Potential impacts from the proposed gas transmission pipeline are unlikely as its preferred habitat is freshwater systems, and it is unlikely to spend any substantial amount of time in intertidal areas.
Australian cotton pygmy-goose	*Nettapus coromandelianus albipennis*	M	Species or species habitat likely to occur within area	Cotton Pygmy-Geese are found on freshwater lakes, swamps and large water impoundments (The Action Plan for Australian Birds 2000).	Unlikely to occur in areas potentially impacted by the proposed transmission pipeline.
Little curlew, little whimbrel	*Numenius minutus*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Curlew is widespread in the north of Australia and scattered elsewhere (Birds Australia).	Potential impacts the proposed transmission pipeline is unlikely as this species is widespread and its preferred habitat is unlikely to be impacted.
Painted snipe	*Rostratula benghalensis s. lat.*	M	Species or species habitat likely to occur within area	(CAMBA); Originally listed based on assumption that *Rostratula australis* was a subspecies of *Rostratula benghalensis* (SPRAT Database). Now known that they are separate species and that *Rostratula benghalensis* is unlikely to occur in Australia. Australia recommended the removal of this species from the CAMBA Annex in 2006. The removal will not lessen the protection of the species due to listing as threatened under the EPBC Act.	Unlikely to occur in areas potentially impacted by the proposed transmission pipeline.
Migratory Marine Birds					
Fork-tailed swift	*Apus pacificus*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA, ROKAMBA); Could find no reports of it being sighted in Gladstone region. This species has a large range, with an estimated global Extent of Occurrence of 10,000,000 km². The global population size has not been quantified, but it is believed to be large as the species is described as 'common' in at least parts of its range (del Hoyo et al. 1999). Global population trends have not been quantified, but there is evidence of a population increase (del Hoyo et al.	Potential impacts from the proposed transmission pipeline are unlikely to be significant as this species habitat is widespread and unlikely to occur in the Gladstone region. Its preferred habitat is unlikely to be impacted.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
				1999), and so the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (http://www.iucnredlist.org/).	
Great egret, white egret[3]	*Ardea alba*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Great Egrets occur throughout most of the world. They are common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008.	Potential impacts from the proposed transmission pipeline are unlikely to be significant as this species is widespread and its preferred habitat is unlikely to be impacted.
Cattle egret	*Ardea ibis*	M	Species or species habitat likely to occur within area	(CAMBA, JAMBA); Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania (Birds Australia).	Potential impacts from the proposed transmission pipeline are unlikely to be significant as this species is widespread and its preferred habitat is unlikely to be impacted.
Southern giant-petrel	*Macronectes giganteus*	E, M	Species or species habitat likely to occur within area	(Bonn); The Southern Giant-Petrel breeds on six subantarctic and Antarctic islands in Australian territory. Longline fishing causes two main forms of mortality in the Southern Giant-Petrel; by-catch during line-setting, and ingestion of discarded fishing hooks (SPRAT Database).	Unlikely to occur in areas potentially impacted by the proposed gas transmission pipeline.
Little tern	*Sterna albifrons*	M	Species or species habitat likely to occur within area	(Bonn, CAMBA, JAMBA, ROKAMBA); The Little Tern is mainly coastal, being found on beaches, sheltered inlets, estuaries, lakes, sewage farms, lagoons, river mouths and deltas. The Little Tern is migratory. Substantial numbers move north from the far south-east after breeding. The Little Tern is extremely sensitive to human disturbance when breeding and is rapidly declining in numbers and range. Nesting sites are usually located where humans swim, walk, exercise dogs, picnic and drive off-road vehicles. The mere presence of people on the beach may cause these terns to desert their eggs and eventually leave the colony altogether. In New South Wales, where they were once quite common, the breeding population of Little Terns has declined to fewer than 50 pairs and of 30 known breeding sites only a handful have been used since 1970 (Birds Australia).	It is unlikely there will be potential impacts from the proposed gas transmission pipeline to Little Tern population.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Migratory Marine Mammals					
Bryde's whale	*Balaenoptera edeni*	M	Species or species habitat likely to occur within area	(Bonn); Bryde's Whales occur in temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40° N and 40° S, or the 20 °C isotherm (Bannister et al. 1996). Bryde's Whales have been recorded from all Australian states except the Northern Territory (Bannister et al. 1996), including one sighting each in Victoria and NSW and 11 reported strandings in South Australia (7), NSW (2), Victoria (1) and Queensland (1) (DEW 2007). As there are no estimates of the Australian Bryde's Whale population size, the proportion of the global population in Australian waters cannot be estimated. The lack of data for Bryde's Whales in Australian waters leads to an inability to assess whether global threats would affect the Australian population. The offshore form could potentially be subjected to threats from incidental entanglement in fishing gear set, lost or discarded in international or adjacent waters (SPRAT Database). A single record of a stranding was found from 1982, south west of Stewart Island, Great Sandy Strait (National Whale and Dolphin Sightings and Strandings Database – DEWHA).	There have been no reports of sightings within Gladstone harbour. It is concluded that potential impacts from the proposed marine crossing of the gas transmission pipeline are unlikely .
Dugong	*Dugong dugon*	M	Species or species habitat likely to occur within area	The Port of Gladstone region is wholly within the Rodds Bay Dugong Protection Area. The most significant seagrass meadows within the port (significant cover) are located approximately 10 km to the east of the LNG facility site at Pelican Banks. To the west of the site, the foreshore mainland north and south of Fisherman's Landing is covered by isolated patches of seagrass. Dugong feeding activity has been observed on the majority of intertidal seagrass meadows surveyed during the 2007 DPI&F long term monitoring program (Rasheed *et. al.*, 2008). The highest density of dugong feeding trails was observed at the aggregated patches of *Zostera capricorni* / *Halophila ovalis* meadow at Wiggins Island with feeding trails recorded at 58% of sampling sites. Dugong feeding trails were also recorded at Pelican Banks and the intertidal meadows to the north and south of Fishermans Landing (Rasheed *et. al.*, 2008).	The seagrass meadows adjacent to the proposed bridge, road and service corridor north of Fisherman's Landing are likely to incur short term impacts from increased sedimentation and turbidity levels. It is considered that potential impacts from proposed bridge; road and services corridor will be mitigated through the use of silt curtains, timing of piling and dredging to avoid neap tides and minimising the footprint of the bridge abutments. The seagrass meadows adjacent to Friend Point are ephemeral and patchy. Dugong foraging behaviour may alter during the construction phase with a preference to forage on seagrass meadows of greater area and biomass at Pelican Banks and Targinie Banks. Changes to foraging behaviour in relation to loss of seagrass has been observed previously in Moreton Bay.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Killer whale, orca	*Orcinus orca*	M	Species or species habitat likely to occur within area	(Bonn); The Killer Whale is found in all oceans and seas of the world usually in family groups. They occur in most habitat types from coastal areas to the deep ocean waters, from the tropics to polar regions, although most sightings are in temperate waters. The Killer Whale has never been the target of serious commercial hunting so the species worldwide is secure. Killer whales have not been reported from within Port Curtis.	Killer whales have not been reported from within Port Curtis. It is concluded that there is little likelihood of impacts from proposed marine crossing of the gas transmission pipeline corridor.
Indo-Pacific humpback dolphin	*Sousa chinensis*	M	Species or species habitat likely to occur within area	The taxonomy of the Australian population of the Indo-Pacific Humpback dolphin (Sousa chinensis) is now undergoing revision, with suggestions that it may in fact be a separate species (Frere et al. 2008). The Qld EPA have records of interactions with these species in the Port Curtis region. Although Sousa chinensis is known to occur within the region, it would appear that boat strike and entanglement in fishing gear and the QDPI&F Shark Control nets pose the greatest threats.	Although *Sousa chinensis* and *Orcaella heinsohni* are known to occur within the region, it would appear that boat strike and entanglement in fishing gear and the QDPI&F Shark Control nets pose the greatest threats. The impact on these species from the proposed MOF, PLF and dredge material placement facility is considered to be low. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts are unlikely.
Humpback whale	*Megaptera novaeangliae*	M	Breeding known to occur within area	(Bonn); Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. The majority of humpbacks in Australian waters migrate north to tropical calving grounds in the Great Barrier Reef complex between approximately 14°S and 27°S from June to August, and south to the Southern Ocean feeding areas from September to November. Gladstone Harbour is not known as an important migration route. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. It is estimated that when the Australian east coast whaling industry ended in 1963, the east coast population of humpbacks had been reduced to a little over 100 individuals. This population has shown steady recovery of around 10 –11% a year, and in 2006 was estimated at around 8000 (SPRAT Database). No reports of humpback whale sightings or strandings in Gladstone harbour could be found (National Whale and Dolphin Sightings and Strandings Database – DEWHA), While humpbacks are known to occur in the region, they are not known to enter Port Curtis. The Qld EPA have records of interactions with these species.	While humpbacks are known to occur in the region, they are not known to enter Port Curtis. It is concluded that potential impacts from the proposed marine crossing of the gas transmission pipeline are unlikely to have a significant impact on this species.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Irrawaddy Dolphin	*Orcaella brevirostris*	M	Species or species habitat likely to occur within area	It should be noted that the Irrawaddy dolphin (*Orcaella brevirostris*) is now generally regarded to not occur in Australian waters. Instead, it is more likely that reports have in fact related to the Snubfin dolphin (*Orcaella heinsohni*) (Beasley et al. 2005). The Snubfin dolphin is not currently listed under the EPBC Act, however, the information that follows shoud be considered to relate to it. The distribution of this species extends from from Broome in Western Australia, along the northern coastline near Darwin and the Gulf of Carpentaria, and off the east coast as far south as the Brisbane River. Irrawaddy dolphins are typically associated with shallow, coastal and estuarine waters, with most sightings recorded within 10 km of the coast, in waters less than 10 m deep, and within 10 km of a river mouth (Parra 2005 – PhD thesis). Since 1968, there have been 36 reported strandings of Irrawaddy dolphins in Queensland, all from around the Townsville region. There have been no reported sightings or strandings from the Gladstone region (National Whale and Dolphin Sightings and Strandings Database – DEWHA). Parra (2005) reports additional strandings, including one from Bundaberg in 1994 and one from the Brisbane River in 1997.	It is unliklet that Irrawaddy dolphins utilise the Port of Gladstone region, however, it is likely that Snubfin dolphins do to a limited extent. The limited number of sightings of Snubfin dolphins indicate that Port Curtis is not a significant habitat for them. As such, it is thus concluded that potential interactions during the construction of the MOF, PLF and dredge material placement facility are unlikely to have a significant impact on this species. LNG carriers will use existing shipping lanes within the GBRWHA and potential impacts are unlikely.
Migratory Marine Reptiles					
Hawksbill turtle	*Eretmochelys imbricata*	M	Species or species habitat may occur within area	(Bonn); Major nesting of hawksbill turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia (Pendoley 2005), and in the northern Great Barrier Reef and Torres Strait (Dobbs et al. 1999; Limpus et al. 1989), Queensland. Hawksbill hatchlings feed on very small (planktonic) plants and animals floating in the ocean. When they grow to between 30 and 40 cm (curved carapace length) they begin feeding among coral and rocky reef habitats on the sea floor. Juvenile and adults hawksbill turtles eat a variety of marine plants and animals, particularly algae, seagrass, sponges and shellfish (SPRAT Database).	It is unlikely that Port Curtis is an important habitat for hawksbill turtles, and thus it is concluded that potential impacts from the proposed marine crossing of the gas transmission pipeline are unlikely to have a significant impact on this species.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Loggerhead turtle	*Caretta caretta*	M	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (see flatback turtle, below). Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Adult Loggerheads feed on a variety of invertebrate animals, such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean. This eastern Australian population has declined by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994) and may not survive the next 100 years (Limpus 1997). Because no interbreeding occurs between breeding units, repopulation would be unlikely (Bowen *et al.* 1994). It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database). The Qld EPA have records of interactions with these species.	Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). With the implementation of mitigation measures during trenching and dredging operations to avoid interactions, potential impacts to this species from the proposed marine crossing of the gas transmission pipeline is considered to be negligible. Mitigation measures include using turtle exclusion devices such as dredge flanges, reducing pump speed and boat speed, maintaining constant watch and adhering to all reporting requirements for any interactions with marine fauna listed under the EPBC Act.
Green turtle	*Chelonia mydas*	M	Species or species habitat may occur within area	(Bonn); Occasional nesting on the ocean side of southern Curtis Island and Facing Island (see Flatback turtle, fbelow). Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds green turtles mainly eat seagrass and seaweed (algae). They also feed on mangrove fruit, jellyfish and sponges. Limpus (2007) reports that the southern GBR stock of green turtles is large by global standards and that, overall, this population is not showing signs of decreasing numbers of breeding females at the nesting beaches over the past four decades. The Qld EPA have records of interactions with these species.	With the implementation of mitigation measures to avoid interactions with this species, the impact on this species from the proposed marine crossing of the gas transmission pipeline is considered negligible. Mitigation measures include using turtle exclusion devices such as dredge flanges, reducing pump speed and boat speed, maintaining constant watch and adhering to all reporting requirements for any interactions with marine fauna listed under the EPBC Act.
Estuarine crocodile, salt-water crocodile	*Crocodylus porosus*	M	Species or species habitat may occur within area	(Bonn); Connell Hatch (2006) reported that saltwater crocodiles had been seen within the Calliope and Boyne Rivers prior to 2004, but there have been no reports of their sighting since that time. Significant breeding populations of *C. porosus* do not occur south of the Tropic of Capricorn. Port Curtis is not considered an important habitat for *C. porosus.*	Port Curtis is not considered an important habitat for *C. porosus* and It is concluded that there is little likelihood of proposed marine crossing of the gas transmission pipeline impacting this species.

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Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
Leathery turtle, leatherback turtle	*Dermochelys coriacea*	M	Species or species habitat may occur within area	(Bonn); The diet of Leatherback hatchlings and juveniles is not known. Adult Leatherbacks feed on jellyfish, salps and squid on the ocean surface and down to depths of 200 metres.	There are records of intermittent nesting on beaches between Rockhampton and Fraser Island, but no records of its occurrence in Port Curtis. The impact on this species from the proposed marine crossing of the gas transmission pipeline is considered negligible.
Pacific Ridley, olive Ridley turtle	*Lepidochelys olivacea*	M	Species or species habitat may occur within area	(Bonn); In Australia, detailed information on the size of nesting and foraging populations is unknown although the nesting population is estimated between 500 and 1,000 (Limpus 1995a). Over 100 turtles were killed by set netting in Fog Bay, NT, in one incident in 1994 (Guinea & Chatto 1992), which indicates that this species can forage in large aggregations. Little is known about what hatchling olive Ridley turtles eat. Studies on adult olive Ridley turtles in Australia show that they mainly eat shellfish. Studies in other countries show that olive Ridley turtles also eat crabs, shrimps, jellyfish and algae. This species is classed as the most abundant of the sea turtles. However, in Malaysia the nesting population has declined to 20% in recent years. Many of the large Arribadas such as in Surinam have been reduced to several hundred individuals (Limpus 1995b) (SPRAT Database).	While it is possible that olive Ridley turtles occur in the Port Curtis region, no records could be found. With the implementation of mitigation measures to avoid interactions with this species, the impact on this species from the proposed marine crossing of the gas transmission pipeline is considered negligible. Mitigation measures include using turtle exclusion devices such as dredge flanges, reducing pump speed and boat speed, maintaining constant watch and adhering to all reporting requirements for any interactions with marine fauna listed under the EPBC Act.
Flatback turtle	*Natator depressus*	M	Breeding known to occur within the area	(Bonn); This species is found only in the tropical waters of northern Aust. and PNG and Irian Jaya (Spring 1982; Zangerl *et al.* 1988) and is one of only two species of sea turtle without a global distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007), with occasional nesting by green and loggerhead turtles (Limpus 1999). The flatback turtle population utilising these beaches for nesting has remained at approximately 50 females annually throughout the 35 years monitoring has been conducted (Limpus et al. 2006). Flatback turtle' nesting commences in mid October, reaches a peak in late November – early December and cease by about late January. Hatchlings emerge from nests between early December and late March, with a peak in	With the implementation of mitigation measures to avoid interactions with this species, the impact on this species from the proposed marine crossing of the gas transmission pipeline is considered negligible. Mitigation measures include using turtle exclusion devices such as dredge flanges, reducing pump speed and boat speed, maintaining constant watch and adhering to all reporting requirements for any interactions with marine fauna listed under the EPBC Act.

Common Name	Scientific Name	EPBC Status	Type of Presence[1]	Comments	Impacts/Mitigation
				February (Limpus 2007). Flatback turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Juvenile flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.	
Sharks					
Whale shark	*Rhincodon typus*	M	Species or species habitat may occur within area	The Whale Shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis.	There is little likelihood of the proposed marine crossing of the gas transmission pipeline site impacting this species

1 – Type of presence as indicated within the DEWHA MNES database.

Section 7 Summary of Findings

7.1 Combined Impacts and Mitigation Measures for all Five Referrals

7.1.1 World Heritage Values

7.1.1.1 Criteria VII - Exceptional Natural Beauty and Aesthetic Importance

The LNG facility, PLF, MOF and dredge material placement facility will potentially impact the natural beauty and aesthetic importance of the south-western part of Curtis Island, part of the Great Barrier Reef World Heritage Area (GBRWHA). Impacts to the natural beauty and aesthetic importance world heritage values of Port Curtis and Curtis Island are summarised as:

- The LNG facility, the potential bridge and access roads, and the dredge material placement facility would be visible from Port Curtis;
- The flare stack and flame would be visible from most views within Port Curtis;
- The LNG train and storage tanks would be visible from Port Curtis and the upper portions the structures would be visible from Tide, Witt and Turtle Islands;
- LNG carriers moored at the product loading facility (PLF) at China Bay will be visible from Port Curtis (when a ship is moored at the PLF it will block views of the land-based components of the LNG facility); and
- Ships/barges/ferries moored at the material offloading facility (MOF) at China Bay will also be visible from Port Curtis.

In contrast:

- The LNG facility, including the flare stack, would not be visible from the portion of the GBRMP zoned Marine National Park that is located along the eastern edge of Cutis Island or Curtis Island National Park, due to the system of hills and ridges in the centre of Curtis Island; and
- The potential bridge and access roads would not be visible from most view situations due to screening by vegetation and/or landforms; however it would be highly visible from Port Curtis. The bridge would also be visible from the Auckland and Round Hill public lookouts even though the views to the potential bridge are from a distance of 13 km and 16 km respectively;

The overall potential visual impact of the LNG facility has been assessed as generally low to moderate through the positioning of the facility in low lying valleys that provide visual screening by the landform of the valley. While the hills and ridges that define the valley in which the site is located are visible from surrounding areas, the centre of the valley itself is generally screened from most surrounding areas. Consequently, the base in the valley which the site would be located is only directly visible from boats travelling in Port Curtis.

The approximate area that the flare is likely to be visible is much larger than the LNG facility, bridge and access road, however the occurrence of the flame is intermittent and irregular. The flare will be most visible at night. It is expected that flaring at night will only occur on a limited number of occasions. The use of aircraft safety lighting will also be a consistent red light against the natural backdrop to minimise visual impacts.

It is anticipated that impact to the natural beauty and aesthetic importance of the of the subtidal area from the gas transmission pipeline will be minimal as the soft coral communities living in the silt/mud and coarse sand substrate between Friend Point and Laird Point are sparse and represented regionally. In contrast, the introduction of new habitat on the sand/rock backfill substrate will increase habitat complexity and available space for marine species such as sponges, gorgonians and soft corals. This new substrate would also provide habitat and food sources for mobile species (e.g. fish, crabs).

Section 7 Summary of Findings

Impacts to seagrass meadows from the gas transmission pipeline are expected to be temporary and will impact the natural beauty and aesthetic importance of the world heritage values of the GBRWHA.

The principal long term visible changes to the landscape will be the installation of pipeline markers and access tracks or upgrading of existing tracks on Curtis Island. Development of the CSG transmission pipeline will involve clearing of vegetation, removal and storage of top soil, grading and installation of temporary fencing where necessary within the gas transmission pipeline corridor, which is typically 30m wide, excavation of the pipeline trench and rehabilitation of the gas transmission pipeline corridor by re-spreading top soil and cleared vegetation and seeding (where applicable) to re-establish cover.

The visual impact associated with the gas transmission pipeline development will primarily result from excavation of the pipeline trench and temporary stockpiling of soil material on Curtis Island resulting in the temporary creation of a high visual contrast between the exposed soil and the adjoining vegetated areas. The most significant long term visible changes to the landscape will result from installation of aboveground pipeline markers and permanent access tracks that will be constructed along the pipeline corridor.

Mitigation measures are considered particularly necessary and recommended, due to the high landscape quality of the LNG facility site, potential bridge and mainland access road location, part of the GBRWHA. The objectives of these measures are to minimise the visual contrast between the LNG facility structures and the tree-covered slopes of Curtis Island by minimising the height of structures and maximising the visual screening provided by the tree-covered ridges and hills that define the valley in which the LNG facility is to be located. This includes minimising the visibility of structures and flames associated with flaring operations in the LNG facility and the visibility of lighting that could be seen against the dark tree-covered slopes of Curtis Island that will form the backdrop to the LNG facility.

In order to meet these objectives the following mitigation measures will be considered:

- adopting of ground level flare option to minimise the visual impact of flaring, particularly at night;
- Planning and management of site works to minimise tree clearing, with revegetation works on disturbed areas to be implemented as quickly as possible after completion of earthworks;
- Retention of mangrove vegetation along the foreshore of China Bay to provide partial visual screening of the ground level components of the LNG facility;
- Design of the LNG facility lighting to minimise light spill (e.g. using light hoods) and avoid direct views of lights from outside the plant, in particular Port Curtis and view situations located south of Port Curtis;
- Installation of aircraft safety lighting on the flare stacks (steady red light) in accordance with clause 9.4.2.4 (c) of the *CASA Manual of Standards Part 139 – Aerodromes*;
- Avoid the use of obstacle markings (e.g. red and white paint on the upper portions of the flare stacks);
- Planning of the potential bridge's construction works to include minimising the area of vegetation clearing at the bridge approaches and implement revegetation works as soon as possible;
- Design of the LNG facility access road to minimise tree clearing and retain foreshore vegetation as a buffer to block views from 'Port Curtis' as well as public land-based view situations; and
- Design of the MOF and PLF to minimise the visual bulk, particularly when viewed from Port Curtis waterway and from view situations to the south.
- The following mitigation measures are consistent with current pipeline development practices:
- Minimise the length and width of roads and tracks required to carry out the pipe installation works and use existing roads and tracks where possible;

- Minimise the extent of vegetation clearing and stockpile cleared vegetation and top soil for reuse in rehabilitation;
- Minimise the area covered by excavated material alongside the trench;
- Carefully place and compact excavated subsoil material to backfill the trench; and
- Spread top soil over the area and apply seed to re-establish a grass cover.

Existing tracks and roads are to be used as much as possible in order to minimise track duplication and the extent of new road construction. Recommended mitigation measures include:

- Aligning access roads and tracks as much as possible with the existing pattern of fencing and natural drainage;
- Avoid impacting upon vegetated areas if possible, particularly along drainage lines (tracks should be deviated so that drainage lines are crossed in naturally clear areas);
- Where vegetated areas do need to be traversed, weave tracks to avoid clearing dense stands of vegetation or mature trees (this practice also breaks up the line of sight);
- Where new roads/tracks are required, orientate them (where safe to do so) so that they intersect existing roads at an angle. This will help disguise them from the general public and discourage unauthorised access from public roads;
- Avoiding roads traversing across steep slopes and highly visible ridges and hills;
- Minimising the width of roads and tracks
- Revegetating table drains and shoulders immediately after construction of access roads;
- Implementing erosion control measures during road construction; and
- Removing temporary roads and tracks as quickly as possible after they are no longer required and immediately carrying out revegetation works.

The revegetation techniques that are adopted by Santos have proven to be effective in re-establishing vegetation along previously completed sections of pipeline. In most instances the original land use will be re-established after the rehabilitation works have been completed, unless the land owner requests the site be rehabilitated to a different land use.

7.1.1.2 Criteria VIII - Significant Geomorphic or Physiographic Features

It is anticipated there will not be potential impacts to the significant geomorphic or physiographic features of the world heritage area from the LNG facility, MOF, PLF, potential bridge, road, gas transmission pipeline and CSG Fields. The coral reef system of the Great Barrier Reef lies outside of Port Curtis on the eastern side of Curtis Island and Facing Island. While some hard corals exist on the western side of Facing Island impacts to these communities are not expected. Worst case scenarios from modelling of dredging operations indicate that sediment plumes may extend to 600m during neap tide cycles, insufficient to reach the hard coral communities present within Port Curtis and in a direction parallel to the inner coast line of Curtis Island.

The soft corals, gorgonians and sponge communities that exist on the western side of Curtis Island will be potentially impacted by capital dredging operations however these communities do not represent significant geomorphic or physiographic features of the world heritage area. The area of capital dredging is estimated at 125.0 ha in total. Direct impacts from dredging for the MOF and PLF footprint will include a direct loss of subtidal and soft bottom communities at China Bay and in the approach channel adjacent

to Hamilton Point. A loss of mangrove, saltpan and intertidal communities at the haul roads will also be incurred. Santos proposes to dispose of all dredge material onshore there will be no anticipated impacts from dredge to the Great Barrier Reef.

Proposed dredging of the Clinton Channel to extend into China Bay will not impact deep water features of the adjoining continental shelf.

7.1.1.3 Criteria IX - Significant Ongoing Ecological and Biological Processes

The complex nature of the cross-shelf, longshore and vertical connectivity of the GBRWHA is facilitated by dynamic current flows that incorporate important ecological processes such as larval dispersal. Potential impacts from the construction and operation of the LNG facility, MOF, PLF, potential bridge, road and gas transmission pipeline is not expected to interrupt the current flows that support this ecological process.

The breeding and spawning grounds of unique coral reef associated species such as turtles, whales and humphead Maori wrasse has not been reported as occurring within Port Curtis. Marine turtles are known to nest on the ocean side of Curtis and Facing Island. Potential impacts from the gas flare will be mitigated through the introduction of measures that minimise exposure to light from the flare at night and during turtle nesting season. This will be developed as part of the Operational EMP for the LNG facility. All other impacts from lights during the construction and operational phases of the GLNG project will be kept to a minimum through mitigation measures developed in the appropriate EMPs.

Fish spawning aggregation sites are influenced by season, lunar phases and temperature (GBRMPA Website, 2009 http://www.gbrmpa.gov.au/corp_site/key_issues/fisheries/spawning_sites). Investigations of the spawning patterns of the common coral trout on the GBR have revealed two types of aggregation. The primary aggregation is located on a particular reef at a primary location, with other fish visiting secondary sites where smaller groups are spawning. Formations of spawning aggregations at primary sites are highly predictable from year to year while formations at secondary sites are fairly random. The GBRMPA report on Spawning Aggregations of Reef Fishes on the Great Barrier Reef: Implications for Management discusses fish spawning aggregation sites and the human impacts on these aggregations. According to this paper, the type of reef area used by spawning aggregations of GBR fishes varies from reef channels, reef promontories or reef flats, around coral bommies or along reef walls. It is considered unlikely that potential impacts will occur to spawning reef fish species resulting from the construction or operation of the GLNG project.

Increased shipping activity from the use of barges and ferries during the construction phase of the LNG facility is estimated up to 196 trips per 14-day work cycle. Mitigation measures such as reduced vessel speed, maintaining constant watch and reporting all incidents will be implemented for all vessel operations.

LNG carriers are proposed to keep to existing shipping lanes within the GBRWHA waters. Interactions with marine fauna will be minimised through the implementation of mitigation measures such as maintaining watches at all times of operation, reducing boat speed within the Port, the use of turtle exclusion devices such as dredge flanges during all dredging operations and adherence to all reporting requirements for any interactions with marine fauna.

Use of the mud flats in China Bay by migratory shorebirds was low. Considering the vast extent of mud flats within Port Curtis it is anticipated that there will be negligible disturbance to breeding colonies of seabirds.

7.1.1.4 Criteria X - Significant Natural Habitat for *In-situ* Conservation of Biological Diversity

The GBRWHA contains over 2000 km^2 of mangroves including 54 per cent of the world's mangrove diversity, ~ 43 000 km^2 of seagrass meadows in both shallow and deep water areas supporting one of the world's most important dugong populations and six of the world's seven species of marine turtles, 70 bioregions (broad-scale habitats) that have been identified comprising 30 reef bioregions and 40 non-

reefal bioregions (including algal and sponge gardens, sandy and muddy bottom communities, continental slopes and deep ocean troughs), one third of the world's soft coral and sea pen species (80 species); 800 species of echinoderms (for example sea stars) equalling 13 per cent of the world's total species; and the location of the world's largest green turtle breeding area, other key breeding areas, regionally important seabird nesting islands, significant spawning ground (for example black marlin) and a significant area for humpback whale calving and rearing. Habitat types potentially affected by the proposed LNG infrastructure are widely represented within Port Curtis and broader regional areas and it is considered unlikely that any particular intertidal habitat or individual species are restricted to areas that would be directly cleared or modified by the project. There are no inter-reefal or lagoonal areas within China Bay that may be directly or indirectly impacted by the LNG facility proposal.

Potential impacts to the natural habitat of mangroves, saltpan and saltmarsh communities within the GBRWHA constitute a small proportion of the total extent of mangrove communities found within the GBRWHA. Potential impacts to mangroves from construction of the LNG facility, dredge material placement facility, the MOF and PLF are estimated to be 5.633ha, 0.084% of the estimated 6736ha of mangrove communities found within Port Curtis. Potential impacts to saltpan and saltmarsh communities from construction of the LNG facility, dredge material placement facility, MOF and PLF are estimated to be 35.194ha, approximately 0.77% of the 4573ha of saltpan and saltmarsh communities found within Port Curtis. The combined potential impact to intertidal communities is estimated at 40.83ha, 0.36% of the estimated 11,309ha of intertidal communities found with Port Curtis.

Potential impacts to seagrass meadows are considered to be temporary and isolated to the meadows north of Fisherman's Landing. These meadows have been assessed as being patchy and ephemeral. Temporary impacts to these meadows from smothering and reduced photosynthesis may result in changes to foraging behaviour by dugong and turtles. This is not anticipated to impact the significant natural habitat for *in situ* conservation of dugong populations found within the GBRWHA. Significant seagrass meadows are located at Pelican Banks and Targinie Banks with feeding trails observed during monitoring studies conducted by DPI&F (Rasheed *et al,* 2003). Temporary disturbance of the seagrass meadow to the north of Fisherman's Landing is not expected to impact dugong populations within the GBRWHA. These meadows were observed to reduce in area and biomass between 2002 and 2005 and observations of changes to foraging behaviour was not observed or recorded. Mitigation measures to minimise impacts to these meadows will be implemented through the development of Dredge Management Plans and Construction and Operational EMPs.

Mitigation measures to avoid indirect impacts from run-off such as the construction of bunds, stormwater controls, upstream treatment and the provision of buffers will minimise sediment loads and increased turbidity to adjacent rocky reef and muddy soft bottom communities such as algal and sponge gardens, soft corals and sea pens that are present at this location.

The nearest significant coral communities are between Curtis and Facing Islands, south of the proposed LNG facility. While parts of Port Curtis may exhibit geological processes linking the various elements of the coastal environment (e.g. estuaries, intertidal flats, mangroves and embayments) the LNG facility will not result in disturbance to these elements.

7.1.2 National Heritage Places

Curtis Island has a variety of habitats that include tall shrubland, paperbark open forest and woodland, headland grasslands, coastal heath communities, extensive marine plains of saltwater couch and sedges, tidal mud flats and salt pans, large patches of vine thickets, swamp mahogany open forest and a range of eucalypt open forests and woodlands. The majority of the area is lightly grazed and the eucalypt woodlands are subject to fairly frequent burning. There are small thickets of weeds such as Lantana and rubber vine particularly in the beach ridge systems. Water hyacinth and para grass have localised occurrences within the area.

Curtis Island is part of the WHA GBR that is internationally recognised as having the largest and most significant expanse and diversity of coral reef formation in the world. Curtis Island shows a diversity of reef morphologies and ongoing geomorphic processes such as parabolic sand dunes, cliffed coastlines, parallel beach ridges, saltpans, rock platforms, mud flats and marine plain.

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Algal and sponge gardens, sandy and muddy bottom communities, and rocky reef subtidal communities are present. The rocky reef and silted embayments contain soft coral, sponges and sea pen species. No breeding and spawning grounds for unique coral reef associated species are known, however threatened and vulnerable species such as turtles and dugong frequent the port. Flatback turtles nest on the eastern side of the island.

Port Curtis contains 6,736 ha of mangroves, 4,573 ha of saltmarsh and saltpan communities that are important breeding and nutrient supply areas for the maintenance of fish and crustacean populations. Impacts to vegetation at the LNG facility site will occur resulting in loss of vegetation and some mangrove, saltmarsh and intertidal communities. The footprint will be kept to a minimum.

The island offers the best potential for study due to the accessibility of the island.

Impacts the outstanding heritage value from the LNG facility are unlikely to impact these values. The GBR is important for its cultural heritage for indigenous populations within Australia in providing habitat for species used as a food source and for culturally significant events. Mitigation measures were consistent in minimising the footprint of the LNG facility and associated infrastructure. In addition Santos will conduct site inspections of the proposed area in consultation with traditional owners or archaeologists.

The marine environment at Hamilton Point, China Bay and Laird Point represent highly turbid estuarine waters with minimal flushing during neap tides. Impacts to the aesthetic characteristics will occur from development of the marine facilities and dredge material placement facility.

7.1.3 Threatened Fauna Species and Ecological Communities

The combined impacts of all five referrals on threatened species and ecological communities likely to be found within the LNG facility, MOF, PLF, dredge material placement facility, potential bridge and road, gas transmission pipeline and CSG Field are described below. Those threatened species and ecological communities that are not likely to be found at these locations are not discussed in this section.

7.1.3.1 Birds

Black-breasted Button-quail (Turnix melanogaster)

Small areas of suitable habitat potentially exist in the vicinity of the LNG facility and in places along the gas transmission pipeline route near the Curtis coast. However, grazing and other disturbances caused by cattle, horses and feral pigs may have reduced habitat values such that the species may not be present in preferred habitat within the project's construction area. The proposed action is not expected to impact this species due to superior quality habitat available elsewhere..

Red Goshawk (Erythrotriorchis radiatus)

This species is known to utilise a very large home range (50 to 220 square km) including a mix of tall open forest, woodland, lightly treed savannah and the edge of rainforest (EPA 2005a). Favoured areas contain permanent water and have large populations of birds of other species. Red goshawks generally avoid very dense or very open habitats, preferring to hunt along ecotones (NSW NPWS 2002). Vegetation within the project's footprint generally does not form core habitat for this species. However, the species may utilise densely vegetated gullies as found within the range crossings within the pipeline alignment. The proposed activities are unlikely to significantly impact this species as infrastructure development will not occur within core habitat and vegetation clearing will be kept to a minimum.

Squatter Pigeon (Geophaps scripta scripta)

Populations in the Curtis Coast area represent the southern sub-species of the squatter pigeon. It is distributed through inland areas from northern NSW to the Burdekin region of Queensland. It occurs patchily, mainly in grassy eucalypt woodland and gravel ridge habitats. The species has declined

significantly in the southern parts of its range (NSW), but appears to be stable in Queensland. Identified threats include cattle grazing and predation by foxes (Garnett & Crowley 2000).

Individuals were observed at various locations along the gas transmission pipeline route on the mainland and at various locations in the CSG Fields. It is anticipated that the squatter pigeon will be present in all of the CSG fields and that suitable habitat is present in many areas along the gas transmission pipeline route. Evidence suggests that this species has adapted to disturbed habitats. Potential impacts from the construction of the gas transmission pipeline and other project components are likely to be low due to the abundance of alternative suitable habitat in the region.

Swift parrot (Lathamus discolour)

This species Inhabits forests and woodlands with flowering trees and is often found in association with lorikeets (Morcombe 2004). It breeds only in Tasmania but overwinters on the mainland. In Qld, the Swift parrot prefers *Eucalyptus crebra* and *E. tereticornis* woodlands (DEWHA, 2008c) and may occasionally utilise woodlands in the area depending upon food availability in southern states. The gas transmission pipeline and CSG fields are at the northern extent of the range of this species. Potential impacts are considered to be low due to the availability of suitable habitat elsewhere and likely low utilisation of vegetation communities within the project's footprint

Black-throated finch (Peophila cincta cincta)

There is a slight chance that this species may be present in small areas of suitable habitat along the pipeline. Potential impacts from construction of the proposed gas transmission pipeline and other project infrastructure are considered low due to the low probability of overlap with actively used habitat.

Star Finch (eastern and southern) (Neochmia ruficauda ruficauda)

There is a very slight chance that this species is present within the project footprint. Potential impacts to this species are considered to be very low due to the low probability of overlap with actively used habitat .

Australian painted snipe (Rostratula australis)

This species may be an occasional visitor to the MOF, PLF and dredge material placement facility site, potential bridge, road and service corridor and may use suitable habitat within the CSG Fields and along the gas transmission pipeline. Potential impacts are likely to be low due to the nomadic nature of the species and minimal overlap of project infrastructure with suitable habitat.

7.1.3.2 Mammals

Large-eared pied bat, Large pied bat (Chalinolobus dwyeri)

This species may be found within areas containing suitable roost habitat along the gas transmission pipeline route and within the CSG Fields. Potential impacts to this species are considered to be low due to planning of the pipeline alignment and CSG facilities to avoid areas of suitable habitat.

Grey-headed flying fox (Pteropus poliocephalus)

Australia's second-largest bat, this species feeds on blossoms, fruit and leaves of many plants. It is an important pollinator and disperser of seed. It is considered that this species may be present on the coastal fringe near Gladstone however potential impacts are considered to a lack of preferred roost habitat affected by the gas transmission pipeline.

Semon's leaf-nosed bat, greater wart-nosed horseshoe-bat (Hipposideros semoni)

Semon's Leaf-nosed Bat is found in tropical rainforest, monsoon forest, wet sclerophyll forest and open savannah woodland. It utilises tree hollows, deserted buildings in rainforest, road culverts and shallow caves amongst granite boulders or in fissures (DEWHA, 2008e).Removal of arboreal hollows along the

proposed gas transmission pipeline route may potentially impact this species in localised areas. However, given the marginal nature of habitat types within the study areas, it is ulikely that significant impacts will occur.

Eastern long-eared Bat (South-eastern form) (Nyctophilus timoriensis)

This species inhabits *Eucalyptus* and *Acacia* woodlands featuring suitable roost sites such as tree hollows. The gas transmission pipeline may traverse suitable habitat for the species however potential impacts to this species are considered to be negligible due to the general paucity of mature hollow-bearing trees within the gas transmission pipeline corridor and alternative suitable habitat in the region. Suitable habitat may also be present within CSG field.. Phase 2 scouting prior to CSG Field development will minimise potential for impacts to the species.

Northern Quoll (Dasyurus hallucatus)

The northern quoll is found in the savannas of northern Australia. Populations of this quoll have declined across much of its former range, with cane toads thought to be a major factor. They utilise a range of habitats, with rocky areas and eucalypt forests preferred (DEH 2005).Considering the habitat alteration and disturbance to the proposed LNG facility site, there is a low probability that the northern quoll is present at this site on Curtis Island. It is also unlikely to be present along the gas transmission pipeline given the disturbed nature of most habitats surveyed. There may be possible occurrence in suitable habitat within the CSG Fields. However CSG facilities will not be developed in or adjacent to core quoll habitat.

Humpback whale (Megaptera novaeangliae)

No reports of humpack whale sightings or strandings in Gladstone harbour could be found (National Whale and Dolphin Sightings and Strandings Database – DEWHA). While humpbacks are known to occur in the region, they are not known to enter Port Curtis. It is thus concluded that potential impacts from the proposed MOF, PLF and dredge material placement facility are considered to be negligible. Increased shipping from the operation and construction of the LNG facility is not expected to potentially impact humpback whales as they have not been sighted within Port Curtis. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.

Water Mouse (false water rat) (Xeromys myoides)

There is a low probability of the water mouse being present within or adjacent to the proposed LNG facility site, potential bridge, road and service corridor and it is unlikely that this species is present on the mainland coast near Gladstone due to industrial and recreational impacts. It is recommended that prior to construction activities on Curtis Island, further assessment of the presence or absence of the species be undertaken. Given current knowledge of the sites, it is expected that potential impacts to the species will be low. If it is determined there are species present in the areas to be disturbed from construction of the GLNG project, suitable management of the area is to be negotiated with the relevant government agencies.

7.1.3.3 Reptiles

Brigalow scaly-foot (Paradelma orientalis)

This species has been recorded from Boyne Island. It is considered that its presence is unlikely within LNG project areas on Curtis Island due to habitat disturbance, lack of micro-habitat features, lack of its preferred brigalow habitat and the presence of feral predators. LNG facility

There is suitable habitat present within the gas transmission pipeline corridor and the CSG Field.However, given the disturbed nature of much of the gas transmission pipeline corridor its presence is unlikely, Scouting for the species within suitable habitat will be undertaken prior to development of the CSG Fields. Given suitable planning it is not expected that this species will be impacted by the proposal.

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Ornamental snake (Denisonia maculata)

This species occurs in brigalow (*Acacia harpophylla*) woodland growing on clay and sandy soils, riverine woodland, and open forest growing on natural levees and shows a preference for moist areas. It is known only to occur within the Brigalow Belt (DEWHA 2008h). Suitable habitat may be present within the gas transmission pipeline corridor and CSG Fields..Selection of the gas transmission pipeline has been undertaken to minimise impacts to sensitive habitat. Phase 2 scouting for the species within suitable habitat will be undertaken prior to CSG Field development to mimise potential impacts to this species.

Dunmall's snake (Furina dunmalli)

Preferred habitat for this species is brigalow (*Acacia harpophylla*) forest and woodland growing on cracking black clay and clay loam soils, indicating a preference for moist areas. It is currently only known as occurring in the Brigalow Belt area (DEWHA 2008h). There is suitable habitat present within gas transmission pipeline corridor and CSG Fields..Selection of the gas transmission pipeline has been undertaken to minimise impacts to sensitive habitat. Phase 2 scouting for the species within suitable habitat will be undertaken prior to CSG Field development. Given suitable planning it is not expected that this species will be impacted by the proposal.

Collared delma (Delma torquata)

This species occurs on rocky hillsides on basalt and lateritic soils supporting open *Eucalyptus* and *Acacia* woodland with a sparse understorey of shrubs and tussocks or semi-evergreen vine thicket (Cogger et al. 1993; Davidson 1993; Porter 1998). Suitable habitat is present within CSG field. Phase 2 scouting for the species within suitable habitat will be undertaken prior to development of CSG facilities. Given suitable planning it is not expected that this species will be impacted by the proposal.

Yakka skink (Egernia rugosa)

This species is usually found in open dry sclerophyll forest or woodland, often taking refuge among dense ground vegetation, hollow logs, and cavities in soil-bound root systems of fallen trees and beneath rocks. Alternatively, skinks may also excavate burrow systems among low vegetation. It has been collected previously from the Arcadia Valley, Banana and near Biloela (DEWHA 2008f). Suitable habitat is present within the gas transmission pipeline corridor and CSG Fields..Selection of the gas transmission pipeline route has been undertaken to minimise impacts to sensitive habitat. Phase 2 scouting for the species within suitable habitat will be undertaken prior to CSG Field development.Given suitable planning it is not expected that this species will be impacted by the proposal.

Fitzroy tortoise (Rheodytes leukops)

This species is found only in the drainage of the Fitzroy River, Qld, in rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity, and are often associated with *Vallisneria* spp. beds. Common riparian vegetation includes *Eucalyptus tereticornis*, *Casuarina cunninghamiana*, *Callistemon viminalis* and *Melaleuca linariifolia*. It is thought that the turtles have an affinity for well-oxygenated riffle zones, moving into deeper pools as the riffle zones cease to flow. Potential impacts to this species are considered unlikely due to a lack of preferred habitat within the gas transmission pipeline corridor or the CSG Fields.

Flatback turtle (Natator depressus)

The flatback turtle is restricted to tropical waters of northern Australia, PNG and Irian Jaya (Spring 1982; Zangerl *et al.* 1988); one of only two species of sea turtle without a global distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007), with occasional nesting by green and loggerhead turtles (Limpus 1999). The flatback turtle population utilising these beaches for nesting has remained constant at approximately 50 females annually throughout the 35 years that monitoring has been conducted (Limpus et al. 2006). Flatback turtle nesting commences in mid October, reaches a peak in late

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November – early December and ceases by about late January. Hatchlings emerge from nests between early December and late March, with a peak in February (Limpus 2007). Juvenile flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.

The impacts to nesting populations of flatback turtles from construction of the MOF, PLF, dredge material placement facility and potential bridge, road and services corridor is considered to be low as these activities are within Port Curtis and away from the ocean beaches. Potential impacts from the operational phase of the LNG facility through increased lighting caused by gas flaring for maintenance purposes will be mitigated using measures such as avoiding flaring at night and avoiding flaring during turtle nesting season, where practicable. Emergency flaring may however occur at any time.

Flatback turtles are also known to occur within the outer harbour of Port Curtis and move north through The Narrows (QDEH 1994), possibly feeding on hydroids, soft corals and other marine invertebrates found within the Port.

The implementation of mitigation measures to avoid potential impacts from capital dredging works, trenching and piling works include:

- minimising the dredging footprint to reduce impacts to subtidal communities found at Hamilton Point;
- the use of silt curtains to contain turbid plumes resulting from dredging and trenching activities;
- timing dredging activities to avoid neap tides where practicable to reduce the time and extent that sediment plumes occur within Port Curtis as a result of dredging and trenching activities;
- maintaining constant watch while underway;
- reducing boat speed;
- reducing dredge pump speed;
- ceasing work if interactions are considered probable;
- employing turtle exclusion devices on dredging equipment where practicable; and
- adherence to reporting requirements for any interactions with flatback turtles that may occur.

Potential impacts to flatback turtles through ferry and barge operations to transport materials, equipment and staff within the port during the construction phase of the LNG facility, MOF, PLF and dredge material placement facility will be mitigated through selected measures addressed in the above points.

LNG carriers will use existing shipping channels in the GBRWHA minimising any increased potential impacts from increased shipping activities as part of the operation phase of the LNG facility.

Green Turtle (Chelonia mydas)

Green turtles are known to nest occasionally on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds green turtles mainly eat seagrass and seaweed as well as mangrove fruit, jellyfish and sponges. The southern GBR stock of green turtles is reported to be large by global standards and the population of breeding females has not shown signs of decline at the nesting beaches over the past four decades.

Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact to nesting behaviour of this species from the proposed construction of the PLF, MOF and dredge material placement facility are considered negligible. Potential impacts from the operational phase of the LNG facility through increased lighting caused by gas flaring for maintenance purposes will be mitigated using measures such as avoiding flaring at night and avoiding flaring during turtle nesting season, where practicable. Emergency flaring may however occur at any time.

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The implementation of mitigation measures to avoid potential impacts from capital dredging works, trenching and piling works include:

- Minimising the dredging footprint to reduce impacts to subtidal communities found at Hamilton Point;
- The use of silt curtains to contain turbid plumes resulting from dredging and trenching activities;
- Timing dredging activities to avoid neap tides where practicable to reduce the time and extent that sediment plumes occur within Port Curtis as a result of dredging and trenching activities;
- Maintaining constant watch while underway;
- Reducing boat speed;
- Reducing dredge pump speed;
- Ceasing work if interactions are considered probable;
- Employing turtle exclusion devices on dredging equipment where practicable; and
- Adherence to reporting requirements for any interactions with flatback turtles that may occur.

Increased vessel operations for transporting materials, equipment and staff will be mitigated selected measures listed above. Potential impacts from trenching the marine crossing of the gas transmission pipeline may be likely although previous interactions with green turtles have been reported as resulting from fishing activities The Qld EPA maintains a database that records of interactions with these species.

Loggerhead Turtle (Caretta caretta)

Adult loggerhead turtles feed on a variety of invertebrate animals, such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean although showing decline by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994). It is reported that no interbreeding occurs between populations. It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database).Occasional nesting of loggerhead turtles occurs on the ocean side of southern Curtis Island and Facing Island. It is considered that the impact to nesting behaviour of this species from the proposed construction of the LNG facility, PLF, MOF and dredge material placement facility are considered to be negligible. Potential impacts from the operational phase of the LNG facility through increased lighting caused by gas flaring for maintenance purposes will be mitigated using measures such as avoiding flaring at night and avoiding flaring during turtle nesting season, where practicable. Emergency flaring may however occur at any time.

Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Potential interactions with loggerhead turtles during trenching of the marine crossing component of the gas transmission pipeline are possible. Mitigation measures to avoid interactions with this species from trenching activities include maintaining watch, interactions, ceasing work if interactions are considered probable and reporting any interactions that may occur. The use of silt curtains and timing works in accordance with the appropriate tidal cycle and will ensure that potential impacts are mitigated.

Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch. With the implementation of mitigation measures to avoid potential impacts to this species from capital dredging works, such as the use of silt curtains, timing of dredging with the tidal cycle and turtle exclusion devices for dredging equipment, interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur.

7.1.3.4 Fish

Whale shark (Rhincodon typus)

The whale shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis. Increased ferry and barge activities from the operation and construction of the LNG facility is not expected to potentially impact them as they have not been sighted within Port Curtis. It is unlikely that they enter Port Curtis as whale sharks prefer offshore clearer waters to turbid estuarine waters. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impacts to this species.

The Murray Cod (Maccullochella peelii peelii)

The Murray cod has a widespread distribution and may occur in larger permanent waterholes in suitable habitat along the gas transmission pipeline and CSG Fields. Due to its widespread distribution, potential impacts are considered to be low.

7.1.4 Threatened Flora Communities

Littoral Rainforest and Coastal Vine Thicket of Eastern Australia

It is proposed that 0.4 ha of this community will be cleared with the construction of the MOF haul road on Curtis Island. Approximately 1,562 ha of this RE is present within the Burnett-Curtis Hills sub-region (Accad *et al.*, 2006). This proposed disturbance represents 0.03 % of the known extent of this community within the sub-region. This relatively small area is not expected to have a significant impact upon the community at a regional scale. Where practicable, potential impacts to this community will be reduced by minimising vegetation clearance.

Semi-evergreen vine thicket of the Brigalow Belt (North and South) and Nandewar Bioregions

This community is present within the gas transmission pipeline corridor and portions of the CSG Fields. Areas of this ecological community within the CSG field will be identified as part of Phase 2 pre-construction surveys prior to development of the field and areas will be retained where practicable. Selection of the gas transmission pipeline route has been undertaken to minimise impacts to sensitive habitat. Due to appropriate planning, potential impacts to this community are considered to be low.

Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin

This community will not be affected by the gas transmission pipeline or the development of the CSG Fields.

Brigalow (Acacia harpophylla dominant and co-dominant)

This community is present within the gas transmission pipeline corridor and the CSG Fields. Preliminary route selection of the gas transmission pipeline has sought to avoid significant vegetation communities and it is anticipated that impacts will be minor. Areas of this ecological community within the CSG Fields will be identified as part of Phase 2 pre-construction surveys and will be retained where practicable, minimising potential impacts to this community.

White box-yellow box-Blakely's red gum grassy woodland and derived native grassland ***This*** ecological community was not recorded from the CSG fields and gas transmission pipeline corridor and is considered unlikely to be present.

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7.1.5 Threatened Flora Species

The following EPBC listed threatened plant species have been identified from desktop studies as being potentially present within components of the GLNG project.

Cycas megacarpa is scattered and localised on clay-loam soils over several substrates, usually on sloping country in wet eucalypt forests or rainforests. This species distribution occurs between near Mount Morgan to near Goomeri in Qld. *Cycas megacarpa* was recorded from several locations within the Callide and Calliope Ranges. It is anticipated that the gas transmission pipeline corridor avoids the core populations of this species within the ranges, and intersects the margins of the populations where plant densities are lower. Some individuals are likely to require translocation however potential impacts are considered to be low. This species is likely to be present within CSG Fields, however the proposed actions are not expected to impact on the presence of this species at this location.

Cadellia pentastylis is known to occur within the gas transmission pipeline route. It is considered unlikely that any individuals will be cleared during construction of the gas transmission pipeline and potential impacts to this species are not anticipated. Although suitable habitat for this species to occur is present within the CSG Fields, potential impacts are not expected.

Aristida annua is restricted to a small area of central Queensland growing on black earth and basalt soils and flowering in March and fruiting between May and June. Suitable habitat is present within the CSG field however it is considered that potential impacts will not occur to this species.

Dichanthium queenslandicum is endemic to Queensland where it occurs mostly on black clay soils around Emerald and more rarely on the Darling Downs. Suitable habitat is present within the CSG field, however it is anticipated that potential impacts will not occur to this species.

Dichanthium setosum is an upright bluegrass less than 1 m tall, associated with heavy basaltic black soils. Suitable habitat is present within the CSG field, however it is anticipated that potential impacts will not occur to this species.

Homoranthus decumbens is found in two isolated locations in south-west and central-west Qld. Suitable habitat is present within the CSG field, however it is anticipated that potential impacts will not occur to this species.

Macrozamia fearnsidei is widely scattered on sandy soil over sandstone in the ranges north and east of Injune. This species likely to be present within the CSG field. However, it is anticipated that potential impacts will not occur to this species.

Rhaphidospora bonneyana is a shrub that grows to 40 cm high and is glabrous or hairy. This species grows in gullies or on rocky mesas in the ranges. Suitable habitat is present within the CSG field, however it is anticipated that potential impacts will not occur to this species.

Tylophora linearis grows in dry scrub and open forest near Glenmorgan in the western Darling Downs. It has been recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa*, *Callitris glaucophylla* and *Allocasuarina luehmannii*. Suitable habitat is present within the CSG field, however it is anticipated that potential impacts will not occur to this species.

Westringia parvifolia*:* is a spreading shrub 0.3 - 1.5 m high growing in mallee, woodland and dry sclerophyll forest, on sandy soils or in deep gravel-rich sands. Suitable habitat is present within the CSG field, however it is anticipated that potential impacts will not occur to this species.

Xerothamnella herbacea grows mainly in shady areas under brigalow trees. Suitable habitat is present within the CSG field, however it is anticipated that potential impacts will not occur to this species.

Section 7 Summary of Findings

7.1.6 Listed Migratory Species

7.1.6.1 Birds

Of the 22 wader and shorebird species identified near the proposed LNG facility, eleven are considered migratory species under the EPBC Act. Foraging behaviour of migratory bird species such as eastern curlew (*Numenius madagascariensis*), whimbrel (*Numenius phaeopus*) and eastern reef egret (*Egretta sacra*) were observed adjacent to the LNG facility area in low numbers, compared to a high abundance and diversity of wader bird species observed foraging on sand/mudflats at low tide on the south-east of the island adjacent to the township of South End, approximately 9 km to the east of the LNG facility area. The Gladstone Port and associated operations have, over time, resulted in increased threatening processes such as water and noise pollution. The significance of the habitats for wader birds within the project area is relatively low when compared to other marine/wader habitats in Queensland (e.g. the Great Sandy Straight and Moreton Bay). Potential impact on wader bird habitat or migratory wader species is considered to be low, however, detailed environmental planning for the proposed works and operational phase will be developed.

The LNG facility study area does not act as core habitat for migratory birds listed as occurring in the area, as similar vegetation communities and topography is found elsewhere in the region. Similarly, those wetland migratory species that favour freshwater wetland habitats are unlikely to be reliant on the two small water bodies present in the study area. The three listed migratory marine species reliant on marine wetlands are Latham's snipe (*Gallinago hardwickii*), little curlew (*Numenius minutus*) and little tern (*Sterna albifrons*).

Rainbow Bee-eater (Merops ornatus)

The rainbow bee-eater was sighted on the hinterland margins of Curtis Island during the intertidal survey in June 2008. Potential impacts to this species are expected to be minimal from removal of the vegetation at the hinterland margin with the development of the LNG facility as it does not represent core habitat. There are no suitable sites for nesting at the LNG facility site. Minor impacts to this species may occur from removal of the vegetation at the hinterland margin with the development of haul road for the MOF. However, this area does not represent core habitat for this species and there is considerable alternative suitable habitat available in other areas within the region.

Rufous Fantail (Rhipidura rufifrons)

Suitable habitat for rufoue fantail includes vine thicket as found at the potential haul road for the MOF on Curtis Island. Although no individuals were sighted during field surveys, potential impacts may occur due to loss of this habitat. Significant impacts are however, not anticipated as this vine thicket does not represent core habitat for the species and alternative suitable habitat is abundant elsewhere.

Little Tern (Sterna albifrons)

Impacts to the the little tern are considered negligible due to the south-western coast of Curtis Island acting as minor habitat. Little Terns are extremely sensitive to disturbance and it is unlikely that they will utilise Port Curtis as a significant feeding resourceLNG facility.

Black-faced Monarch (Monarcha melanopsis)

The black-faced monarch occurs in rainforests, mangroves and eucalypt woodlands. It migrates from north Queensland to south-east Australia and possibly utilises the area. This species will not be impacted by the proposed activities as the site of the LNG Facility and other components do not act as core habitat.

Spectacled Monarch (Monarcha trivirgatus)

The spectacled monarch usually occurs in rainforests, mangroves occasionally moist dense wet eucalypt gullies and possibly utilises the area. This species will not be impacted by the proposed activities as the site of the LNG facility does not act as core habitat.

Satin Flycatcher (Myiagra cyanoleuca)

The satin flycatcher migrates between north Qld and south-east Australia. It was recorded from the south-western coast of Curtis Island. This species will not be impacted by the proposed activities as the site of the LNG facility does not act as core habitat.

Rufous Fantail (Rhipidura rufifrons)

The rufous fantail migrates between north Qld and south-east Australia. It favours moist gullies or semi-evergreen vine thickets and possibly utilises the area. Potential impacts to this species are expected to be minimal from the proposed LNG facility and other components of the project on Curtis Island as it does not act as core habitat.

Great Egret, White Egret (Ardea alba)

This species occurs throughout most of the world and is common throughout Australia (Birds Australia). This species was sighted on low tidal mud flats within Port Curtis during the intertidal survey in June 2008. Potential impacts to this species may occur from some loss of low tidal mudflats in China Bay resulting from the construction and operation of the PLF, MOF and dredge material placement facility and at Friend Point and Laird Point resulting from the construction the bridge, road and services corridor.. The extent of mudflats dominating the lower intertidal habitats within Port Curtis provide suitable alternative habitat for this species and impacts are likely to be negligible.

White-bellied Sea Eagle (Haliaeetus leucogaster)

The white-bellied sea eagle is commonly found in coastal and near coastal areas of Australia and was sighted on low tidal mud flats, mangroves and rocky foreshore habitat of Curtis Island during field surveys conducted in 2008. Potential impacts to this species from the construction of the MOF, PLF and dredge material placement facility may occur through some loss of mangrove and intertidal habitat for the haul road for, and construction of the PLF and MOF. The extent of mangrove loss is anticipated to be minimal. Some loss of low tidal mud flats will occur within China Bay. It is considered that the impacts will not be significant due to the availability of suitable habitat regionally.

Potential impacts to this species from the construction of the bridge, road and services corridor may occur through some loss of mangrove, saltmarsh and intertidal habitat at the bridge abutments on Friend Point and Laird Point and along the mainland section of the road proposed on tidal land on the mainland. The extent of mangrove loss is anticipated to be minimal; however some loss of saltmarsh and intertidal habitat will occur adjacent to the seagrass beds north of Fisherman's Landing. It is considered that the impacts to this species birds will not be significant due to the availability of suitable habitat within Port Curtis.

7.1.6.2 Mammals

Dugong (Dugong dugon)

The Dugong is a benthic feeder usually occurring in turbid waters of shallow coastal areas and is considered particularly vulnerable to human impacts (Hodgson 2004). The Port of Gladstone region is wholly within the Rodd's Bay Dugong Protection Area. There are significant seagrass meadows within the port and dugongs are known to occur within the port. Seagrass is a major contributor to dugong and sea turtle diets (Rasheed *et al*, 2003). Although dugong and sea turtle frequent the area the grazing potential of Port Curtis has not yet been quantified (Rasheed *et al*, 2003). Seagrass meadows of

extensive area and biomass are located within the port approximately 10 km to the southeast at Pelican Banks and at Targinie Banks.

Dugong feeding activity has been observed on the majority of intertidal seagrass meadows in Port Curtis surveyed during the 2007 DPI&F long term monitoring program (Rasheed et. al., 2008). The highest density of dugong feeding trails was observed at the *Zostera capricorni/Halophila ovalis* meadow at Wiggins Island with feeding trails recorded at 58% of sampling sites. Dugong feeding trails were also recorded at Pelican Banks and the intertidal meadows to the north and south of Fishermans Landing (Rasheed et. al., 2008). During monitoring studies conducted by DPI&F, seagrass meadows north of Fisherman's Landing were observed to be ephemeral and patchy. This was confirmed during the 2008 seagrass assessment.

Due to the distance of seagrass meadows north of Fisherman's Landing from the LNG facility it is considered unlikely that potential impacts would occur to seagrass meadows from construction of the LNG facility and dredging of the MOF and PLF. However, these meadows are likely to be impacted by trenching the gas transmission pipeline, bridge piling work and construction of the bridge abutments. Potential impacts from trenching the gas transmission pipeline, bridge piling work and construction of the bridge abutments include increased sedimentation and turbidity. As stated previously, dugong feeding trails have been reported on the meadows north of Fishermans Landing and changes to foraging behaviour of dugong may result during the construction phases of the potential bridge and gas transmission pipeline. Implementation of mitigation measures such as using silt curtains, timing activities to avoid neap tide periods and minimising the footprint of the bridge abutments can reduce potential impacts from elevated turbidity that cause decreased light penetration and smothering of seagrass.

Previous studies on seagrass following increased sedimentation have indicated large scale seagrass mortality (Preen *et al*, 1995) with resulting migration and mortalities of dugong (Preen and Marsh, 1995). Dugongs also eat marine algae and invertebrates such as ascidians but this is believed to occur only when seagrass is scarce (Preen, 1995). Due to the ephemeral and patchy nature of the seagrass meadows to the north of Fisherman's Landing, it is considered that potential impacts to the resident dugong population resulting from short term impacts to this seagrass meadow will be minimal.

The GBRMPA Position Statement on conservation of dugongs in the Great Barrier Reef Marine Park (GBRMPA 2007) lists boating activity as one of the key pressures of greatest relevance to dugong populations in the Marine Park. Through observations of the response of dugong to passing boats, Hodgson (2004) concluded that the speed of an approaching boat determines the time dugong have to avoid being hit and that speed is the main factor affecting the risk of boat strike. Potential impacts to dugong may occur from increased numbers of ferry's and barges used to transport materials, equipment and staff during the construction phase of the LNG facility, MOF, PLF and dredge material placement facility. This will extend into the operational phase if the "no bridge" option is adopted. Potential impacts from boat strike will be mitigated through maintaining constant watch and reducing vessel speed if interactions are likely. All interactions will be reported to the EPA. Mitigation measures to avoid interactions with dugong will be developed and implemented through a Dredge Management Plan for all capital dredging works and Construction EMPS' for the potential bridge and Operational EMP's for the LNG facility.

Irrawaddy Dolphins (Orcaella brevirostris)

It is now thought that previous reports of Irrawaddy dolphins (*Orcaella brevirostris*) in Australia have been misidentifications of the Snubfin dolphin (*Orcaella heinsohni*) (Beasley et al. 2005). The information below should be considered in this light.

Irrawaddy dolphins occur from Broome in Western Australia, along the northern coastline near Darwin and the Gulf of Carpentaria, and off the east coast as far south as the Brisbane River. Irrawaddy dolphins are typically associated with shallow, coastal and estuarine waters, with most sightings recorded within 10 km of the coast, in waters less than 10 m deep, and within 10 km of a river mouth (Parra 2005 – PhD thesis). Since 1968, there have been 36 reported strandings of Irrawaddy dolphins in Queensland, all from around the Townsville region. There have been no reported sightings or strandings from the Gladstone region (National Whale and Dolphin Sightings and Strandings Database – DEWHA). Parra

(2005) reports additional strandings, including one from Bundaberg in 1994 and one from the Brisbane River in 1997. Although it is likely that Irrawaddy dolphins do utilise the Port of Gladstone region, the limited number of sightings would indicate that the area is not a significant habitat for them. Potential impacts to this species may occur from increased numbers of ferrys and barges during the construction phase of the LNG facility, that will extend into the operational phase if the "no bridge" option is adopted. Potential impacts from boat strike will be mitigated through and maintaining constant watch and reduced vessel speed where practicable.

Increased shipping from the operation and construction of the LNG facility is not expected to potentially impact this species. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.

Indo-Pacific Humpback Dolphin (Sousa chinensis)

Although *Sousa chinensis* and *Orcaella heinsohni* are known to occur within the region, it would appear that boat strike and entanglement in fishing gear and the QDPI&F Shark Control nets pose the greatest threats. Although it is possible that the Indo-Pacific humpback dolphin do utilise the Port of Gladstone region, the lack of any sightings would indicate that the area is not a significant habitat for them. Potential impacts to this species may occur from increased numbers of ferry's and barges during the construction phase of the LNG facility, MOF, PLF and dredge material placement facility. This will extend into the operational phase if the "no bridge" option is adopted. Potential impacts from boat strike will be mitigated through and maintaining constant watch and reduced vessel speed where practicable.

Increased shipping from the operation and construction of the LNG facility is not expected to potentially impact this species. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.

The Queensland EPA reported interactions with an Indo-Pacific humpback dolphin (*Sousa chinensis*) at the mouth of the Calliope River, another at Fisherman's Landing and another on the seaward beach of Facing Island in 2005. Interactions with the Indo-Pacific humpback dolphin were recorded on Facing Island with net/rope marks on its body. Seven turtles, one dugong and 30 large fish were also reported. In 2003, and again in 2004, interactions with an Indo-Pacific humpback dolphin were recorded at the mouth of the Calliope River and another on Facing Island. Interactions with a snubfin dolphin (*Orcaella heinsohni*) were recorded at Sea Hill Beach, Curtis Island on 9 August 2007. Although *Sousa chinensis* and *Orcaella heinsohni* are known to occur within the region, it would appear that boat strike and entanglement in fishing gear and the QDPI&F Shark Control nets pose the greatest threats (EPA 2004, 2005, 2006, 2008).

Humpback Whale (Megaptera novaeangliae)

Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. The majority of humpbacks in Australian waters migrate north to tropical calving grounds in the Great Barrier Reef complex between approximately 14°S and 27°S from June to August, and south to the Southern Ocean feeding areas from September to November. Gladstone Harbour is not known as an important migration route. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. It is estimated that when the Australian east coast whaling industry ended in 1963, the east coast population of humpbacks had been reduced to a little over 100 individuals. This population has shown steady recovery of around 10 –11% a year, and in 2006 was estimated at around 8000 (SPRAT Database).

Gladstone Harbour is not known as part of an important migration route for cetaceans. Important resting areas include the Whitsundays, Hervey Bay, Moreton Bay, the Swain Reefs complex Great Barrier Reef, Bell Cay, and the Palm Island Group. No reports of humpback whale sightings or strandings in Gladstone Harbour could be found on the National Whale and Dolphin Sightings and Strandings Online Database – DEWHA. However, a dead humpback calf was recorded washed ashore on the seaward beach at Curtis Island in 2007 (EPA 2008). While humpbacks are known to occur in the region, they are not known to enter Port Curtis. It is thus concluded that potential impacts from GLNG project within Port Curtis are

unlikely to occur. Further, it is unlikely that humpbacks breed in Port Curtis. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.

Killer whale (Orcinus orca)

The killer whale is found in all oceans and seas of the world usually in family groups. They occur in most habitat types from coastal areas to the deep ocean waters, from the tropics to polar regions, although most sightings are in temperate waters. The killer whale has never been the target of serious commercial hunting so the species worldwide is secure. Killer whales have not been reported from within Port Curtis and it is unlikely to be found within Port Curtis. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impact on this species.

7.1.6.3 Reptiles

Flatback Turtle (Natator depressus)

Flatback turtles are restricted to tropical waters of northern Australia, PNG and Irian Jaya (Spring 1982; Zangerl *et al.* 1988); one of only two species of sea turtle without a global distribution. The beaches on the ocean side of southern Curtis Island and Facing Island supports an important, intermediate breeding population of flatback turtles (Limpus 2007), with occasional nesting by green and loggerhead turtles (Limpus 1999). The flatback turtle population utilising these beaches for nesting has remained constant at approximately 50 females annually throughout the 35 years that monitoring has been conducted (Limpus et al. 2006). Flatback turtle nesting commences in mid October, reaches a peak in late November – early December and ceases by about late January. Hatchlings emerge from nests between early December and late March, with a peak in February (Limpus 2007). Juvenile flatback turtles eat shellfish, squid and jellyfish. Adult flatback turtles are known to forage soft-bottom habitats and eat cuttlefish, hydroids, soft corals, crinoids, shellfish and jellyfish.

The impacts to nesting populations of flatback turtles from construction of the MOF, PLF, dredge material placement facility and potential bridge, road and services corridor is considered to be low as these activities are within Port Curtis and away from the ocean beaches. Potential impacts from the operational phase of the LNG facility through increased lighting caused by gas flaring for maintenance purposes will be mitigated using measures such as avoiding flaring at night and avoiding flaring during turtle nesting season, where practicable. Emergency flaring may however occur at any time.

Flatback turtles are also known to occur within the outer harbour of Port Curtis and move north through The Narrows (QDEH 1994), possibly feeding on hydroids, soft corals and other marine invertebrates found within the Port.

The implementation of mitigation measures to avoid potential impacts from capital dredging works, trenching and piling works include:

- Minimising the dredging footprint to reduce impacts to subtidal communities found at Hamilton Point;
- The use of silt curtains to contain turbid plumes resulting from dredging and trenching activities;
- Timing dredging activities to avoid neap tides where practicable to reduce the time and extent that sediment plumes occur within Port Curtis as a result of dredging and trenching activities;
- Maintaining constant watch while underway;
- Reducing boat speed;
- Reducing dredge pump speed;
- Ceasing work if interactions are considered probable;
- Employing turtle exclusion devices on dredging equipment where practicable; and
- Adherence to reporting requirements for any interactions with flatback turtles that may occur.

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Potential impacts to flatback turtles through ferry and barge operations to transport materials, equipment and staff within the port during the construction phase of the LNG facility, MOF, PLF and dredge material placement facility will be mitigated through selected measures addressed in the above points.

LNG carriers will use existing shipping channels in the GBRWHA minimising any increased potential impacts from increased shipping activities as part of the operation phase of the LNG facility.

Green Turtle (Chelonia mydas)

Green turtles are known to nest occasionally on the ocean side of southern Curtis Island and Facing Island (Limpus, 1999). Green turtles feed on small marine animals when they are young, but once they move to their adult foraging grounds green turtles mainly eat seagrass and seaweed as well as mangrove fruit, jellyfish and sponges. The southern GBR stock of green turtles is reported to be large by global standards and the population of breeding females has not shown signs of decline at the nesting beaches over the past four decades.

Due to the location of occasional nesting on the ocean side of southern Curtis Island and Facing Island, the impact to nesting behaviour of this species from the proposed construction of the PLF, MOF and dredge material placement facility are considered negligible. Potential impacts from the operational phase of the LNG facility through increased lighting caused by gas flaring for maintenance purposes will be mitigated using measures such as avoiding flaring at night and avoiding flaring during turtle nesting season, where practicable. Emergency flaring may however occur at any time.

The implementation of mitigation measures to avoid potential impacts from capital dredging works, trenching and piling works include:

- minimising the dredging footprint to reduce impacts to subtidal communities found at Hamilton Point;
- the use of silt curtains to contain turbid plumes resulting from dredging and trenching activities;
- timing dredging activities to avoid neap tides where practicable to reduce the time and extent that sediment plumes occur within Port Curtis as a result of dredging and trenching activities;
- maintaining constant watch while underway;
- reducing boat speed;
- reducing dredge pump speed;
- ceasing work if interactions are considered probable;
- employing turtle exclusion devices on dredging equipment where practicable; and
- adherence to reporting requirements for any interactions with flatback turtles that may occur.

Increased vessel operations for transporting materials, equipment and staff will be mitigated selected measures listed above. Potential impacts from trenching the marine crossing of the gas transmission pipeline may be likely although previous interactions with green turtles have been reported as resulting from fishing activities The Qld EPA maintains a database that records of interactions with these species.

Loggerhead Turtle (Caretta caretta)

Adult loggerhead turtles feed on a variety of invertebrate animals, such as crabs, shellfish, starfish, and sea cucumbers living on the sea floor. They can burrow into the soft sea floor to find their food. The eastern Australian population is the most significant in the southern Pacific Ocean although showing decline by an estimated 50 - 80 % in the last 10 to 15 years (Limpus & Reimer 1994). It is reported that no interbreeding occurs between populations. It is estimated that approximately 1,000 individuals nest each season in Queensland (Limpus & Reimer 1994) (SPRAT Database).Occasional nesting of loggerhead turtles occurs on the ocean side of southern Curtis Island and Facing Island. It is considered that the impact to nesting behaviour of this species from the proposed construction of the LNG facility,

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PLF, MOF and dredge material placement facility are considered to be negligible. Potential impacts from the operational phase of the LNG facility through increased lighting caused by gas flaring for maintenance purposes will be mitigated using measures such as avoiding flaring at night and avoiding flaring during turtle nesting season, where practicable. Emergency flaring may however occur at any time.

The loggerhead turtle has been impacted during previous dredging operations within Port Curtis, indicating that dredging operations may also directly impact turtles through interactions with the dredger and associated equipment. Mitigation measures to avoid such interactions will be included into the Dredge Management Plan for all dredging operations as part of the construction phase. During construction of the potential bridge, road and services corridor, interactions with marine turtles will be minimised through the implementation of mitigation measures such as the installation of turtle exclusion devices, reducing dredge pump speed and reducing boat speed.

Loggerhead turtles are known to occur within the outer harbour and to move north through The Narrows (QDEH 1994). Potential interactions with loggerhead turtles during trenching of the marine crossing component of the gas transmission pipeline are possible. Mitigation measures to avoid interactions with this species from trenching activities include maintaining watch, interactions, ceasing work if interactions are considered probable and reporting any interactions that may occur. The use of silt curtains and timing works in accordance with the appropriate tidal cycle and will ensure that potential impacts are mitigated.

Olive Ridley Turtle (Pacific Ridley) (Lepidochelys olivacea)

The olive Ridley turtle is classed as the most abundant of the sea turtles. However, in Malaysia the nesting population has declined to 20% in recent years. Many of the large Arribadas such as in Surinam have been reduced to several hundred individuals (Limpus 1995b) (SPRAT Database). Little is known about what hatchling olive Ridley turtles eat. Studies on adult olive Ridley turtles in Australia show that they mainly eat shellfish. Studies in other countries show that olive Ridley turtles also eat crabs, shrimps, jellyfish and algae.

While it is possible that olive ridley turtles occur in the Port Curtis region, no records could be found. Potential impacts from capital dredging for the MOF and PLF will be mitigated to avoid interactions. Mitigation measures will include turtle exclusion devices on dredging equipment, reduced dredge pump speed and adherence to all reporting requirements for interaction with marine fauna will also be employed.

Increased vessel operations for transporting materials, equipment and staff will be mitigated through reduced boat speeds and maintaining constant watch. With the implementation of mitigation measures to avoid potential impacts to this species from capital dredging works, such as the use of silt curtains and the use of turtle exclusion devices for dredging equipment, interactions will be kept to a minimum. Santos will adhere to all reporting requirements for any interactions that may occur.

LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impacts to this species.

Estuarine Crocodile (Saltwater Crocodile) (Crocodylus porosus)

The breeding populations of this species are reported not to occur south of the Tropic of Capricorn. Connell Hatch (2006) reported that saltwater crocodiles had been seen within the Calliope and Boyne Rivers prior to 2004, but there have been no reports of their sighting since that time. Port Curtis is not considered an important habitat for *C. porosus* and it is concluded that there is little likelihood of the proposed GLNG Project impacting this species.

Whale Shark (Rhincodon typus)

The whale shark is a pelagic species that occurs in continental shelf and offshore waters in both tropical and warm temperate waters of all oceans. They are uncommon in Queensland waters, and it is unlikely to occur within Port Curtis. Increased ferry and barge activities from the operation and construction of the LNG facility is not expected to potentially impact them as they have not been sighted within Port Curtis. It

is unlikely that they enter Port Curtis as whale sharks prefer offshore clearer waters to turbid estuarine waters. LNG carriers will use existing shipping lanes within the GBRWHA is therefore unlikely to increase potential impacts to this species.

7.2 Cumulative Impacts

7.2.1 Nature Conservation

Coal Seam Gas Field

Other CSG development projects planned for the surrounding region are up to 100 km from the GLNG Project CSG fields areas. Despite this, some of these projects may be within the GLNG Project future development area. There is limited information available as to the planned development of those projects or the quantity and timing of the development of the wells or associated infrastructure; however, a qualitative assessment can be made of the possible cumulative impacts.

Santos will develop the RFD areas in accordance with the EIS. There will be no other development by other petroleum producers in the tenements described in the RFD area. It is however, possible that other companies may develop CSG facilities within the Future Development Area as part of the planned CSG development projects in addition to the existing CSG domestic supply facilities. This will mean that there will be more CSG development in the Future Development Area than the Santos project. As an area is developed, the number of wells will increase. The spacing of wells will not intensify with field development.

The total land surface area directly impacted by the Santos activities in the RFD Area is estimated at 2,500 ha. This constitutes 0.37% of the RFD area of 6,800 km^2. The impacted surface area is associated with a network of trunk roads and access roads that connect the CSG wells. Accordingly the impacts described in this section affect a relatively small area of land and the impact on such areas will be reduced by the application of the mitigation methods described in this section.

Much of the future development area (FDA) is cleared agricultural land and as such is unlikely to reduce nature conservation values significantly. The ongoing operation of the developed fields is unlikely to have any cumulative effects upon nature conservation values. Nevertheless, the greatest cumulative impacts from the development of the CSG fields will be the fragmentation of habitat and disturbance to microhabitat such as hollow-bearing trees, fallen timber and thickets of vegetation. Progressive rehabilitation, appropriate field planning and pre-development scouting will assist in the mitigation of these cumulative impacts.

Cumulative impacts may occur if additional fields in the FDA are developed whilst existing fields in the RFD area continue to produce. Clearing will be widely dispersed over the area, and will occur gradually over a 25+ year timeframe. Rehabilitation of disturbed areas such as seismic lines and well lease pads will also occur progressively over the life of the projects. The conversion of appraisal wells to operating wells in particular will result in a significant reduction in the cleared area with rehabilitation of the impacted area to a standard consistent with the existing land use and vegetation type.

The cumulative impact will carry a relatively small footprint over the large regional area of the FDA. Impacts are expected to be greater at creek crossings, riparian areas and aquatic ecosystems.

It is expected that the other CSG fields development projects will include some or all of the proposed mitigation measures in relation to flora and fauna impacts described in this section. By utilising these mitigation measures, it is anticipated that there will be a minimal cumulative impact on the surrounding environment.

Gas Transmission Pipeline

Other proposed gas transmission pipelines are associated with other potential CSG Projects. There is limited information available as to the planned development or timing of these projects. However, a qualitative assessment can be made of the possible cumulative impacts.

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The regions of central Queensland the gas transmission pipeline traverses have been historically altered by clearing for pastoral and agricultural activities. In addition, forestry, road development, mining and existing pipeline easements have further reduced the amount of remnant vegetation. Route selection and planning from the commencement of the project has aimed to minimise impacts on remnant vegetation and fauna habitat through the avoidance of these areas wherever practicable. As a result, approximately 81% of the gas transmission pipeline corridor traverses cleared or non-remnant vegetation. Field studies have determined that areas of remnant vegetation impacted by the pipeline corridor have often experienced historical disturbance from forestry and grazing activities. It is not anticipated that the proposed works will significantly reduce the overall conservation values of central Queensland.

Some sections of the proposed gas transmission pipeline corridor may be located within an area where these other pipelines are proposed to be located in the future. The duplication of pipelines may result in further loss of remnant vegetation and habitat.

In the event that the “Yarwun Neck” in the Gladstone State Development Area (GSDA) contains multiple pipelines, cooperation between the relevant pipeline development proponents and regulatory agencies will be required to minimise impacts to flora and fauna.

The Queensland Government has advised that its preference is for the gas transmission pipelines for all LNG facilities proposed for Curtis Island to be located in a common pipeline corridor across the Gladstone State Development Area, including the Port Curtis Crossing and Curtis Island pipeline sections to minimise potential impacts in this area.

It is expected that the other gas transmission pipeline development projects will include some or all of the proposed mitigation measures in relation to flora and fauna described in this section. By utilising the mitigation methods the expectation is the minimisation of the cumulative impacts on the receiving environment.

The revegetation techniques that are adopted by Santos have proven to be effective in re-establishing vegetation along previously completed sections of pipeline. In most instances the original land use will be re-established after the rehabilitation works have been completed, unless the land owner requests the site be rehabilitated to a different land use.

LNG Facility

Including the GLNG project there are a number of industrial facilities that are proposed for Curtis Island. There is limited information available as to the planned development of these proposed projects or the scale and timing of their development. However, a qualitative assessment can be made of the possible cumulative impacts.

The southern portion of the Curtis Island GSDA has been designated for future industrial development. In addition to the Santos LNG facility, there are a number of other LNG facilities potentially planned for Curtis Island. It is understood that at least one of these facilities is proposed to be located directly to the north of the Santos site.

Should other LNG projects proceed, there will be cumulative impacts to Port Curtis for marine transport and shipping and the visual amenity values of the Port Curtis area along the western shoreline of Curtis Island. Depending on their location, structure and layout, the broader visual impact of these additional facilities are likely to be visible from parts of the mainland and Port Curtis. Flare stacks, if installed, will also be visible. Lighting typical of industrial facilities will also increase.

The south west corner of Curtis Island where the LNG facility is proposed has been historically altered by clearing for pastoral, agricultural and forestry activities. Specific impacts have included grazing, weed invasion and selective thinning. In this context therefore, the construction of the LNG facility is not expected to significantly reduce the overall conservation values of Curtis Island. Field studies have determined that areas of remnant vegetation impacted by the LNG facility have low habitat values and have been degraded to some degree by exotic weed invasion. It is not anticipated that the proposed works will significantly further reduce current conservation values of Curtis Island.

Section 7 Summary of Findings

Over time, the construction of additional industrial developments may result in further loss of remnant vegetation and habitat. The adherence to sound environmental policy and planning frameworks will assist in ensuring that additional developments on or nearby Curtis Island will not significantly impact on natural ecosystems in the region. Also it is likely that these proposed facilities will include some or all of the proposed mitigation measures outlined, thereby minimising cumulative impact on the receiving environment.

It is anticipated that similar mitigation measures to those identified in this EIS will need to be considered and implemented by other future developments.

Dredging and construction activities which have the potential to impact the marine environment are planned for a number of other projects in Port Curtis. These include the BG project (QLD Curtis LNG), the Wiggins Island project and the Fisherman's Landing expansion. Cumulative impacts from activities associated from these potential projects may be additional to the potential impacts described above. It is possible that dredging activities for these projects could occur concurrently with the dredging planned for GLNG.

Santos is committed to managing the potential cumulative impacts, and will closely liaise with the other proponents, the GPC, the EPA, the DPI&F and other relevant agencies to develop management plans to minimise the potential cumulative impacts. Santos recommends the development of a coordinated approach for a Dredge Management Plan (DMP) that includes appropriate mitigation measures to minimise cumulative impacts on the receiving environment.

7.2.2 Visual Impacts

Coal Seam Gas Fields

Other CSG development projects planned for the surrounding region are up to 100 km from the GLNG Project CSG field areas. Despite this, some of these projects may be within the GLNG Project future development area. There is limited information available as to the planned development of those projects or the quantity and timing of the development of the wells or associated infrastructure; however, a qualitative assessment can be made of the possible cumulative impacts.

Santos will develop the RFD areas in accordance with the EIS. There will be no other development by other petroleum producers in the tenements described in the RFD area. Infrastructure impacts will not exceed those stated in the project description.

It is however, possible that other companies may develop CSG facilities within the Future Development Area as part of the planned CSG development projects in addition to the existing CSG domestic supply facilities. This will mean that there will be more CSG development in the Future Development Area than the Santos project. As an area is developed, the number of wells will increase. The spacing of wells will not intensify with field development.

The total land surface area directly impacted by the Santos activities in the RFD Area is estimated at 2,500 ha. This constitutes 0.37% of the RFD area of 6,800 km^2. The impacted surface area is associated with a network of trunk roads and access roads that connect the CSG wells. Accordingly the impacts described in this section affect a relatively small area of land and the impact on such areas will be reduced by the application of the mitigation methods described in this section.

The longer term components of the production wells are relatively small in scale and do not form visually prominent elements in the rural landscape in which the CSG fields are to be developed. In situations where these components are not visible from public roads or homesteads, the longer term visual impact will be negligible. The permanent production wells will constitute a relatively minor component of the wider landscape view and might be missed by a casual observer. Visual impact from the air is not considered to be high as the majority of the CSG fields are not located in major flight paths.

Gas Transmission Pipeline

Other proposed gas transmission pipelines associated with other potential CSG projects. There is limited information available as to the planned development or timing of these projects however a qualitative assessment can be made of the possible cumulative impacts.

Some sections of the proposed gas transmission pipeline corridor may be located within an area where these other pipelines are proposed to be located in the future. Within these areas there would be an increased visual impact. The principal long term visible changes to the landscape will be the installation of pipeline markers and access tracks or upgrading of existing tracks. The most significant long term visible changes to the landscape will result from installation of aboveground pipeline markers and permanent access tracks that will be constructed along the pipeline corridor.

The anticipated impacts of the pipeline installation are considered to be the same for the other envisaged pipelines. It may be considered that where pipeline alignments coincide consideration should be made, where appropriate, for multiuse corridors or parallel right of ways (ROW).

The revegetation techniques that are adopted by Santos have proven to be effective in re-establishing vegetation along previously completed sections of pipeline. In most instances the original land use will be re-established after the rehabilitation works have been completed, unless the land owner requests the site be rehabilitated to a different land use.

LNG Facility

Including the GLNG project there are a number of industrial facilities that are proposed for Curtis Island. There is limited information available as to the planned development of these proposed projects or the scale and timing of their development. However, a qualitative assessment can be made of the possible cumulative impacts.

The southern portion of the Curtis Island GSDA has been designated for future industrial development. In addition to the Santos LNG facility, there are a number of other LNG facilities potentially planned for Curtis Island. It is understood that at least one of these facilities is proposed to be located directly to the north of the Santos site.

Should other LNG projects proceed, there will be cumulative impacts to the visual amenity values of the Port Curtis area along the western shoreline of Curtis Island. Depending on their location, structure and layout, the broader visual impact of these additional facilities are likely to be visible from parts of the mainland and Port Curtis. Flare stacks, if installed, will also be visible. Lighting typical of industrial facilities will also increase. The overall potential visual impact of the LNG facility has been assessed as generally low to moderate through the positioning of the facility in low lying valleys that provide visual screening by the landform of the valley. While the hills and ridges that define the valley in which the site is located are visible from surrounding areas, the centre of the valley itself is generally screened from most surrounding areas. Consequently, the base in the valley which the site would be located is only directly visible from boats travelling in Port Curtis.

7.2.3 Surface Water

Coal Seam Gas Fields

Other CSG development projects are planned for the surrounding region. Some of these projects are up to 100 km from the GLNG Project CSG field areas and some may be within the GLNG Project future development area. There is limited information available as to the planned development of those projects or the quantity and timing of the development of the wells or associated infrastructure; however, a qualitative assessment can be made of the possible cumulative impacts.

Santos will develop the CSG fields in accordance with the EIS. There will be no other development by other petroleum producers in the tenements described in the CSG fields. Infrastructure impacts will not exceed those stated in the project description.

Section 7 Summary of Findings

It is however, possible that other companies may develop CSG facilities within the CSG fields future development area as part of their planned CSG development projects in addition to the existing CSG domestic supply facilities. This will mean that there will be more CSG development in the future development area than the Santos project. As an area is developed, the number of wells will increase, but the spacing of wells will not intensify.

Cumulative impacts of these activities will potentially occur from operational activities, such as vehicular traffic and infrastructure development. This may be especially exacerbated at creek crossings, impacting upon surface water environmental values. Increases in the volume of associated water managed at the surface will also increase the risk of impacts to surface waters from uncontrolled discharges.

It is expected that the other CSG field development projects would include some or all of the proposed mitigation measures in relation to surface water impacts proposed for the GLNG Project. By utilising these mitigation measures, it is anticipated that there will be a minimal cumulative impact on the surrounding environment.

At the height of field development, each CSG field could potentially produce large volumes of associated water. However, it is expected that other CSG field development projects would involve the management of associated water in accordance with current Queensland Government policies, as well as include some or all of the mitigation measures proposed by the GLNG Project, thereby minimising the cumulative impacts on the receiving environment.

The associated management plans of other CSG producers are likely to involve significant amounts of desalination coupled with local/regional beneficial use of permeate to meet local and regional agricultural, municipal and industrial water demands. The management of brine (reject) is therefore potentially a key issue across the region. The Australian Petroleum Production and Exploration Association (APPEA) has recently commissioned a study to undertake a technical and economic feasibility study for the aggregation of associated water from CSG members from across the region. The outcomes of this study will further address issues of water treatment, local and regional demands and the management of brine.

Gas Transmission Pipeline

Other proposed gas transmission pipelines associated with other potential CSG projects. There is limited information available as to the planned development or timing of these projects, however a qualitative assessment can be made of the possible cumulative impacts.

Some sections of the proposed gas transmission pipeline corridor may be located within an area where these other pipelines are proposed to be located in the future. Within these areas there would be an increased disturbed area and possible impacts on surface water. The anticipated impacts of the pipeline installation are considered to be the same for the other envisaged pipelines. Earthmoving activities, works adjacent to/within drainage lines, contaminant mobilisation, pollution and flooding will each impact on the waterways.

It may be considered that where pipeline alignments coincide consideration should be made, where appropriate, for multiuse corridors or parallel right of ways (ROW).

In the event that the “Yarwun Neck” in the Gladstone State Development Area (GSDA) contains multiple pipelines, cooperation between the relevant pipeline development proponents and regulatory agencies will be required to minimise impacts to surface water.

The Queensland Government has advised that its preference is for the gas transmission pipelines for all LNG facilities proposed for Curtis Island to be located in a common pipeline corridor across the Gladstone State Development Area, including the Port Curtis Crossing and Curtis Island pipeline sections to minimise potential impacts in this area.

It is expected that the other gas transmission pipeline development projects would include some or all of the proposed mitigation measures in relation to surface water described in this section. By utilising the mitigation methods the expectation is the minimisation of the cumulative impacts on the receiving environment.

LNG Facility

Including the GLNG project there are a number of industrial facilities that are proposed for Curtis Island. There is limited information available as to the planned development of these proposed projects or the scale and timing of their development. However, a qualitative assessment can be made of the possible cumulative impacts.

Any subsequent proposed project is expected to be situated within a separate watershed catchment to the proposed LNG facility. As there is little or no connection between these watershed catchments, it is expected that limited cumulative impacts will arise.

Further, it is expected that the other projects would include some or all of the proposed mitigation measures in relation to surface water management as described in this section. Utilisation of these mitigation methods is expected to minimise the potential cumulative impacts on the receiving environment.

7.2.4 Groundwater

Coal Seam Gas Field

Other CSG development projects planned for the surrounding region. Some of these projects are up to 100 km from the GLNG Project CSG field areas and some may be within the GLNG Project future development area. There is limited information available as to the planned development of those projects or the quantity and timing of the development of the wells or associated infrastructure; however, a qualitative assessment can be made of the possible cumulative impacts.

Santos will develop the CSG fields in accordance with the EIS. There will be no other development by other petroleum producers in the tenements described in the CSG fields. Infrastructure impacts will not exceed those stated in the project description.

It is however, possible that other companies may develop CSG facilities within the CSG fields future development area as part of their planned CSG development projects in addition to the existing CSG domestic supply facilities. This will mean that there will be more CSG development in the future development area than the Santos project. As an area is developed, the number of wells will increase, but the spacing of wells will not intensify.

Current CSG projects, such as the Spring Gully CSG project, are recognised adjacent to the proposed CSG fields. The deep groundwater modelling included the current CSG activities at Spring Gully to ensure representative predictions regarding the impacts of CSG depressurisation. The cumulative impacts of increased dewatering volumes, to produce CSG, were considered.

Possible cumulative impacts associated with additional CSG development projects will be an increased area of influence (dewatering extent) and increased induced flows, thus, the possible impacts on the groundwater resources will occur more rapidly and over a larger area. The impacts are associated with increased dewatering, increased contaminant sources, and larger disturbed areas.

It is expected that the other CSG field development projects would include some or all of the proposed mitigation measures in relation to groundwater impacts described in this section. By utilising these mitigation measures, it is anticipated that there will be a minimal cumulative impact on the surrounding environment.

In addition to the proposed mitigation measures to reduce cumulative impacts CSG producers will need to provide continued groundwater monitoring of the Surat and Bowen Basins, which will allow for the update of the deep groundwater prediction model (increasing the accuracy of the model), further assessment of the groundwater impacts and allow for the apportioning of responsibility to the CSG operators within the Surat and Bowen Basins. This will require the sharing of information and the development of working group(s) amongst the various projects to allow for the identification of impacts and the development of optimum mitigation measures for all CSG operators in the Surat and Bowen Basins.

Gas Transmission Pipeline

Other proposed gas transmission pipelines associated with other potential CSG Projects. There is limited information available as to the planned development or timing of these projects. However, a qualitative assessment can be made of the possible cumulative impacts.

Some sections of the proposed gas transmission pipeline corridor may be located within an area where these other pipelines are proposed to be located in the future. Within these areas there will be an increased disturbed area and possible impacts on shallow groundwater. The envisaged impacts of the pipeline installation, due to blasting or dewatering, are considered to be the same for the other pipelines.

In the event that the "Yarwun Neck" in the Gladstone State Development Area (GSDA) contains multiple pipelines, cooperation between the relevant pipeline development proponents and regulatory agencies will be required to minimise impacts to groundwater.

The Queensland Government has advised that its preference is for the gas transmission pipelines for all LNG facilities proposed for Curtis Island to be located in a common pipeline corridor across the Gladstone State Development Area, including the Port Curtis Crossing and Curtis Island pipeline sections to minimise potential impacts in this area.

It is expected that the other gas transmission pipeline development projects will include some or all of the proposed mitigation measures in relation to groundwater described in this section. By utilising the mitigation methods the expectation is the minimisation of the cumulative impacts on the receiving environment.

LNG Facility

Including the GLNG project there are a number of industrial facilities that are proposed for Curtis Island. There is limited information available as to the planned development of these proposed projects or the scale and timing of their development. However, a qualitative assessment can be made of the possible cumulative impacts.

Only proposed facilities located on Curtis Island will contribute to any cumulative impacts on the groundwater resources on the LNG facility site. Due to the limited data available for the projects, it is envisaged that the impacts associated with the construction and operation of facilities on the shallow groundwater resources would be similar to those identified for the GLNG facility, these include reduced recharge, altered aquifers below the facility footprint (permanent alteration to aquifers due to compaction), and potential contaminant sources.

Poor quality and limited aquifers can be impacted over a larger area on the island as a result of the cumulative impacts of developments in the area, potentially resulting in the loss of usable groundwater resources for life of projects. Additional risk of spills, leaks, and leachate generation will occur, which can result in the alteration of groundwater quality over a larger area.

Detailed groundwater characterisation and impact assessment is required for each potential development to manage cumulative impacts. It is likely, however, that these facilities will include some or all of the proposed mitigation measures outlined within, thereby minimising cumulative impact on the receiving environment.

7.3 Impacts and Likelihood of Structural Failure

All relevant structures such as the gas transmission pipeline, well heads, the potential bridge and LNG facility will be developed in accordance with relevant Australian Standards and Codes of Practice.

Relevant and site specific investigations will be undertaken where necessary as part of the infrastructure design to ensure compliance with the relevant Australian Standards and Codes of Practice to minimise the likelihood of structural failure and potential impacts to Matters on National Environmental Significance.

Section 8 Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Santos Limited and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 5 October 2007.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between December 2008 and February 2009 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Section 9 References

Accad, A; Neldner, V.J; Wilson, B. A; and Niehus, R.E. (2006). *Remnant Vegetation in Queensland. Analysis of remnant vegetation 1997-1999-2000-2001-2003, including regional ecosystem information*. Brisbane: Queensland Herbarium, Environmental Protection Agency.

Anderson, P.K. 1982b. Studies of dugongs at Shark Bay, Western Australia I. Analysis of population size, composition, dispersion and habitat use on the basis of aerial survey. *Australian Wildlife Research* 9: 69-84.

Ayers D., Nash S. and Baggett K. (1996). *Threatened Species of Western NSW*. NSW NPWS, Hurstville

BAAM (2008) *Gladstone LNG Plant and Pipeline Curtis Island: Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations*, Report prepared for URS Australia, Biodiversity Assessment and Management, Brisbane.

BEASLEY, ISABEL; ROBERTSON, KELLY M. & ARNOLD, PETER W. (2005): Description of a new dolphin, the Australian Snubfin Dolphin *Orcaella heinsohni* sp. n. (Cetacea, Delphinidae). *Marine Mammal Science* **21**(3): 365-400

Birds Australia (2008) *Birds Australia Database.* Accessed 18 April 2008. http://www.birdsaustralia.com.au/our-projects/atlas-birdata.html

Cardno Eppell Olsen (2008), *Gladstone LNG Environmental Impact Statement – Marine Transport Strategy*, Prepared for Santos via URS, November 2008

Churchill, S. (1998) *Australian Bats*. National Library of Australia.

Cogger, H (2000) *Reptiles & Amphibians of Australia. Reed Books*, Melbourne.

Commonwealth of Australia Gazette (2007), Determination regarding including World Heritage Places in the National Heritage List, *Environment and Heritage Legislation Amendment Act (No. 1) 2003*, No. S 99, Monday 21 May, Commonwealth of Australia

Connolly, RM & Guest, MA (2004). *Critical estuarine habitats for food webs supporting fisheries in Port Curtis, central Queensland, Australia,* CRC for Coastal Zone, Estuary and Waterway Management, Brisbane.

Connolly RM, Currie DR, Danaher KF, Dunning M, Melzer A, Platten JR, Shearer D, Stratford PJ, Teasdale PR & Vandergragt M (2006). Intertidal wetlands of Port Curtis: ecological patterns and processes, and their implications. *Technical Report No. 43,* CRC for Coastal Zone, Estuary and Waterway Management, Brisbane.

Convention on the Conservation of Migratory Species of Wild Animals Website (2009); http://www.cms.int/

Danaher, KF, Rasheed, MA, & Thomas, R (2005). *The intertidal wetlands of Port Curtis. Information Series QI05031*. Department of Primary Industries and Fisheries, Queensland.

DEH (2003) *Australian Painted Snipe* (Rostratula australis) *Nationally Threatened Species and Ecological Communities Information Sheet*, Department of the Environment and Heritage, Commonwealth Government, Canberra. Viewed 19/12/07. http://www.environment.gov.au/biodiversity/threatened/publications/painted-snipe.html.

DEH (2005) *Northern Quoll* (Dasyurus hallucatus) *Threatened Species Day fact sheet.* Department of the Environment and Heritage, Commonwealth Government, Canberra. http://www.environment.gov.au/biodiversity/threatened/publications/tsd05northern-quoll.html. Viewed 19/12/07.

Section 9 References

Department of Environment, Water, Heritage and the Arts Website: http//www.deh.gov.au/ (Accessed 12/08)

Department of the Environment and Conservation (2005) *Rufous Scrub-bird – profile*. Available from: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10076. Accessed 24 November 2008.

DEWHA (2008a) EPBC Act Protected Matters Report. Viewed online 12 March 2008. http://www.environment.gov.au/erin/ert/epbc/index.html

DEWHA (2008b). Turnix melanogaster in *Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed 2008-12-02@15:20:13.

DEWHA (2008c). Lathamus discolor in *Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed 2008-11-24@13:37:54.

DEWHA (2008d). Psephotus pulcherrimus in *Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed 2008-11-24@13:49:54.

DEWHA (2008e). Hipposideros semoni in *Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed 2008-11-25@12:06:46

DEWHA (2008f). Egernia rugosa in *Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed 2008-11-25@10:29:01.

DEWHA (2008g). Paradelma orientalis in *Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed 2008-11-25@13:38:40.

DEWHA (2008h). Denisonia maculata in *Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed 2008-11-25@10:43:39.

DNRM&W, (2005). "State Government Regional Ecosystems Mapping v.5 Government Regional Ecosystem mapping v.5

Duke, NC, Lawn, PT, Roelfsema, CM, Zahmel, KN, Pedersen, DK, Harris, C, Steggles, N & Tack, C. (2003). *Assessing Historical Change in Coastal Environments – Port Curtis, Fitzroy River Estuary and Moreton Bay Regions*. Report to the CRC for Coastal Zone, Estuary & Waterway Management. July 2003. Marie Botany Group, Centre for Marine Studies, University of Queensland.

EPA and QPWS (1999). *Conservation and management of the dugong in Queensland 1999–2004*, The State of Queensland, Environmental Protection Agency, ISSN 1037-4698.

EPA (2004). Marine wildlife stranding and mortality database, *annual report 2003*, II. Cetacean and Pinniped, Conservation technical and data report, Volume 2003. Number 2, ISSN 1449–194X.

EPA (2005). Marine wildlife stranding and mortality database, *annual report 2004*, II. Cetacean and Pinniped, Conservation technical and data report, Volume 2004. Number 2, ISSN 1449–194X.

EPA (2005a) Threatened Plants and Animals Factsheet: Red Goshawk. Viewed online 3 November 2008. [http://www.epa.qld.gov.au/nature_conservation/wildlife/threatened_plants_and_animals/endangered/red_goshawk/]

Section 9 References

EPA (2005b) *Park Guide Chillagoe – Mungana Caves National Park*. Queensland Government, Brisbane.

EPA (2005c). *Golden-tailed Gecko profile*. Available from: http://www.epa.qld.gov.au/nature_conservation/wildlife/threatened_plants_and_animals/near_threatened/goldentailed_gecko/ Accessed 24 November 2008.

EPA (2006). *Ghost Bat profile*. Available from: http://www.epa.qld.gov.au/nature_conservation/wildlife/az_of_animals/micro_bats_the_insect_terminators/ghost_bat/ Accessed 24 November 2008.

EPA (2006). Marine wildlife stranding and mortality database, *annual report 2005*, II. Cetacean and Pinniped, Conservation technical and data report, Volume 2005. Number 2, ISSN 1449–194X.

EPA (2007a) *Wildlife of Calliope Basin – species list.* Available at: http://www.epa.qld.gov.au/wetlandinfo/site/MappingFandD/WetlandMapsAndData/SummaryInfo/WildlifeSpeciesList.jsp?AreaID=B-132&AreaName=Calliope&AreaTypeDescription=Basin Accessed 25 November 2008.

EPA (2007b) *Conservation Management Profile - Rusty Monitor* (Varanus semiremex). Available at: http://www.epa.qld.gov.au/publications/p02332aa.pdf/Rusty_monitor_emVaranus_semiremex/em.pdf Accessed 24 November 2008

EPA (2008). Marine wildlife stranding and mortality database, *annual report 2007*, II. Cetacean and Pinniped, Conservation technical and data report, Volume 2007. Number 2, ISSN 1449–194X.

Eyre. T, Kreiger, G., Venz, M., Hines, B., Hannah, D. and Schultz, M. (1997) *Systematic Vertebrate Fauna Survey in the South East Queensland Bioregion.* Queensland Department of Environment.

Frere, C.H., Hale, P. T., Porter, L., Cockcroft, V.G. and Dalebout, M.L. (2008) Phylogenetic analysis of mtDNA sequences suggests revision of humpback dolphin (Sousa spp.) taxonomy is needed. *Marine and Freshwater Research*, *59* 3: 259-268.

Garnet S.T. and Crowley, G.M. (2000) *The Action Plan for Australian Birds 2000*. Environment Australia, Canberra.

Great Barrier Reef Marine Park (2007), *Great Barrier Reef Marine Park Authority Position Statement on conservation of dugongs in the Great Barrier Reef Marine Park,* GBRMPA Position Statement.

Great Barrier Reef Marine Park (2001), *Spawning Aggregations of Reef Fishes on the Great Barrier Reef: Implications for Management*, GBRMPA Issues Paper

Hodgson, AJ (2004) *Dugong behaviour and responses to human influences*, PhD thesis, JCU, Australia.

Lanyon, J.M. (1991). *The nutritional ecology of the dugong* (Dugong dugon) *in tropical north Queensland.* Unpublished PhD Thesis, Monash University, Clayton, Victoria.

Limpus, CJ & Gilmore, K (1999). *Queensland Turtle Conservation Project. Curtis Island marine turtle nesting study: 1998-1999.* Unpublished report to the Gladstone Port Authority and Queensland Parks and Wildlife Service.

Limpus, CJ (1999). *Distribution of Flatback turtle nesting in Central-southern Queensland: 1998-1999 breeding season*. Unpublished report to the Gladstone Port Authority and Queensland Parks and Wildlife Service.

Limpus, CJ (2007). *A biological review of Australian marine turtle species. 5. Flatback turtle,* Natator depressus *(Garman).* Queensland Environmental Protection Agency.

Limpus, CJ, McLaren, M, Mclaren, G & Knuckey, B (2006). *Queensland Turtle Conservation Project: Curtis Island and Woongarra Coast Flatback Turtle Studies, 2005-2006.* Conservation technical and data report, Volume 2006, Number 4. Freshwater and Marine Sciences Unit, Environmental Sciences Division.

Section 9 References

Lindenmayer, D. (2002) *Gliders of Australia – A natural History*. University of New South Wales Press, Sydney.

Lucas, P.H.C.; Webb, T.; Valentine, P.S. and Marsh, H. (1997), *The Outstanding Universal Value of the Great Barrier Reef World Heritage Area*, Great Barrier Reef Marine Park Authority.

Marsh, H., Eros, C., Corkeron, P. and Breen, B. 1999, 'A conservation strategy for dugongs: implications of Australian research', *Marine and Freshwater Research*, vol. 50, pp. 979 - 990.

McKinnon, S.G.; Lupton, C.J. and Long, P.E.(1995) *A fisheries resource assessment of the Calliope River system in Central Queensland 1994*, Department of Primary Industries, Q195001.

Menkhorst, P. and F. Knight. (2001) *A Field Guide to the Mammals of Australia*. Oxford University Press.

Morcombe (2004) *Field Guide to Australian Birds.* Steve Parish Publishing, Brisbane.

Native Fish Australia Website (2009) http://www.nativefish.asn.au/

Neldner, V.J., Wilson, B. A., Thompson, E.J. and Dillewaard, H.A. (2005). *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland.* Version 3.1.

NSW National Parks & Wildlife Service (2002) *Approved Recovery Plan for the Red Goshawk (Erythrotriorchis radiatus)*, NSW National Parks & Wildlife Service, Hurstville. Viewed online 3 November 2008. http://www.environment.nsw.gov.au/resources/nature/recoveryplanFinalRedGoshawk.pdf

NSW National Parks & Wildlife Service (2005) *Cotton Pygmy-goose - profile*, NSW National Parks & Wildlife Service, Hurstville. Viewed online 3 November 2008. http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10557

Parra, GJ (2005). *Behavioural ecology of Irrawaddy, Orcaella brevirostris (Owen in Gray, 1866), and Indo-Pacific humpback dolphins, Sousa chinensis (Osbeck, 1765), in northeast Queensland, Australia : a comparative study*. PhD thesis, James Cook University.

Preen, A.R. (1993). *Interactions between dugongs and seagrasses in a subtropical environment.* Unpublished PhD Thesis, James Cook University, Townsville.

Preen, A.R. (1995) Impacts of dugong foraging on seagrass habitats. Observational and experimental evidence for cultivation and grazing. Mar Ecol Prog Ser 124: 201-213

Preen, A.R.; Lee Long, W.J. and Coles, R.G. (1995) Flood and cyclone related loss, and partial recovery of more than 1000 km^2 of seagrass in Hervey Bay, Queensland Australia, Aquat Bot 52:3-17

Preen, A.R. and Marsh, H. (1995) Response of dugongs to large scale loss of seagrass from Hervey Bay, Queensland, Australia, Wildlife Research 22:507-519

Rasheed, MA, Thomas, R, Roelofs, AJ, Neil, KM and Kerville, SP (2003). Port Curtis and Rodds Bay seagrass and benthic macro-invertebrate community baseline survey, November/December 2002. *DPI Information Series QI03058* (DPI, Cairns), 47 pp.

Rasheed, M. A., McKenna, S.A., Taylor, H.A., and Sankey, T.L. 2008. *Long term seagrass monitoring in Port Curtis and Rodds Bay, Gladestone – October 2007*. DPI&F Publication PR07-3271 (DPI&F, Cairns), 32 pp.

Ripple, J. (1996) *Sea Turtles*, Colin Baxter Photography Limited, Scotland.

Robinson, M. (1998) *A field Guide to Frogs of Australia*, Australian Museum, Reed New Holland

Simpson, K. and Day, N. (2004) *Field Guide to the Birds of Australia*, Fifth Ed, Penguin books.

(SPRAT Database). Species Profile and Threats Database, http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl (Accessed 12/12/08)

Section 9 References

Stanger, M., Clayton, M., Schodde, R., Wombey, J., Mason, I. (1998) *CSIRO List of Australian Vertebrates: with Reference to Conservation Status*. CSIRO Australia, Collingwood, Victoria

Stanisic, J. (1996) New land snails from the boggomoss environments in the Dawson Valley, Southeastern Queensland (Eupulmonata: Charapidae and Carmaenidae). *Memoirs of the Queensland Museum.* 39:343-354

Stanisic, J. (2008) *Recovery Plan ofr the boggomoss snail* Adclarkia dawsonensis*. Report to the Department of Environment and Water Resources, Canberra,* Brisbane, Queensland Parks and Wildlfie Service. Available from http://www.environment.gov.au/biodiversity/threatened/publications/a-dawsonensis.html.

Strahan (Ed) (2008) *The Mammals of Australia*, Australian Museum, Reed Books.

Taylor, HA, Rasheed, MA, Dew, K & Sankey, TL (2007). Long term seagrass monitoring in Port Curtis and Rodds Bay, Gladstone – November 2006. *DPI&F Publication PR07- 2774* (DPI&F, Cairns), 30 pp.

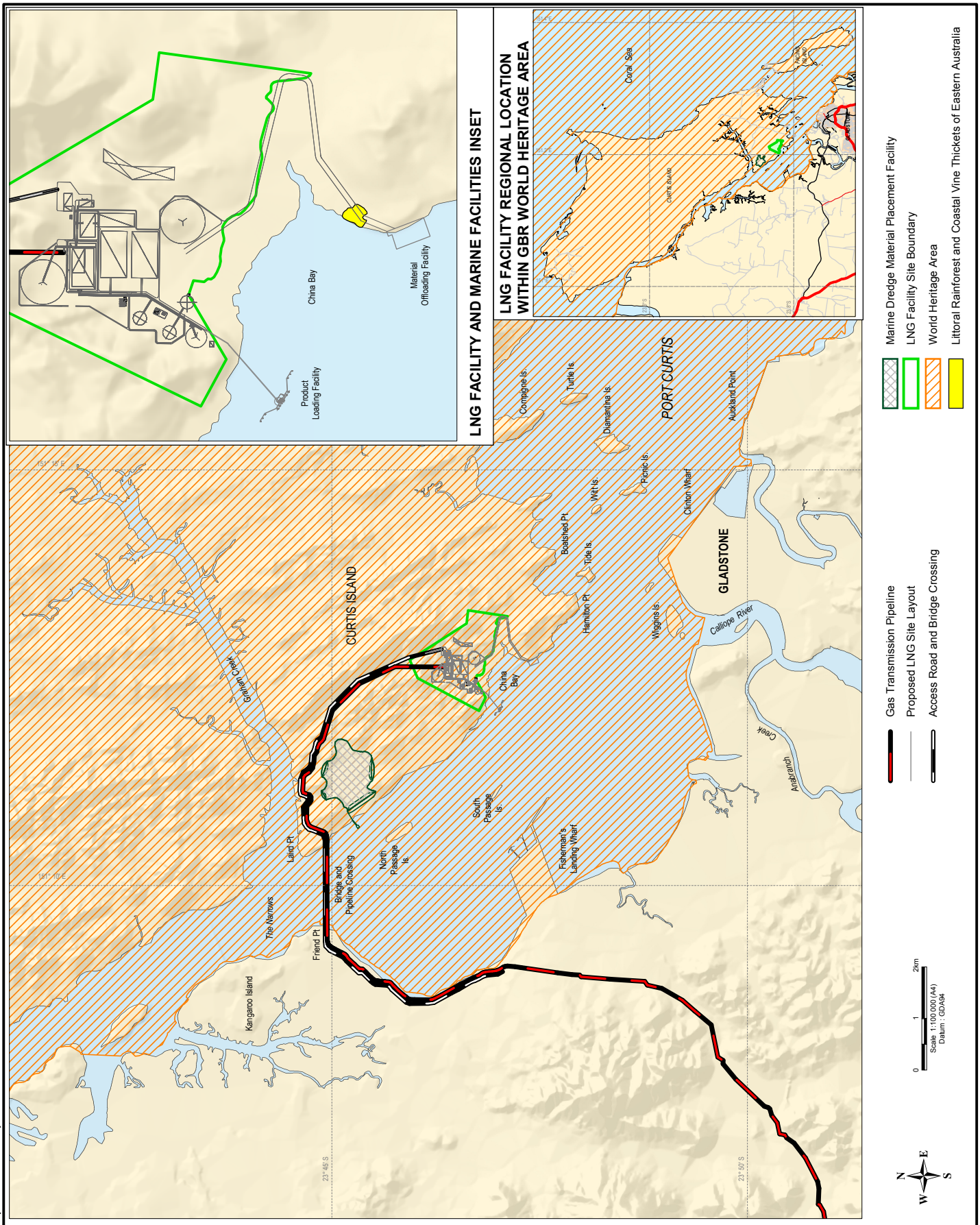
Triggs, B (2004) *Tracks, Scats and Other Traces - A Field Guide to Australian Mammals.* Oxford University Press, Oxford, United Kingdom.

WBM (2004). Moreton Bay Sand Extraction Study Phase 2 – Benthic Fauna Assessments.

Wilson, S. (2005) A *Field Guide to Reptiles of Queensland*, Reed New Holland.

WBM (2008) Proposed Santos LNG facility- Localised Hydrodynamic Data Collection. Prepared for URS.

Figures



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Source 2: With regard to Product Loading Facility and Material Offloading Facility - These layouts are subject to alteration during detailed design development and ongoing consultation with the Gladstone Ports Corporation and the Gladstone Regional Harbour Master to ensure issues of navigation safety are appropriately addressed.

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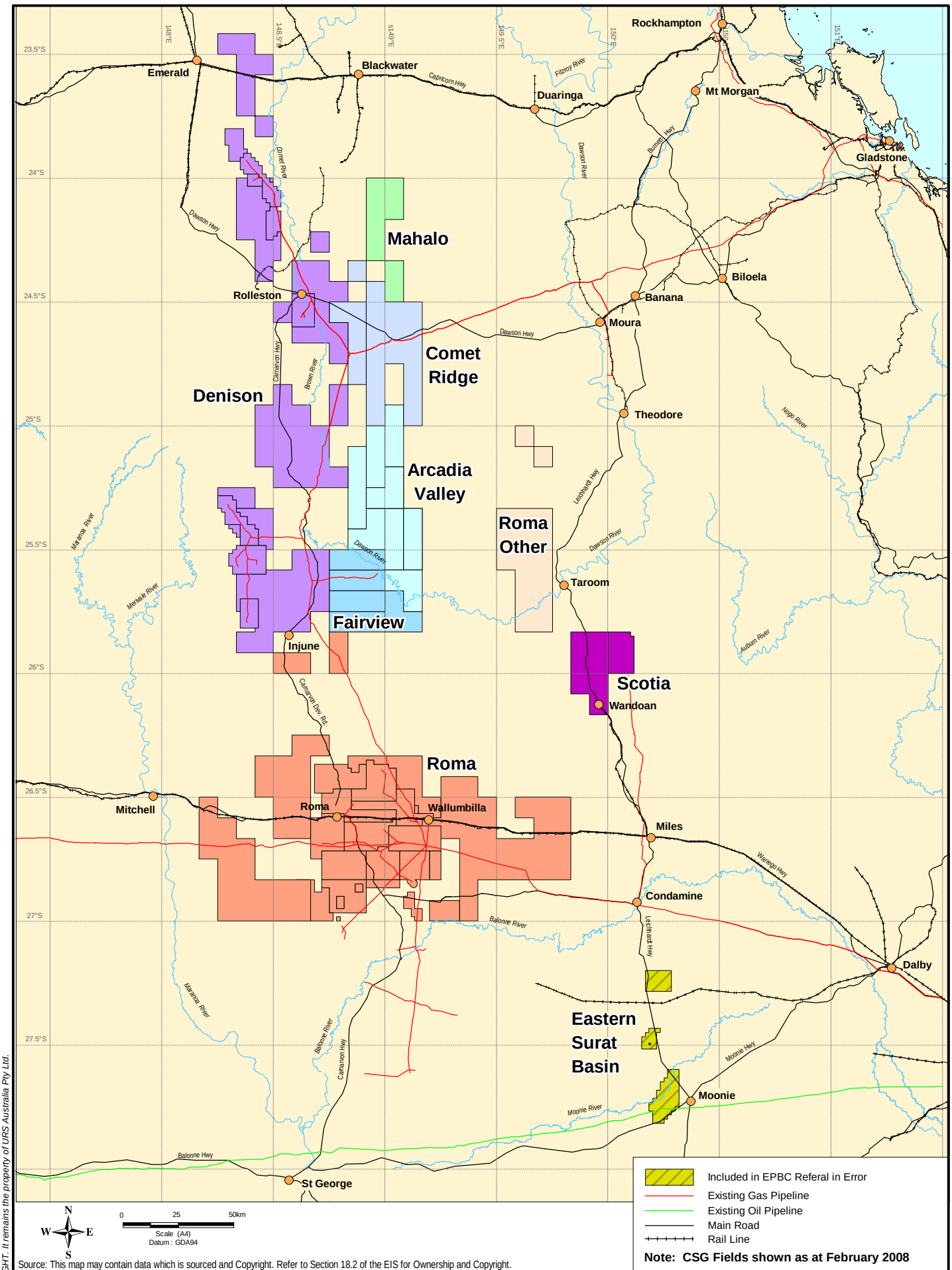
Client	Project	Title
LNG / URS	GLADSTONE LNG PROJECT EPBC ACT REPORT	**GREAT BARRIER REEF WORLD HERITAGE AREA**

Drawn: LL	Approved: JB	Date: 22-03-2009	Figure: **1-1**	Rev:C
Job No: **4262 6220**	File No: 42626220-g-760b.wor			**A4**



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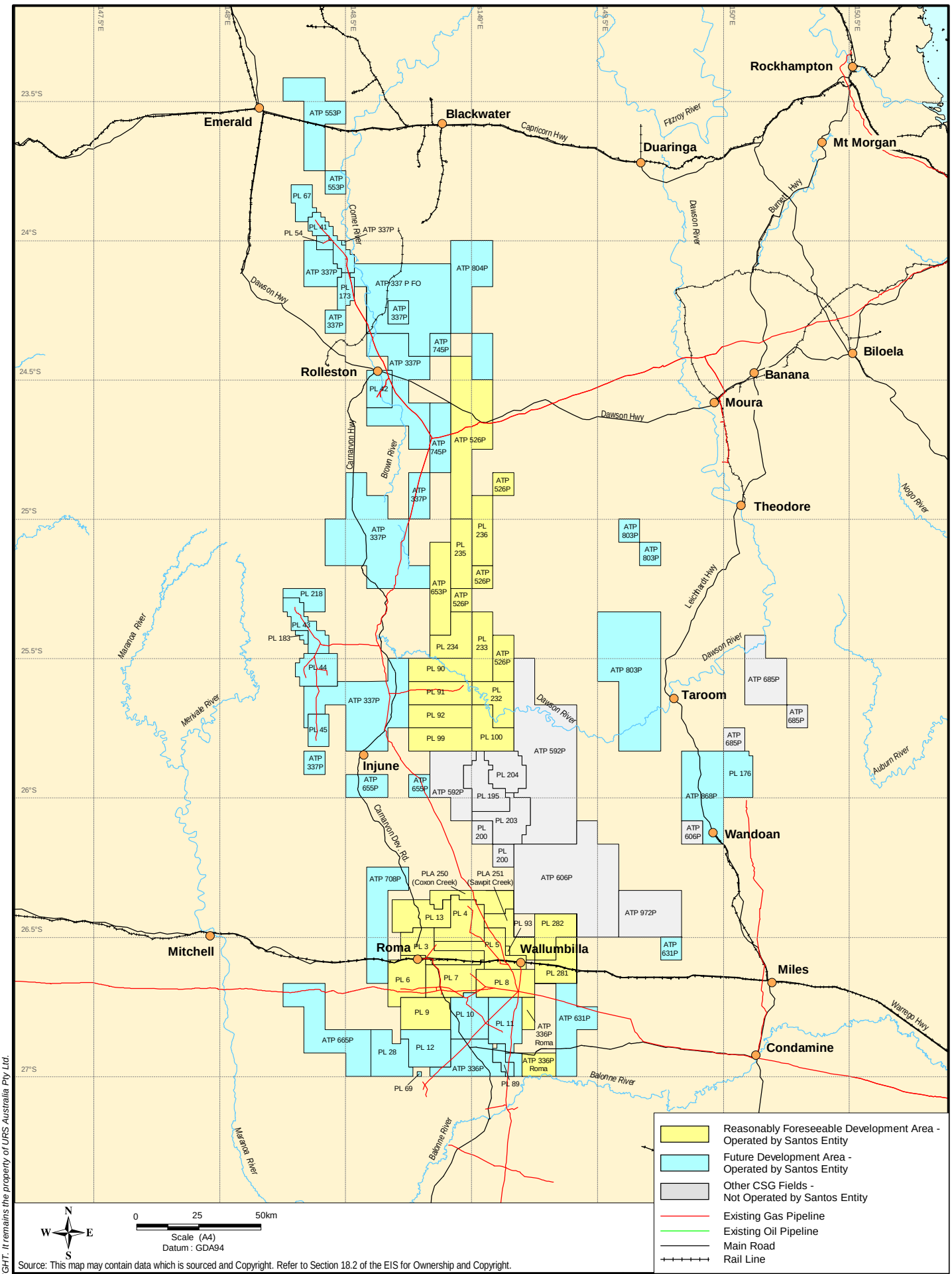
Client: LNG	Project: GLADSTONE LNG PROJECT EPBC ACT REPORT		Title: **LOCATION OF CSG FIELDS**
URS	Drawn: VH	Approved: JB	Date: 26-03-2009
	Job No: **4262 6220**	File No: 42626220-g-265.wor	Figure: **1-2**
			Rev:A **A4**



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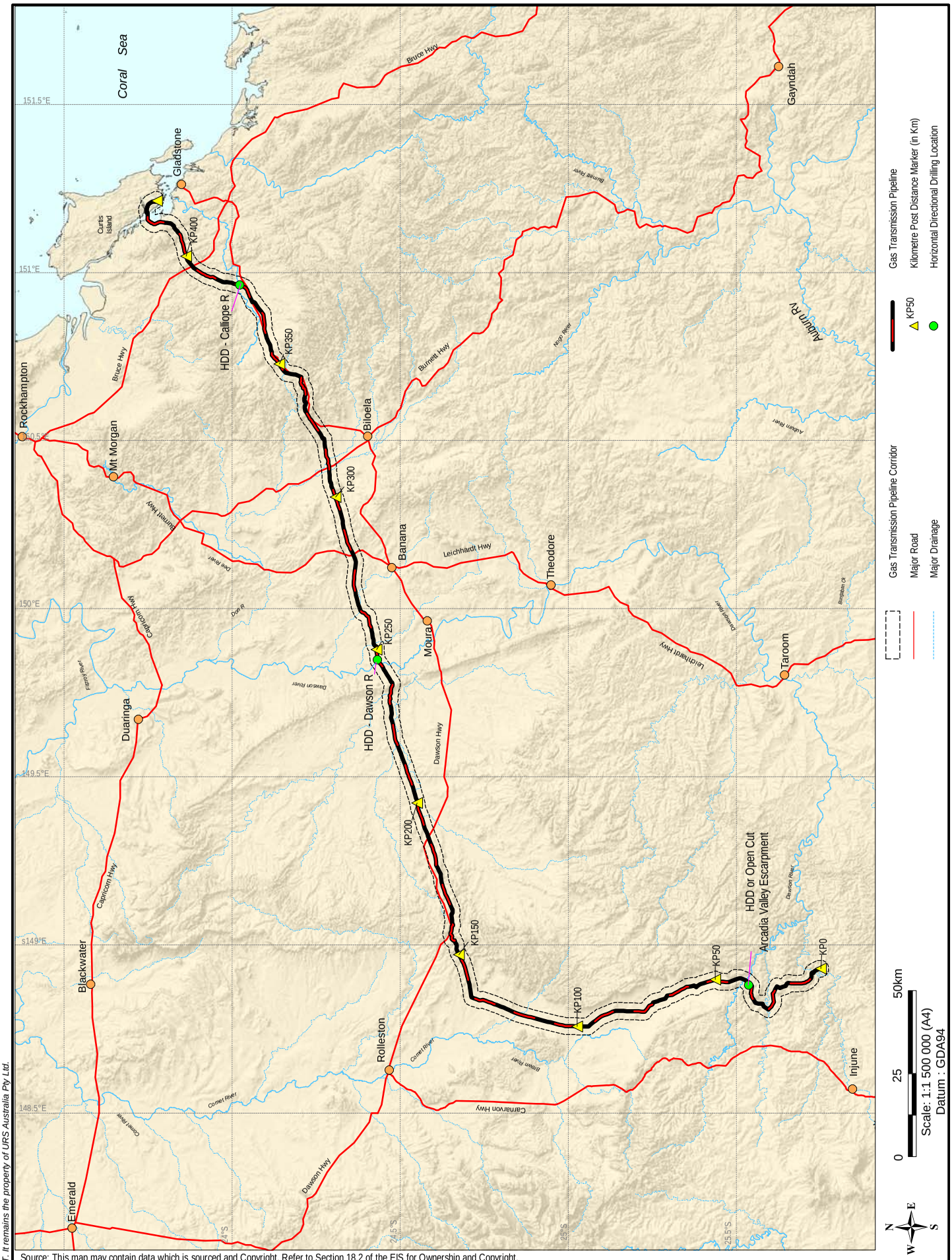
Client	Project	Title
	GLADSTONE LNG PROJECT EPBC ACT REPORT	**CSG FIELD DEVELOPMENT AREAS JANUARY 2009**
Drawn: VH	Approved: JB	Date: 26-03-2009
Job No: **4262 6220**	File No: 42626220-g-265.wor	Figure: **1-3**
		Rev:A **A4**



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Client

Project
GLADSTONE LNG PROJECT
EPBC ACT REPORT

Title
GAS TRANSMISSION PIPELINE ALIGNMENT

Drawn: CA	Approved: JB	Date: 26-03-2009	Figure: **1-4**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-266.wor			**A4**

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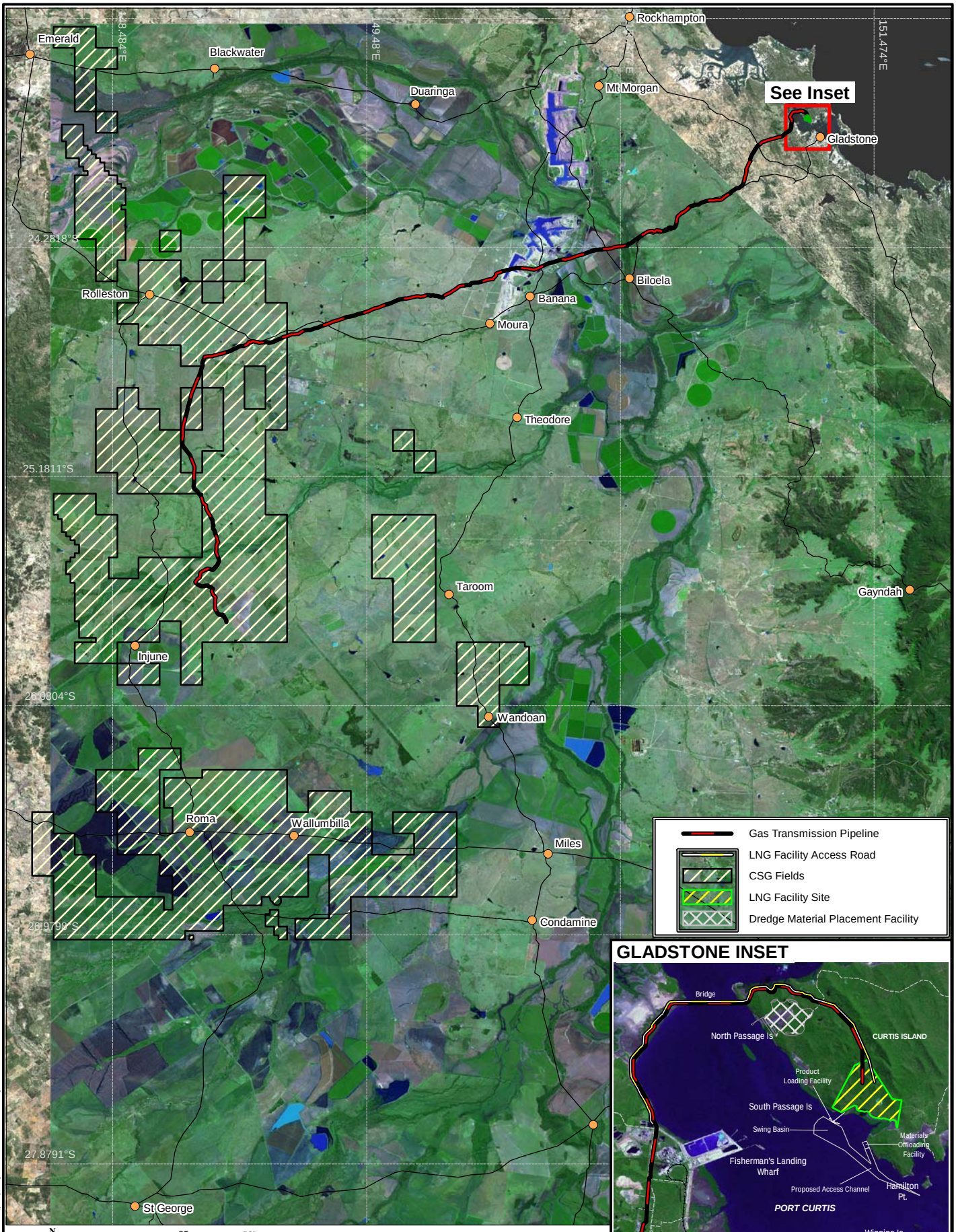
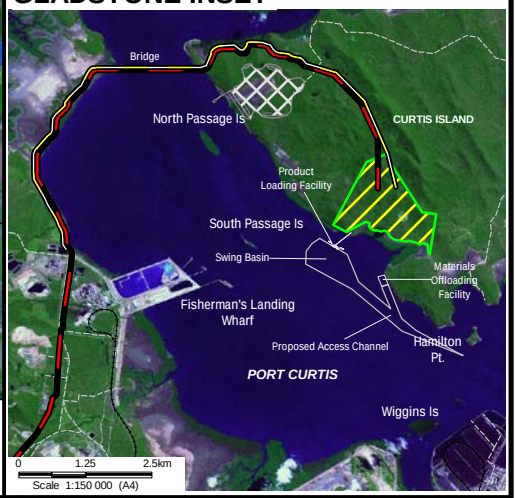


GLADSTONE INSET



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Client

Project

GLADSTONE LNG PROJECT
EPBC ACT REPORT

Title

PROJECT COMPONENTS

Drawn: CA	Approved: JB	Date: 26-03-2009	Figure: **2-1**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-267.wor			**A4**

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Client

Project
GLADSTONE LNG PROJECT
EPBC ACT REPORT -
LNG FACILITY

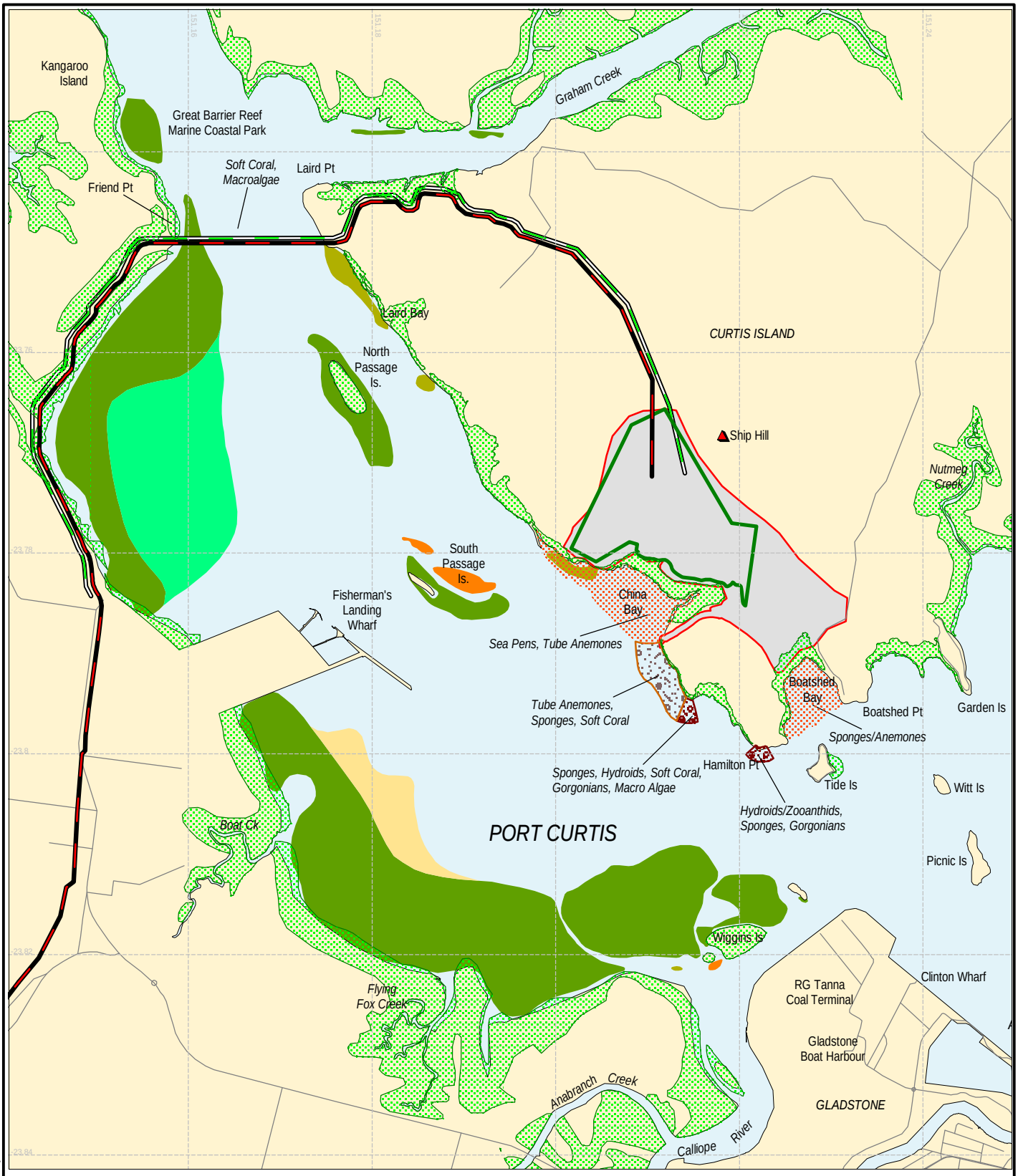
Title
TURTLES AND SHOREBIRDS

Drawn: CA	Approved: JB	Date: 25-02-2009
Job No: **4262 6220**	File No: 42626220-g-773b.wor	

Figure: **3-1**

Rev:B

A4



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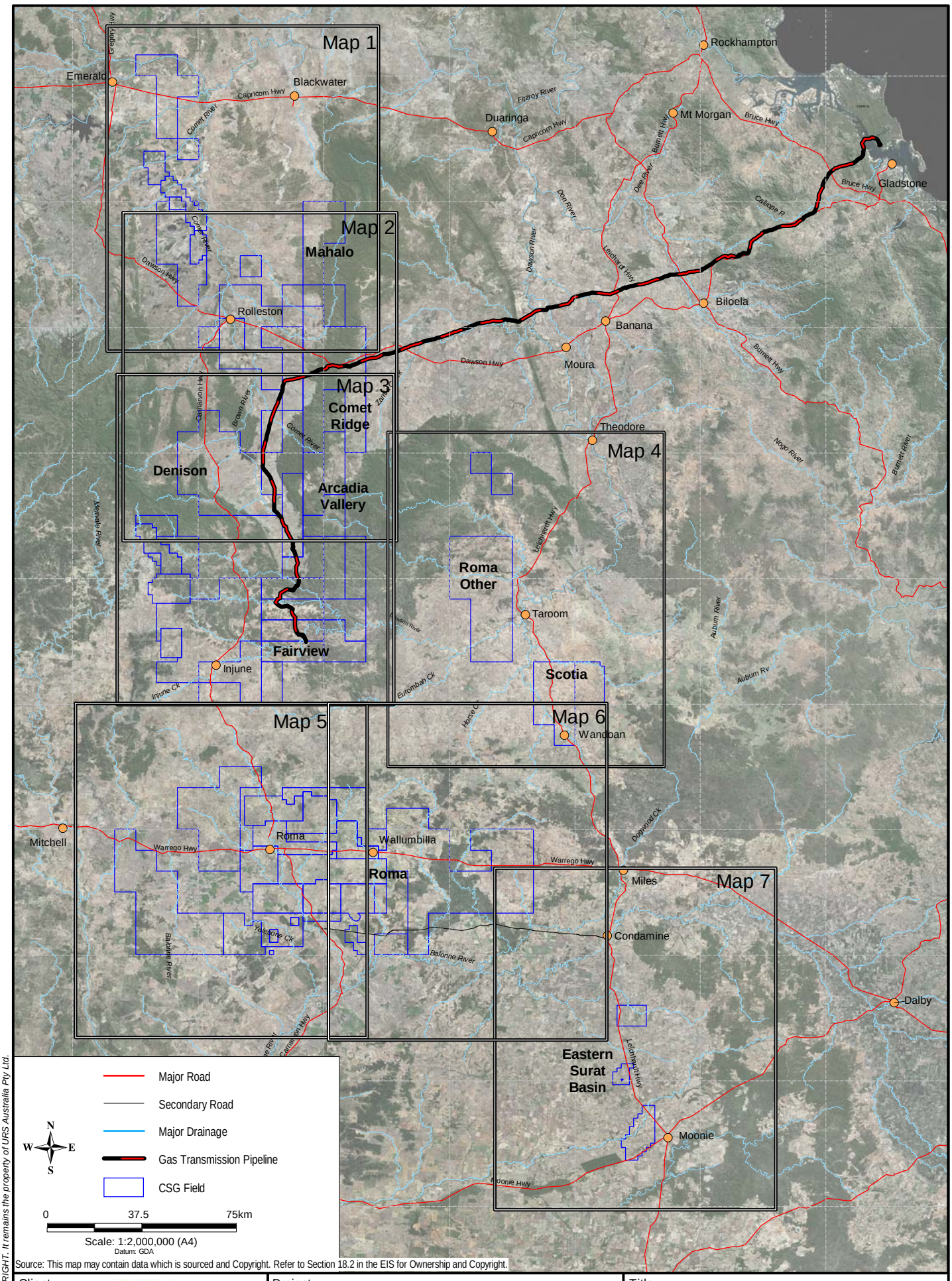
Client

Project
GLADSTONE LNG PROJECT
EPBC ACT REPORT -
LNG FACILITY

Title
SEAGRASS MEADOWS AND OTHER MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Drawn: RG	Approved: JB	Date: 25-02-2009	Figure: **4-1**	Rev:A
Job No:**4262 6220**	File No: 42626220-g-794.wor			**A4**



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Client

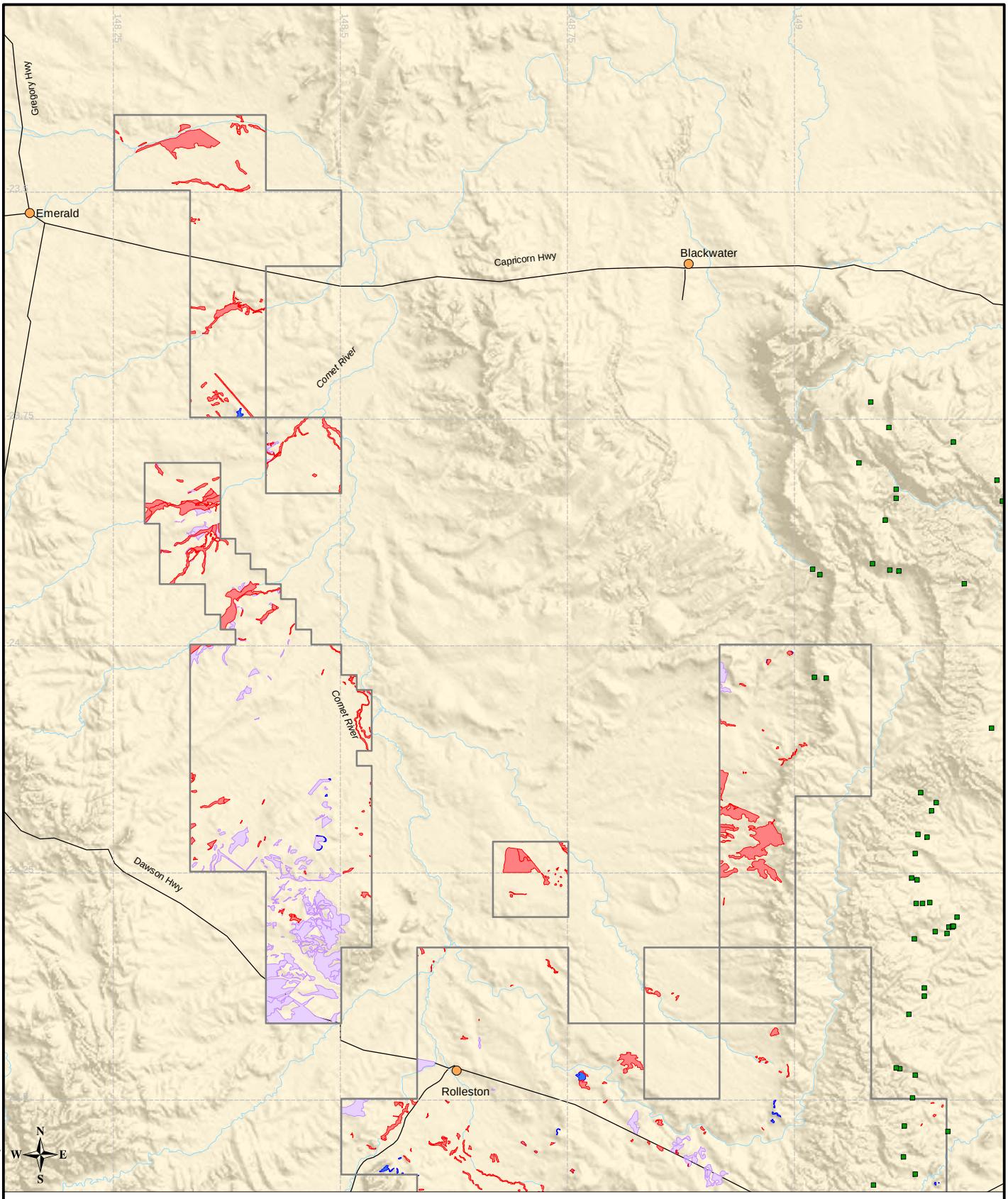
Project

GLADSTONE LNG PROJECT
EPBC ACT REPORT -
CSG FIELD

Title

MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - CSG FIELD KEY MAP

Drawn: RG	Approved: JB	Date: 24-02-2009	Figure: **5.1a**	Rev:B
Job No: **4262 6220**	File No: 42626220-g-765b.wor			**A4**



Major Road

Major Drainage

Springs Identified April 2008

EPA Listed Active Springs 2006

EPA Listed Inactive Springs 2006

Brigalow (*Acacia harpophylla* dominant and co-dominant)

Semi-evergreen vine thickets of the Brigalow Belt and Nandewar Bioregions

Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

CSG Field

0 10 20Km

Scale: 1:600 000 (A4)
Datum : GDA94

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Client

Project

GLADSTONE LNG PROJECT
EPBC ACT REPORT -
CSG FIELD

Title

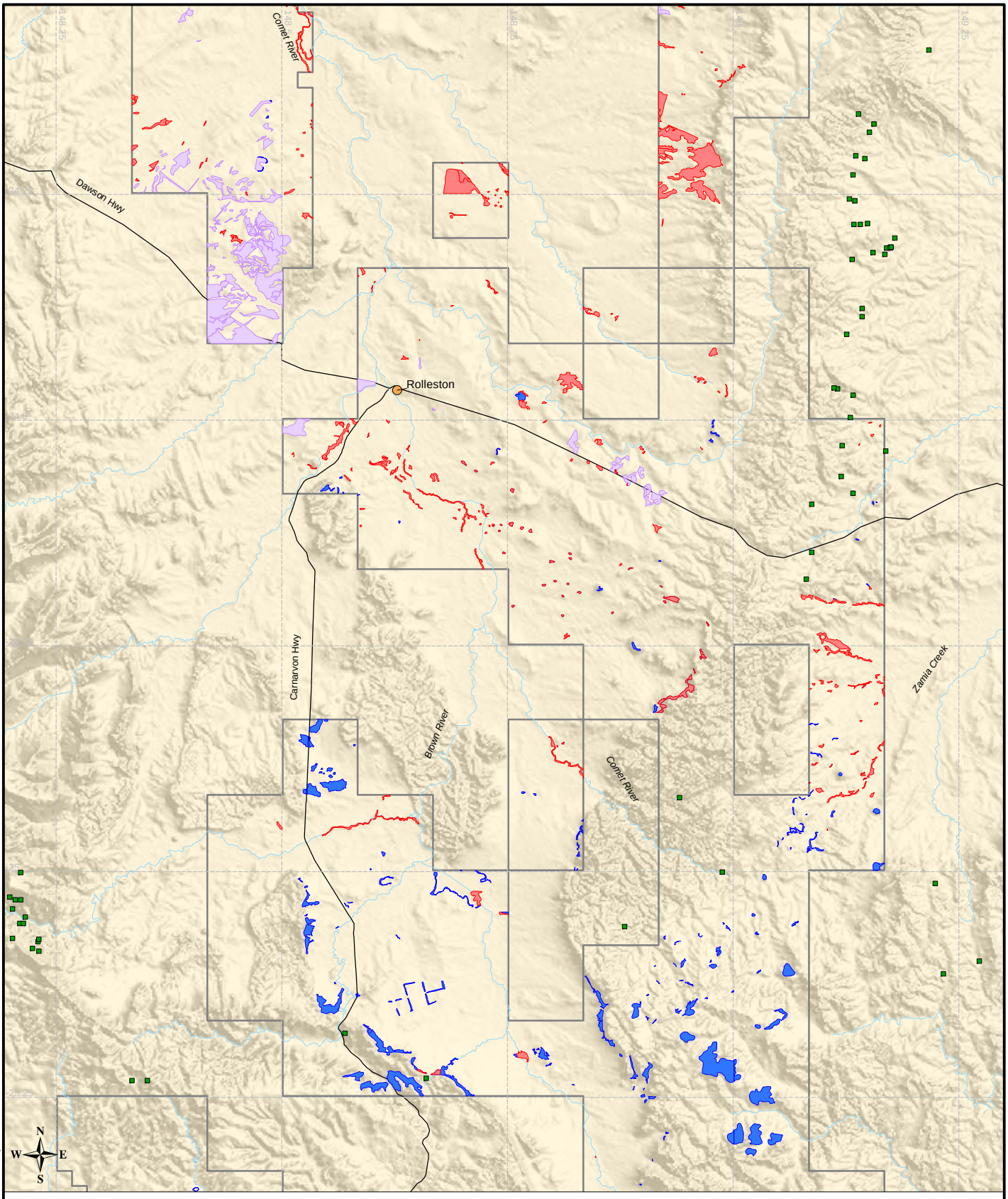
MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - CSG FIELD (MAP 1 OF 7)

Drawn: RG	Approved: JB	Date: 24-02-2009
Job No: **4262 6220**	File No: 42626220-g-766b.wor	

Figure: **5-1b**

Rev:B

A4



Major Road

Major Drainage

Springs Identified April 2008

EPA Listed Active Springs 2006

EPA Listed Inactive Springs 2006

Brigalow (*Acacia harpophylla* dominant and co-dominant)

Semi-evergreen vine thickets of the Brigalow Belt and Nandewar Bioregions

Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

CSG Field

0 10 20Km

Scale: 1:600,000 (A4)
Datum: GDA94

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Client: LNG

URS

Project: GLADSTONE LNG PROJECT
EPBC ACT REPORT -
CSG FIELD

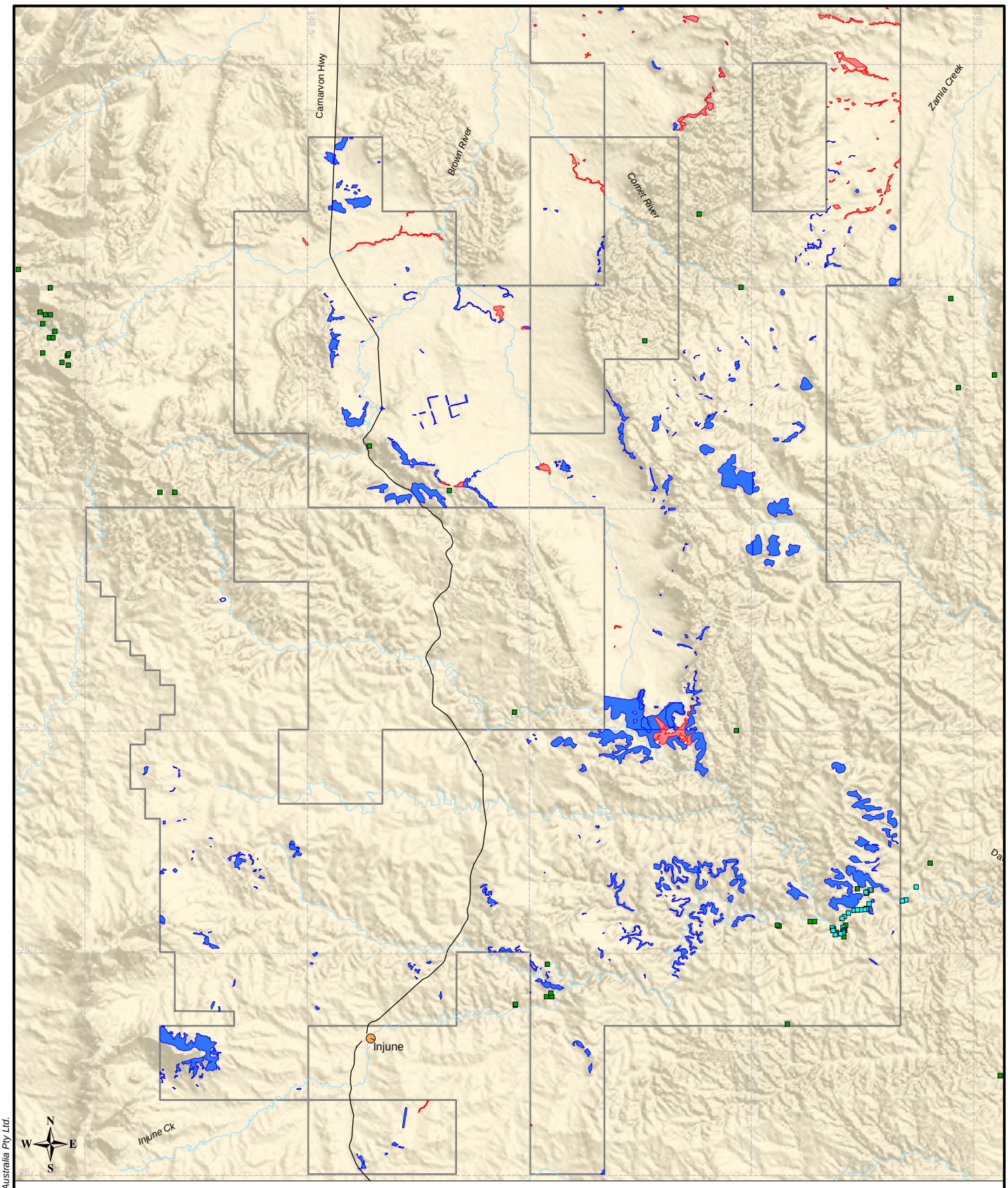
Title: **MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - CSG FIELD (MAP 2 OF 7)**

Drawn: RG	Approved: JB	Date: 24-02-2009
Job No: **4262 6220**	File No: 42626220-g-767b.wor	

Figure: **5-1c**

Rev:B

A4



Major Road

Major Drainage

Springs Identified April 2008

EPA Listed Active Springs 2006

EPA Listed Inactive Springs 2006

Brigalow (*Acacia harpophylla* dominant and co-dominant)

Semi-evergreen vine thickets of the Brigalow Belt and Nandewar Bioregions

Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

CSG Field

0 10 20Km

Scale: 1:600,000 (A4)
Datum: GDA94

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Client: LNG

URS

Project: GLADSTONE LNG PROJECT
EPBC ACT REPORT -
CSG FIELD

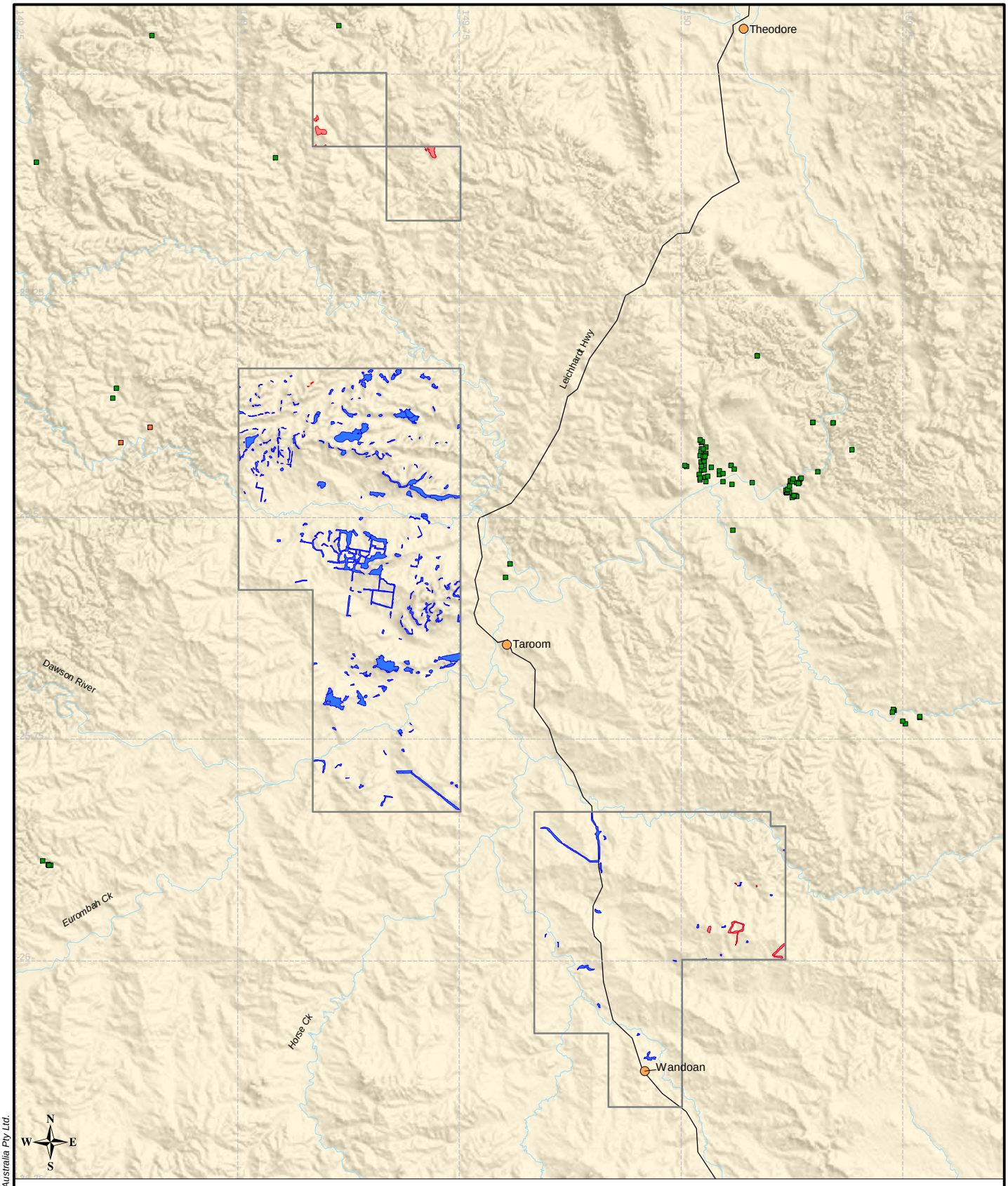
Title: **MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - CSG FIELD (MAP 3 OF 7)**

Drawn: RG	Approved: JB	Date: 24-02-2009
Job No: **4262 6220**	File No: 42626220-g-768b.wor	

Figure: **5-1d**

Rev:B

A4



Major Road

Major Drainage

Springs Identified April 2008

EPA Listed Active Springs 2006

EPA Listed Inactive Springs 2006

Brigalow (*Acacia harpophylla* dominant and co-dominant)

Semi-evergreen vine thickets of the Brigalow Belt and Nandewar Bioregions

Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

CSG Field

0 10 20Km

Scale: 1:600,000 (A4)
Datum: GDA94

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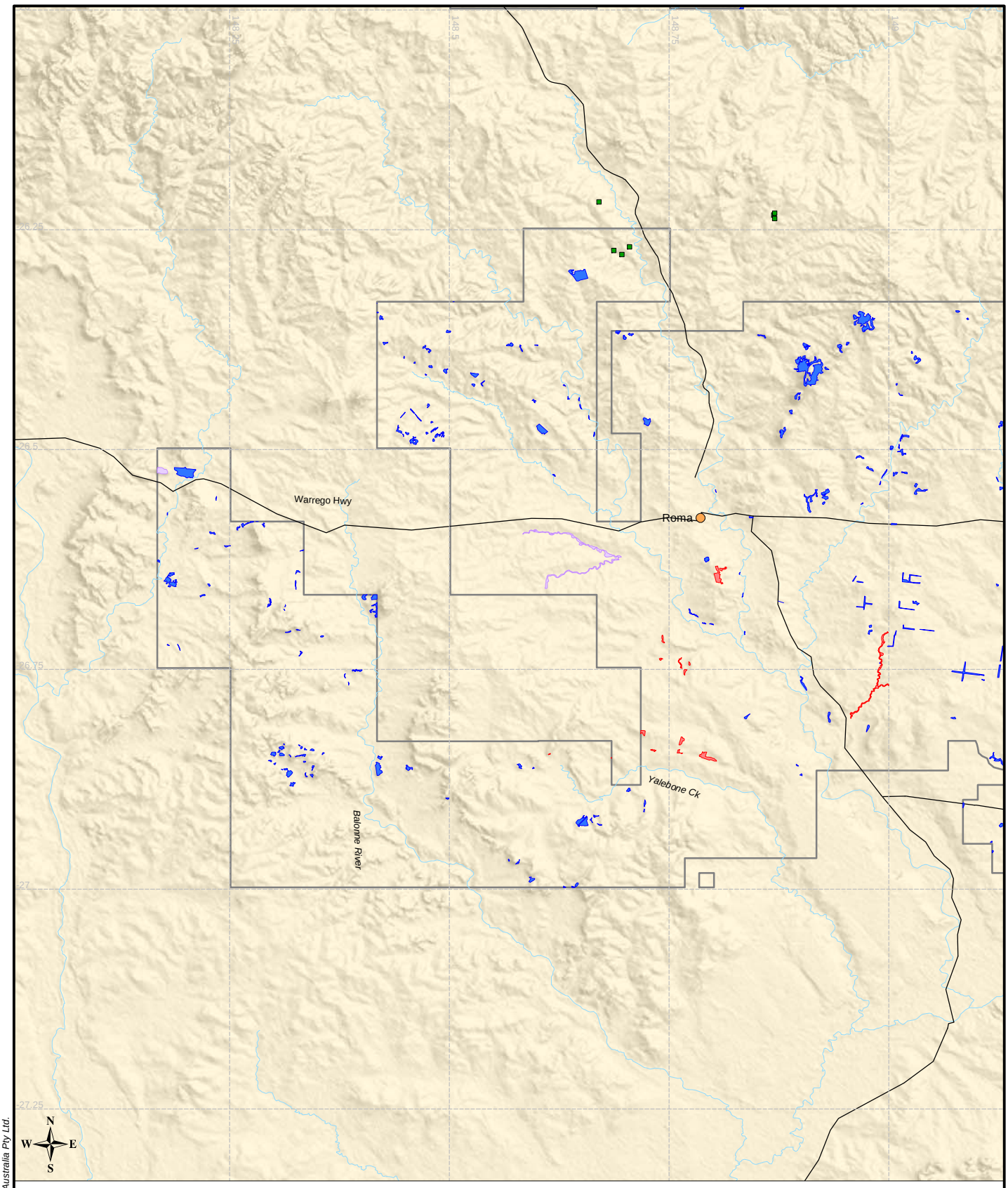
Client	Project	Title
LNG / URS	GLADSTONE LNG PROJECT EPBC ACT REPORT - CSG FIELD	**MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - CSG FIELD (MAP 4 OF 7)**

Drawn: RG	Approved: JB	Date: 24-02-2009	Figure: **5-1e**	Rev:B
Job No: **4262 6220**	File No: 42626220-g-769b.wor			**A4**



Major Road

Major Drainage

Springs Identified April 2008

EPA Listed Active Springs 2006

EPA Listed Inactive Springs 2006

Brigalow (*Acacia harpophylla* dominant and co-dominant)

Semi-evergreen vine thickets of the Brigalow Belt and Nandewar Bioregions

Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

CSG Field

0 10 20Km

Scale: 1:600,000 (A4)
Datum: GDA94

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Client: LNG

URS

Project: GLADSTONE LNG PROJECT
EPBC ACT REPORT -
CSG FIELD

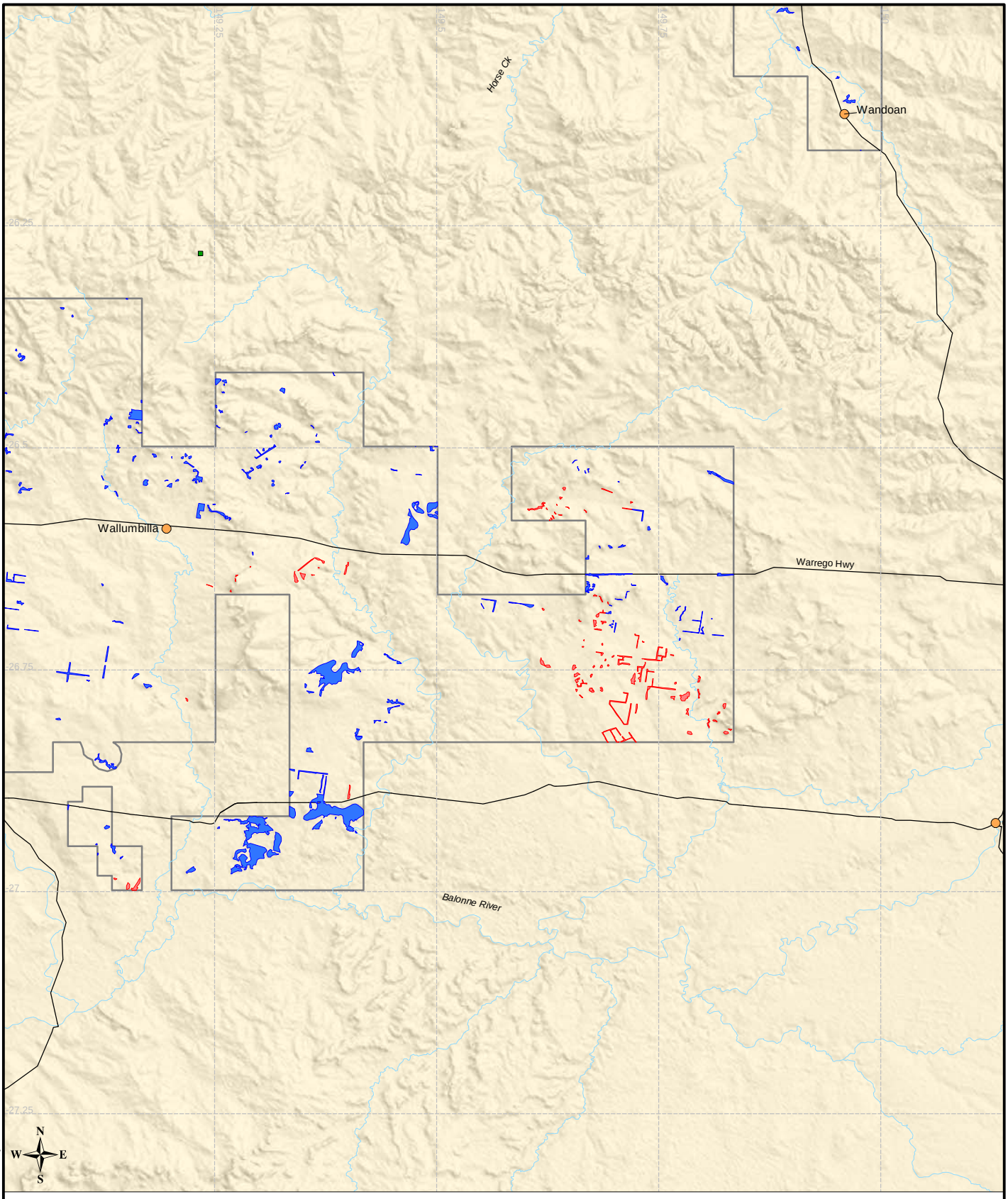
Title: **MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - CSG FIELD (MAP 5 OF 7)**

Drawn: RG	Approved: JB	Date: 24-02-2009
Job No: **4262 6220**	File No: 42626220-g-770b.wor	

Figure: **5-1f**

Rev:B

A4



Major Road

Major Drainage

Springs Identified April 2008

EPA Listed Active Springs 2006

EPA Listed Inactive Springs 2006

Brigalow (*Acacia harpophylla* dominant and co-dominant)

Semi-evergreen vine thickets of the Brigalow Belt and Nandewar Bioregions

Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

CSG Field

0 10 20Km

Scale: 1:600,000 (A4)
Datum: GDA94

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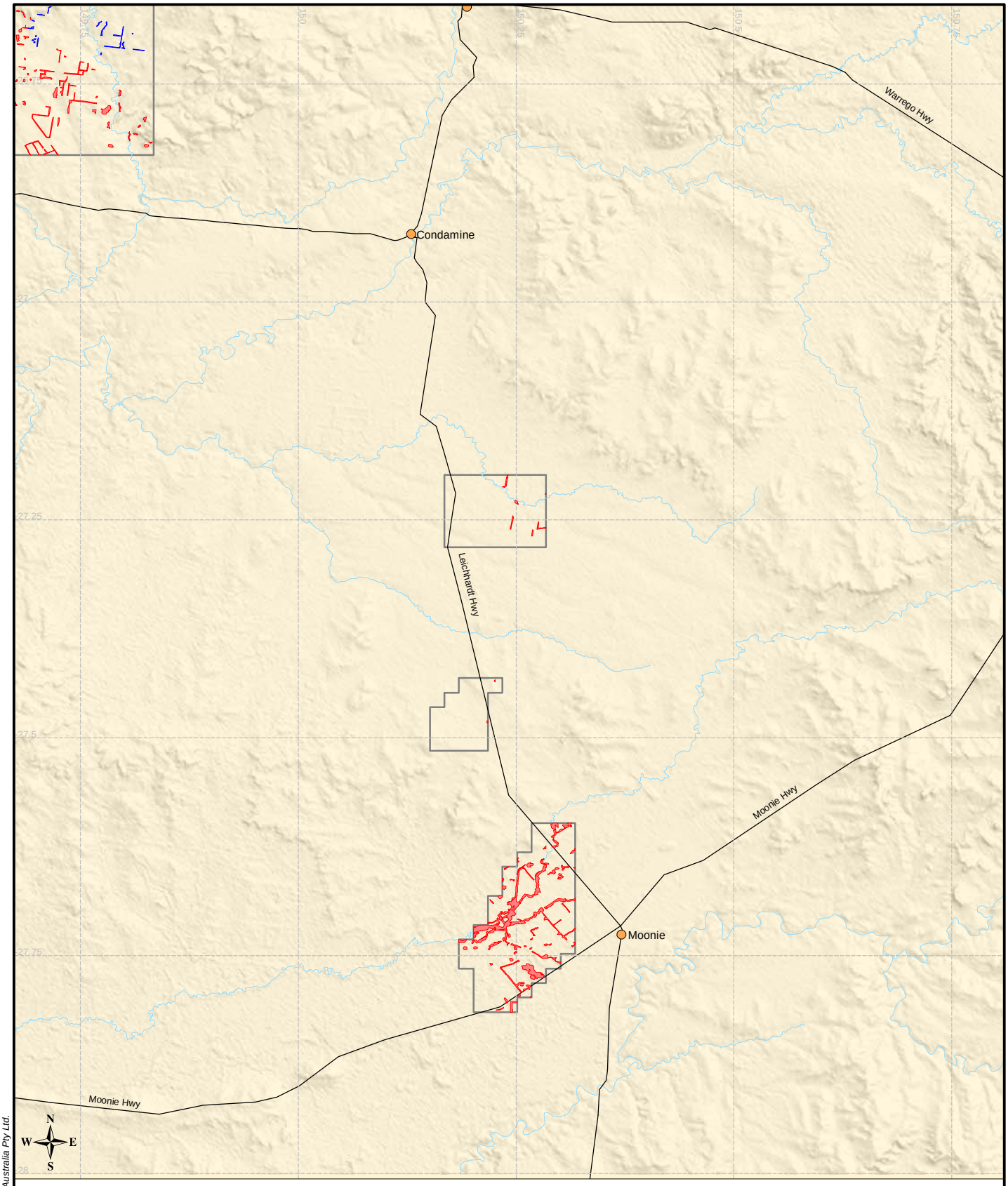
Client: LNG	Project: GLADSTONE LNG PROJECT EPBC ACT REPORT - CSG FIELD	Title: **MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - CSG FIELD (MAP 6 OF 7)**
URS	Drawn: RG | Approved: JB | Date: 24-02-2009 Job No: **4262 6220** | File No: 42626220-g-771b.wor	Figure: **5-1g** Rev:B A4



Major Road

Major Drainage

Springs Identified April 2008

EPA Listed Active Springs 2006

EPA Listed Inactive Springs 2006

Brigalow (*Acacia harpophylla* dominant and co-dominant)

Semi-evergreen vine thickets of the Brigalow Belt and Nandewar Bioregions

Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

CSG Field

0 10 20Km

Scale: 1:600,000 (A4)
Datum: GDA94

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Client: LNG

URS

Project: GLADSTONE LNG PROJECT
EPBC ACT REPORT -
CSG FIELD

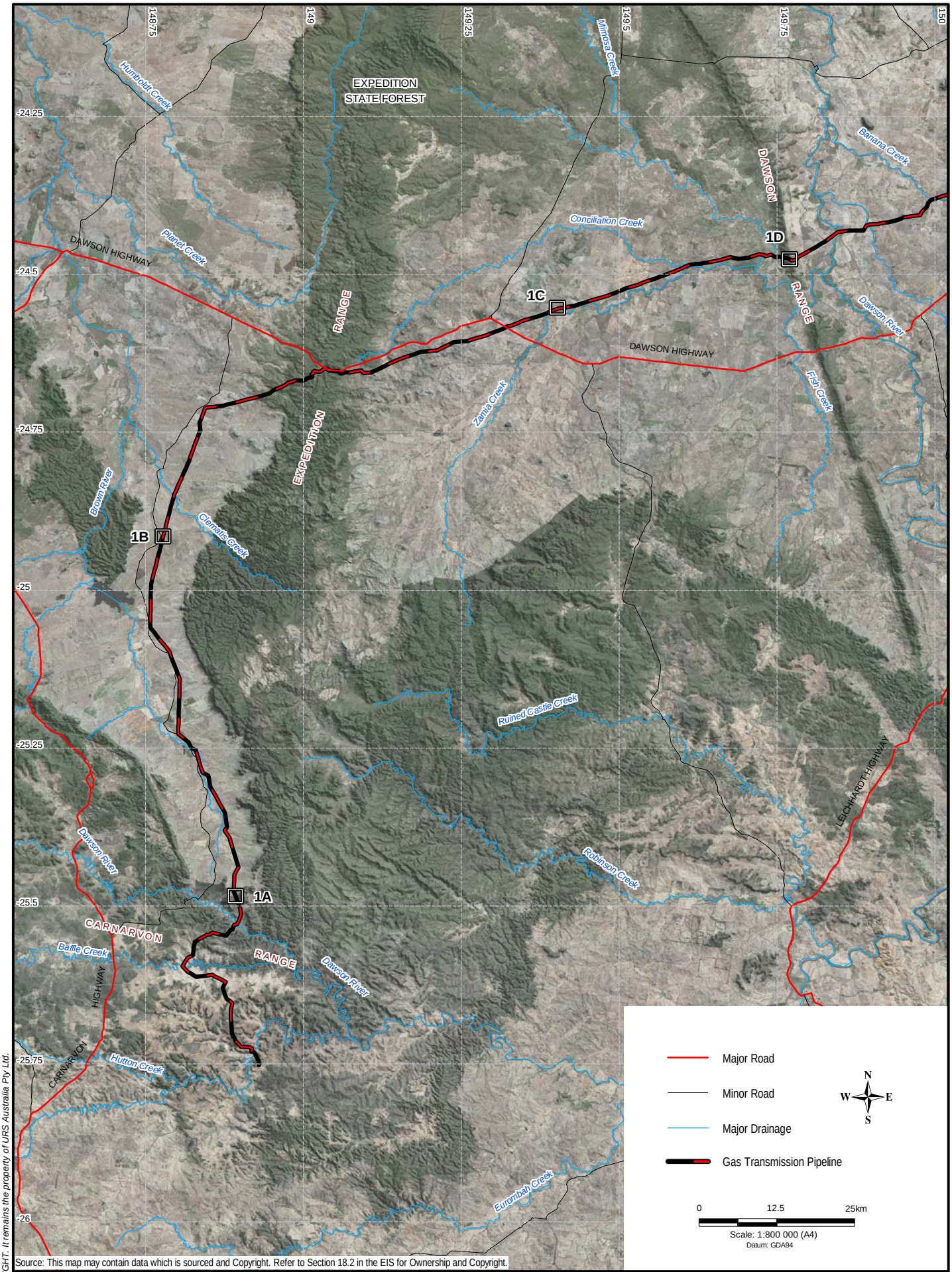
Title: **MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - CSG FIELD (MAP 7 OF 7)**

Drawn: RG	Approved: JB	Date: 24-02-2009
Job No: **4262 6220**	File No: 42626220-g-772b.wor	

Figure: **5-1h**

Rev:B

A4



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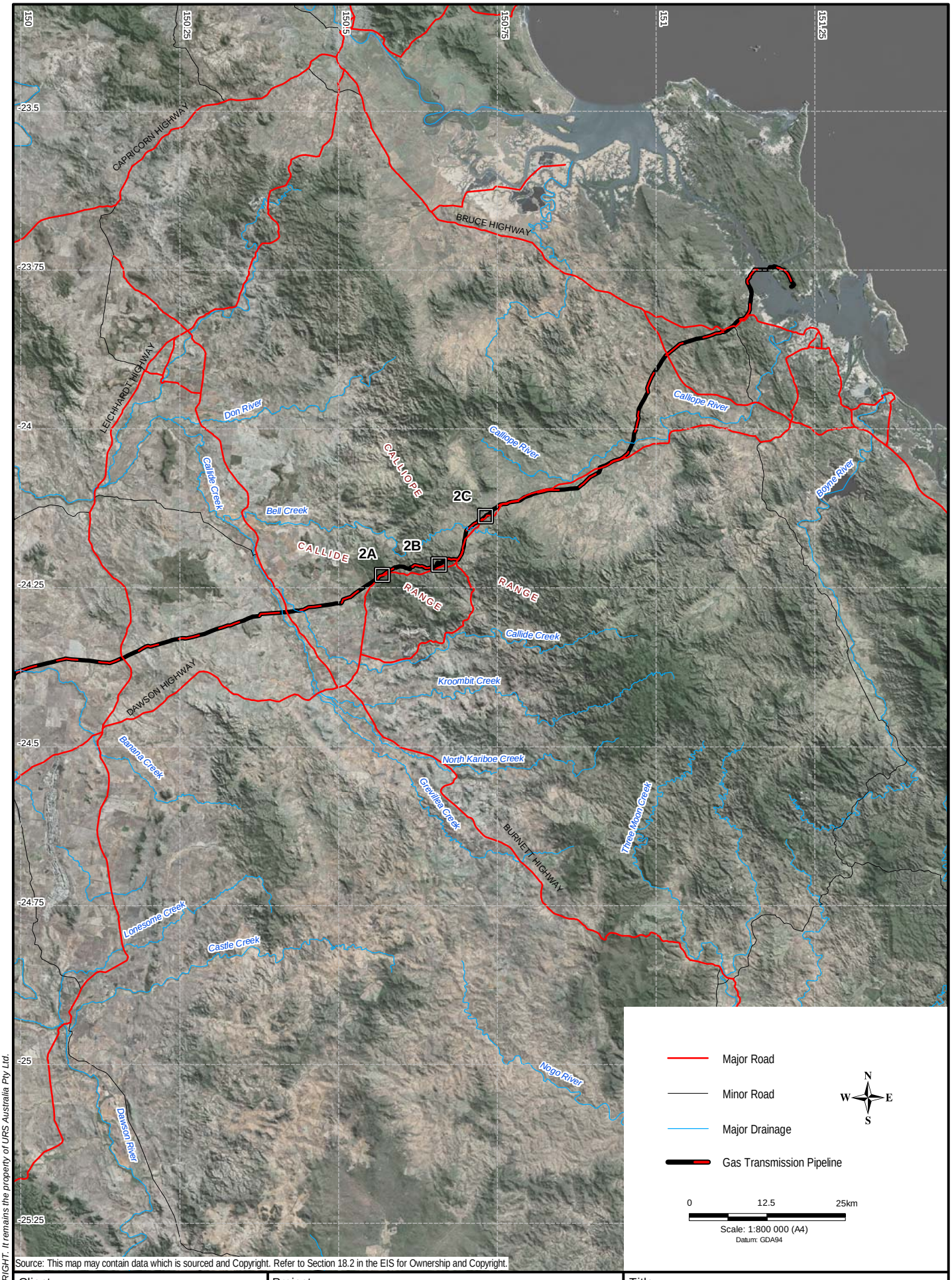
Client: LNG	Project: GLADSTONE LNG PROJECT EPBC ACT REPORT - GAS TRANSMISSION PIPELINE	Title: **MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE GAS TRANSMISSION PIPELINE KEY MAP 1 OF 2**
URS	Drawn: RG | Approved: JB | Date: 24-02-2009 Job No: **4262 6220** | File No: 42626220-g-761b.wor	Figure: **7-1a** | Rev:B | **A4**



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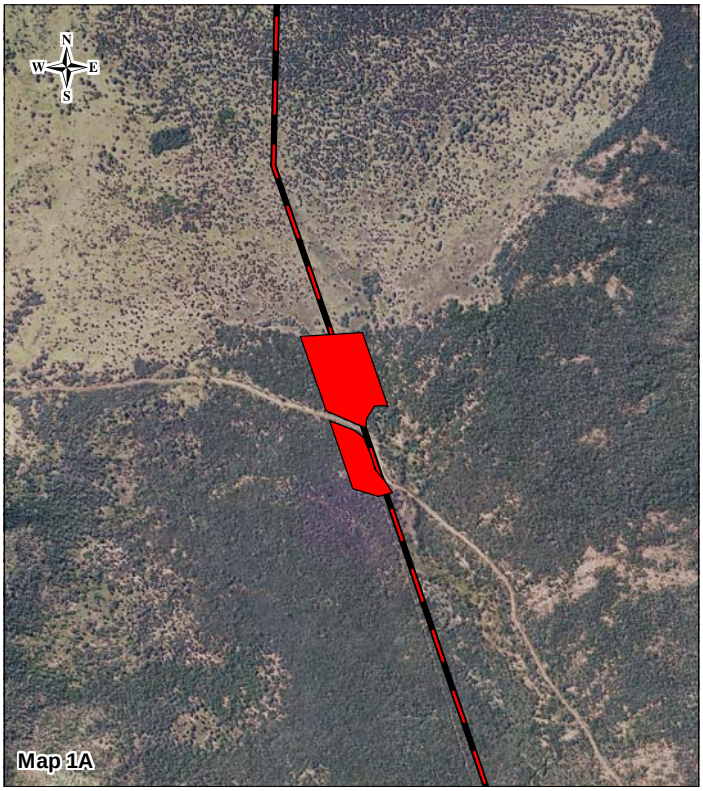
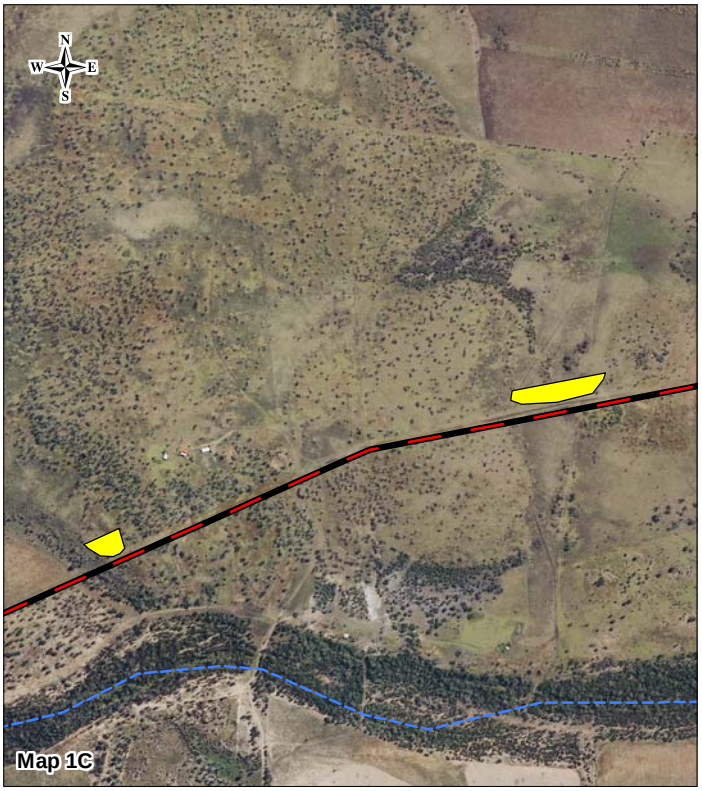
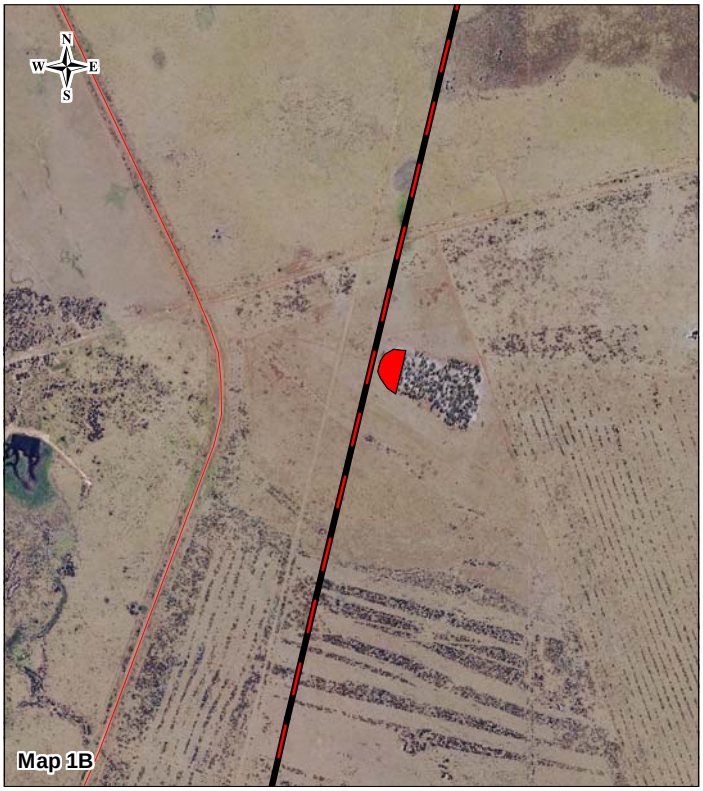
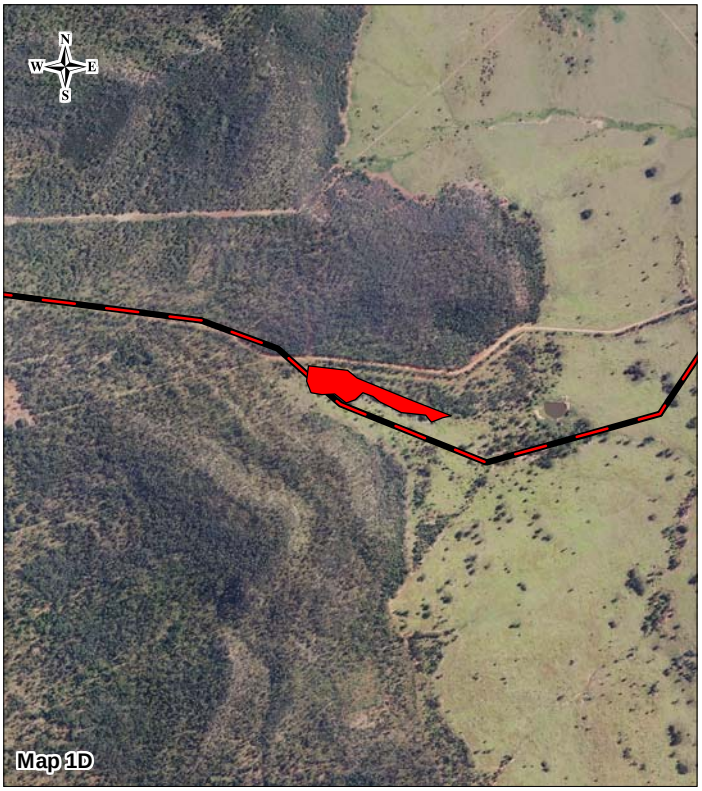
Client: LNG	Project: GLADSTONE LNG PROJECT EPBC ACT REPORT - GAS TRANSMISSION PIPELINE	Title: **MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE GAS TRANSMISSION PIPELINE KEY MAP 2 OF 2**
URS	Drawn: RG | Approved: JB | Date: 24-02-2009 Job No: **4262 6220** | File No: 42626220-g-762b.wor	Figure: **7-1b** | Rev:B | **A4**









Major Road
Secondary Road
Minor Road
Gas Transmission Pipeline
Major Drainage
Minor Drainage
Brigalow (*Acacia harpophylla* dominant and co-dominant)
Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

0 500 1000m

Scale: 1:25,000 (A4)
Datum: GDA94

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Client: LNG

URS

Project: GLADSTONE LNG PROJECT
EPBC ACT REPORT -
GAS TRANSMISSION PIPELINE

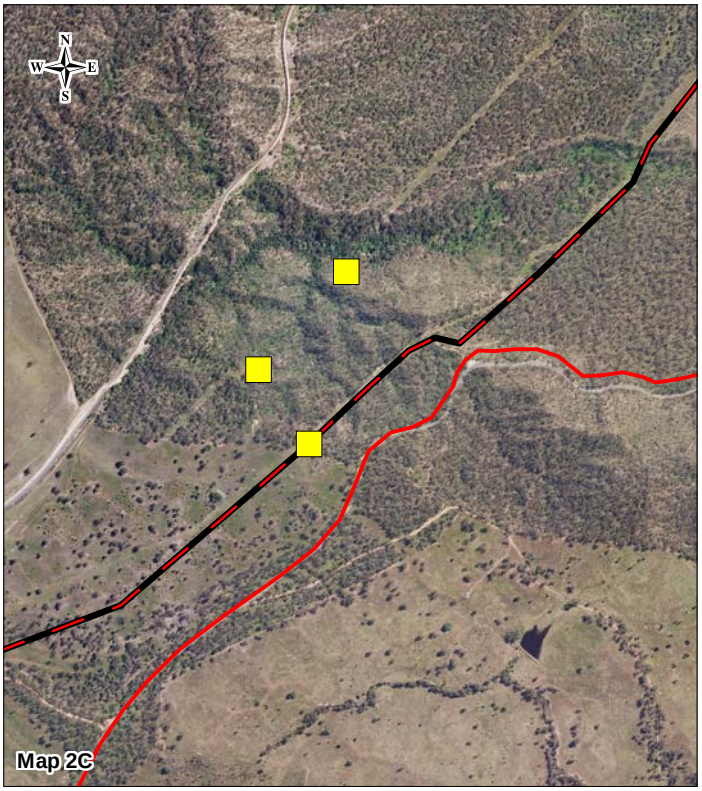
Title: **MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - GAS TRANMISSION PIPELINE (MAP 1 OF 2)**

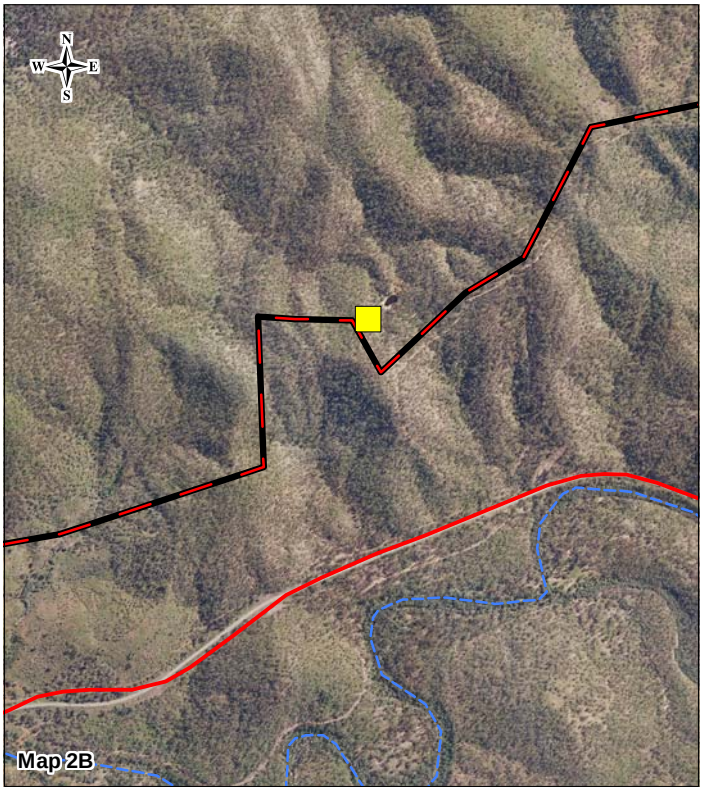
Drawn: RG	Approved: JB	Date: 24-02-2009
Job No: **4262 6220**	File No: 42626220-g-763b.wor	

Figure: **7-1c**

Rev:B

A4





Major Road

Secondary Road

Minor Road

Gas Transmission Pipeline

Major Drainage

Minor Drainage

Cycas megacarpa
(Endangered - EPBC Act)

0 500 1000m

Scale: 1:25,000 (A4)
Datum: GDA94

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Client: LNG	Project: GLADSTONE LNG PROJECT EPBC ACT REPORT - GAS TRANSMISSION PIPELINE	Title: **MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE - GAS TRANMISSION PIPELINE (MAP 2 OF 2)**
URS	Drawn: RG | Approved: JB | Date: 24-02-2009 Job No: **4262 6220** | File No: 42626220-g-764b.wor	Figure: **7-1d** | Rev:B | **A4**