7.4 Nature Conservation

7.4.1 Introduction

The gas transmission pipeline nature conservation study has been split into two study areas (the mainland and Curtis Island) and two disciplines, namely terrestrial flora and fauna. This nature conservation section addresses all of these areas in summary and is supplemented by detailed appendix reports (Appendix N2). The assessment of the potential marine impacts is addressed in Section 8.4. As there are a number of similarities between the study sections in relation to legislative and regional context and the study site descriptions these have been summarised in this introductory section.

In addition, the effect of the project's gas transmission pipeline component on matters of national environmental significance (MNES) has also been assessed. This has been undertaken in accordance with the requirements of the Environmental Protection Biodiversity Conservation (EPBC) Act 1999 and is reported separately in Appendix G (EPBC Act Report). Appendix G includes a specific section on the gas transmission pipeline (Section 6: Gas Transmission Pipeline – EPBC 2008/4096) and includes a description of proposed actions, a description of environmental values (MNES) and potential impacts to MNES and mitigation measures.

7.4.1.1 Study Area

The gas transmission pipeline will link the Coal Seam Gas (CSG) fields to the Liquefied Natural Gas (LNG) facility on Curtis Island. The gas transmission pipeline is to be approximately 435 km in length within a 30 m wide easement on the mainland and a 100 m wide combined user infrastructure easement on Curtis Island that will accommodate road and power infrastructure. The gas transmission pipeline route and study area are presented on Figures 7.4.1 and 7.4.2. Existing land use along the route is predominantly rural. Curtis Island and the Calliope, Callide, Dawson, Expedition and Carnarvon Range crossings are generally well-vegetated. Grazing and cropping dominates the remaining areas with few large expanses of remnant vegetation enduring. Isolated patches of woodland and riparian vegetation remain as relics of the extent of former widespread vegetation communities over the majority of the area.

Curtis Island

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 across at its widest point. It is located within the Gladstone Regional Council area.

Typical landforms on the island include moderate to steep wooded slopes, wooded alluvial plains, ephemeral watercourses, estuarine systems and fresh and saltwater wetlands. The gas transmission pipeline is to be constructed primarily in the basin of a narrow fluvial valley. The valley is dominated by *Eucalyptus* and *Corymbia* woodlands on moderate to low slopes. Mangrove and saltmarsh communities are present within intertidal areas. The gas transmission pipeline area displays disturbance consistent with a long history of land use that includes grazing, clearing, and selected timber felling. The presence of weeds and a history of fire have also impacted upon the ecological values of the site. Whilst the majority of the woodland is regrowth, mature trees are present, especially along the ephemeral creeks in the low-lying portions of the extended valley within which the gas transmission pipeline is proposed. In the north of the valley, streams discharge into Graham Creek. Southern streams drain to The Narrows north of China Bay.

Mainland Section

The gas transmission pipeline on the mainland traverses a range of landforms and land uses. The majority of the route (approximately 81 %) is situated within cleared land supporting grazing or cropping activities. The Calliope, Callide, Dawson, Expedition and Carnarvon ranges generally feature large expanses of bushland with various degrees of integrity. Isolated patches of bushland exist as open woodland, often along and adjacent to the waterways. Much of the bushland is held in forestry leases with

typical uses being commercial timber harvesting and grazing. The field survey indicated bushland on privately owned land is generally grazed and is often subject to light timber harvesting.

7.4.2 Methodology

7.4.2.1 Terrestrial Flora

This section outlines the background and baseline work undertaken to identify and map the vegetation communities and areas of vegetation or species of conservation significance within the gas transmission pipeline study area. It also assesses the potential impacts of the proposed works on the identified flora species and communities and the appropriate mitigation measures.

The key findings of the nature conservation (flora) assessment for the gas transmission pipeline are described within this section, with a full copy of the assessment report provided in Appendix N2. The gas transmission pipeline study area is presented in Figures 7.4.1 and 7.4.2.

Literature Review

The review of existing data aided the identification of the range of species, habitats and communities that may be present within the gas transmission pipeline study area. The sources reviewed included:

- Queensland Environmental Protection Agency (EPA) Herbarium flora database (HERBRECS);
- Queensland EPA Wildlife Online Database;
- Queensland EPA 1:100 000 Regional Ecosystems mapping;
- Queensland EPA Ecomap Environmentally Sensitive Areas database;
- Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) 'Matters of National Environmental Significance' EPBC database;
- Central Queensland University (2007) Flora and Fauna Assessment of the Calliope Ranges Roadway Realignment;
- Well Site Inspection Report – Emu Nest 1C (Boobook, 2008); and
- Environmental Management Plan for Fairview Project Area (Santos, 2008).

As a result of the literature review, 68 significant flora species listed under both state and commonwealth legislation were identified as being potentially present within the study area. Fifteen of these species were considered either 'possible' or 'likely' to be present within the gas transmission pipeline corridor based upon their known distributions and habitat requirements and were targeted as part of the field survey effort. A list of target species and ecological notes for each are provided in Appendix N2.

Flora Methodology Overview

The flora survey employed an assessment of floral taxa and vegetation communities in keeping with the methodology employed by the Queensland Herbarium for the survey of regional ecosystems and vegetation communities (Neldner et al., 2005). The survey design was established in consultation with the EPA. Surveys were restricted to a 100 m buffer either side of the gas transmission pipeline (200 m wide survey corridor).

Preliminary community definition using 1:100 000 Regional Ecosystems coverage (EPA, 2008a) was undertaken to identify locations for representative field survey plots to ground truth communities and obtain floristic and structural data. Fieldwork for the flora survey was conducted over three periods during May to October 2008 (dry season). A total of 32 days of field survey was undertaken by two qualified ecologists. Field surveys involved conducting botanical assessments in environmentally sensitive areas,

vegetation communities of conservation significance, riparian areas and EPA Essential Habitat[1]. A number of standard botanical assessment methods were employed including secondary transects, quaternary sample plots, and random meander searches. Vehicle traverses of the gas transmission pipeline study area were also undertaken throughout the survey period. Regional ecosystem classification of communities was determined as per Sattler and Williams (1999) and in accordance with the Regional Ecosystems Description Database (REDD) (EPA, 2005). Final vegetation mapping was undertaken utilising field survey data and aerial photograph interpretation of stereo pair images. Full details on the methodology employed including survey limitations and site access information are presented in Appendix N2.

Terrestrial Fauna

The assessment of fauna and habitat for the gas transmission pipeline study area was undertaken utilising different survey approaches for the Mainland and Curtis Island sections.

The approach for the mainland section utilised several accepted standard fauna assessment methodologies traditionally employed for the assessment of large scale corridors (HLA, 2006 & HLA, 2007), in this case approximately 420 km for the mainland section. This approach focussed on assessing fauna habitat values in conjunction with incidental observations and analysis of fauna signs along the corridor. The study area for the gas transmission pipeline was within a 100 m buffer either side of the nominated gas transmission pipeline centreline.

The smaller scale of the Curtis Island section, and the incorporation of a combined user infrastructure corridor (total width 100 m) necessitated a trapping fauna survey to be undertaken allowing for assessment of habitat and species diversity.

Aquatic surveys for both the mainland and Curtis Island gas transmission pipeline sections employed standard methodology for the assessment of aquatic habitat values and physical stream characteristics for ephemeral waterways.

Preliminary identification of vegetation communities and habitats of potential significance within both the Curtis Island and mainland gas transmission pipeline routes was conducted prior to the commencement of fieldwork via interpretation of colour aerial photography and RE. The survey design was established in consultation with the EPA.

Curtis Island

Following identification of potential habitat sites, fauna survey transect sites were selected to target and characterise key habitats within the study area. Fauna surveys were undertaken in keeping with the accepted standard methods for the systematic survey of terrestrial fauna in eastern Australia (Eyre et al., 1997 and EPA, 1999) and a number of non standard observational methods. Aquatic assessments were undertaken at a number of ephemeral waterways found within the study area using methodology in keeping with the AUSRIVAS Physical Assessment Protocol (Parsons et al., 2002) to record physical habitat descriptions. Surveys were conducted in accordance with the required permit and approval conditions. The Curtis Island fauna survey was undertaken over 10 days between 14 and 23 May, 2008.

Survey effort, methodology and survey limitations and weather conditions are described in further detail in Appendix N2. Fauna survey locations are shown on Figure 7.4.3.

Mainland

Following identification of potential habitat sites, fauna observations and analysis of fauna signs, tracks and scats were undertaken along the gas transmission pipeline route to enable identification of habitat

[1] Essential habitat is vegetation in which a species that is endangered, vulnerable, rare or near threatened has been known to occur.

values present. The assessments were conducted concurrently with the flora surveys at 124 sites (Figures 4 to 28 of Appendix N2). Sites were chosen based on accessibility, representativeness of habitat within the landscape and also to target areas identified as potential Essential Habitat by the EPA for conservation significant species.

Specific methods used to assess habitat value and fauna presence at each site included:

- Opportunistic observations of mammals, reptiles and amphibians;
- Targeted bird observations for the duration of the site assessment (45 minutes at each site);
- Opportunistic micro-habitat searches concentrating on features such as loose bark, fallen woody debris, cracking clay surfaces, rocky habitat and flowering trees; and
- Analysis of tracks, signs, scats and scratchmarks to indirectly determine faunal usage of the site.

Incidental observations of fauna were also recorded whilst driving through the region and between survey sites.

The flora and fauna assessments for the mainland gas transmission pipeline study area were undertaken during two survey periods; over the course of 20 days between 30 June and 25 July 2008 and over a 5 day period between 6 and 10 October 2008.

The assessment of aquatic values was undertaken as part of the surface water component of the EIS. Detailed results from this study can be found in Appendix O2. Aquatic assessments were undertaken at a number of waterways found within the study area using methodology in keeping with the AUSRIVAS Physical Assessment Protocol (Parsons et al. 2002) to record physical habitat descriptions.

Review of Existing Information

The review of existing data aided in the identification of the range of species and habitats that may be present within the gas transmission pipeline study area. The sources reviewed included:

- Department of Water, Heritage & the Arts (DEWHA) online Environmental Protection & Biodiversity Conservation (EPBC) Matters of Environmental Significance (MNES) database;
- Queensland Museum fauna records;
- Queensland Environmental Protection Agency Wildnet database;
- Queensland Environmental Protection Agency Essential Habitat mapping; and
- Species distribution maps from current field guides.

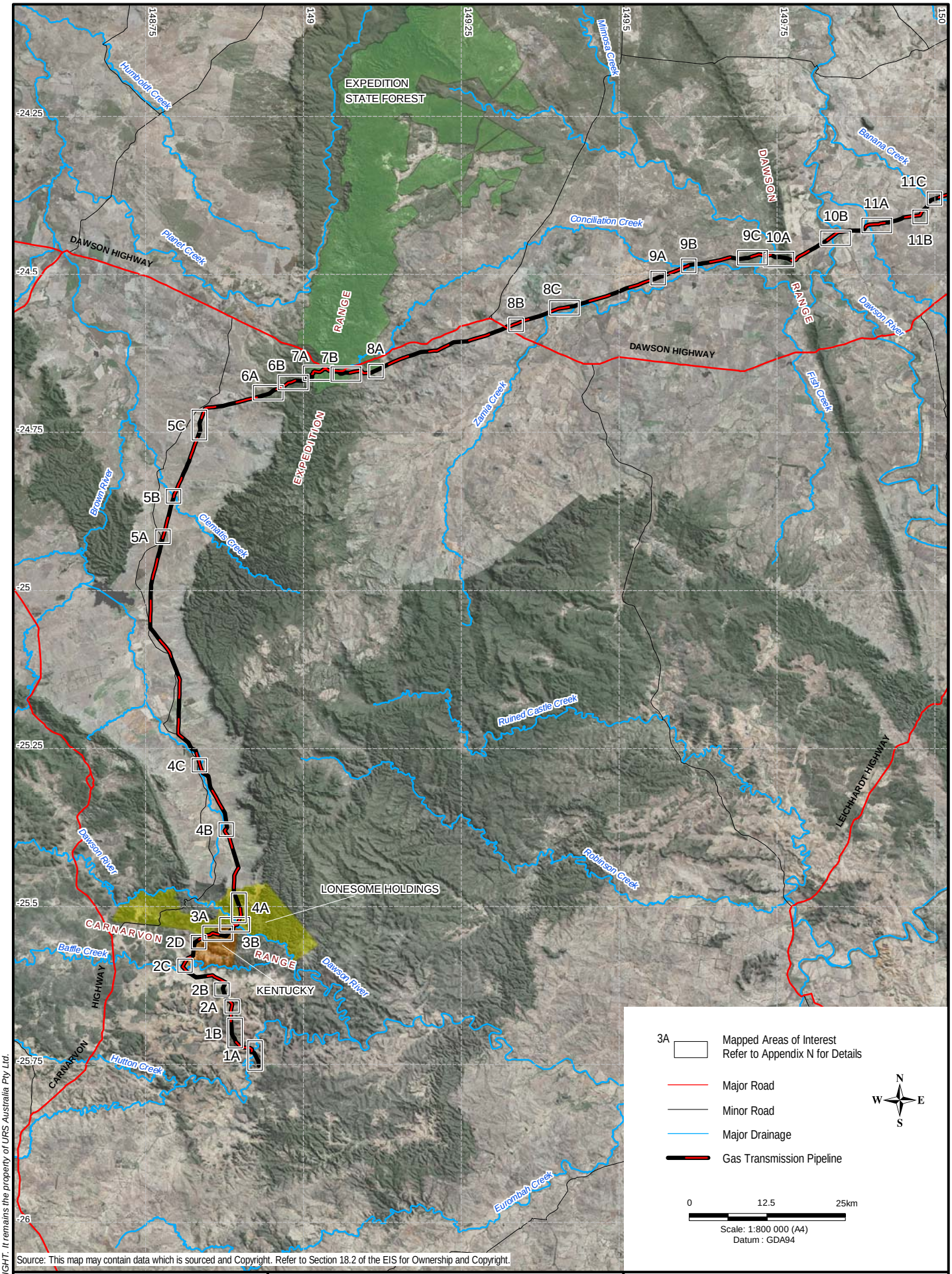
Significant species identified include any Critically Endangered, Endangered, Vulnerable or Rare taxa listed under:

- The Queensland *Nature Conservation (Wildlife) Regulation*, *2006* under the provisions of the Queensland *Nature Conservation Act, 1992* (NC Act); and
- The Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act).

The study area coordinates utilised for the above information sources are provided in Appendix N2. The gas transmission pipeline study area is the same as the flora study area and is presented in Figures 7.4.1 and 7.4.2.

7.4.3 Regulatory Framework

Refer to Section 6.4.3.



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Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT

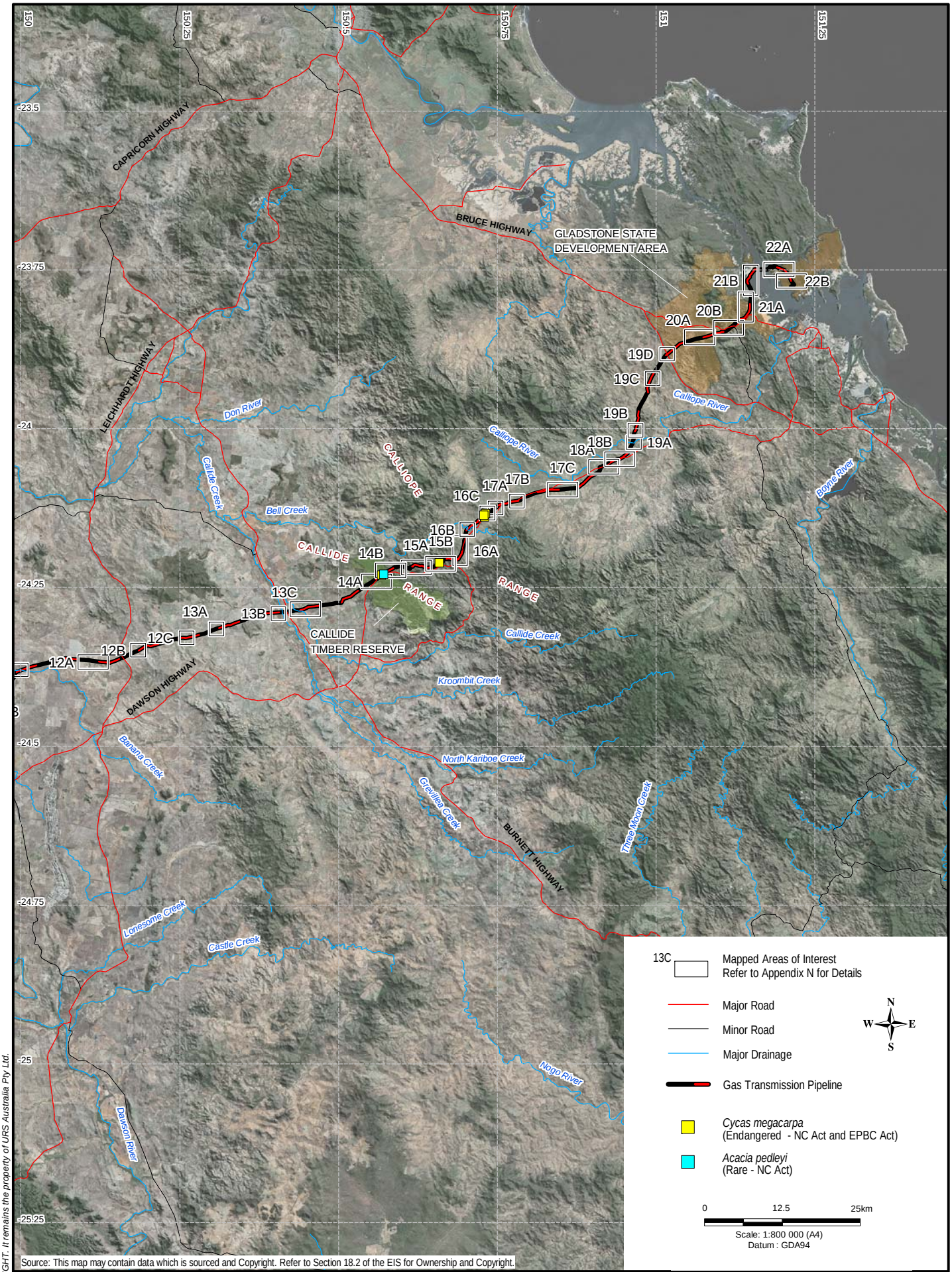
Title
GAS TRANSMISSION PIPELINE
FLORA STUDY AREA
WESTERN SECTION

Drawn: CA	Approved: JB	Date: 16-01-2009
Job No: **4262 6220**	File No: 42626220-g-877.wor	

Figure: **7.4.1**

Rev:A

A4



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Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title
GAS TRANSMISSION PIPELINE
FLORA STUDY AREA
EASTERN SECTION

Drawn: CA	Approved: JB	Date: 16-01-2009	Figure: **7.4.2**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-878.wor			**A4**

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Project

GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Drawn: RG | Approved: JB | Date: 16-01-2009

Job No: **4262 6220** | File No: 42626220-g-879.wor

Title

GAS TRANSMISSION PIPELINE
CURTIS ISLAND
FAUNA SURVEY LOCATIONS

Figure: **7.4.3**

Rev: A

A4

Graham Creek

Laird Point

North Passage Island

Ship Hill

151.17°E

151.18°E

151.19°E

23.74°S

23.75°S

23.76°S

23.77°S

N
W E
S

0 250m 500m
Scale: 1:25 000 (A4)
Datum : GDA94

- LNG Facility Site Boundary
- Gas Transmission Pipeline
- Potential Site Access Road
- Track
- Drainage
- Area of Spotlighting
- Elliott Trapline Centre of Transect
- Pitfall Trapline Centre of Transect
- Anabat
- Location of Powerful Owl Sighting
- Location of Glossy Black Cockatoo Sighting

7.4.4 Existing Environmental Values

7.4.4.1 Regional Context

Bioregion

The gas transmission pipeline corridor is predominantly situated within the Brigalow Belt bioregion, with a small northern section situated within the South-East Queensland bioregion. The bioregions of Queensland are based on landscape patterns that reflect changes in geology and climate, as well as major changes in floral and faunal assemblages at a broad scale and are used as the fundamental framework for the planning and conservation of biodiversity.

Subregion

The Brigalow Belt bioregion contains 36 sub-regions or provinces that delineate significant differences in geology and geomorphology (Young et al., 1999). The gas transmission pipeline falls within several sub-regions within the Brigalow Belt including the Mount Morgan Ranges, Callide Creek Downs, Banana-Auburn Ranges, Dawson River Downs, Arcadia, and Carnarvon Ranges.

The South-East Queensland bioregion contains 10 sub-regions or provinces that delineate significant differences in geology and geomorphology (Young and Dillewaard, 1999). The section of the gas transmission pipeline corridor within the South-East Queensland bioregion is located only within the Burnett-Curtis Hills and Ranges sub-region.

Regional Ecosystems (REs)

A description of the Queensland Herbarium developed RE maps and their legislative importance is provided Appendix N2. Within the identified 7 sub-regions occurring along the gas transmission pipeline (see above) the number of REs mapped within each sub-region ranges from 50 to 104. Following field assessment a total forty-seven REs were identified as being present within the gas transmission pipeline study area. REs of relevance are further discussed below.

Environmentally Sensitive Areas – Mainland and Curtis Island

Curtis Island

Desktop studies have ascertained that there are no environmentally sensitive areas[2] that will be impacted by the gas transmission pipeline. A number of sensitive areas are located on or around Curtis Island or in the region as described below. There are no Ramsar-listed wetlands on or near Curtis Island (EPA, 2007).

World Heritage Areas

The Great Barrier Reef Marine Park (GBRMP) extends for approximately 2,000 km along the Queensland coast. On the western side of Curtis Island, the GBRMP stretches along The Narrows, south to Graham Creek, approximately 6 km north of the study area (GBRMPA, 2003).

[2] Environmentally sensitive areas include areas classified as having national, state, regional or local biodiversity significance, or flagged as important for their integrated biodiversity values. Other areas could include nature refuges, national parks, conservation parks, declared fish habitat areas, wilderness areas, aquatic reserves, heritage/historic areas or items, national estates, world heritage listings and sites covered by international treaties or agreements (e.g. Ramsar, Japan-Australia Migratory Bird Agreement, China-Australia Migratory Bird Agreement), areas of cultural significance and scientific reserves.

Commonwealth Reserves

The Commonwealth *Great Barrier Reef Marine Park Act 1975* (GBRMP Act) established the Great Barrier Reef Region (GBR Region), within which sections of the GBRMP were established and are controlled and developed. The boundary of the GBR Region is nearly identical to that of the GBRWHA with the exclusion of state owned islands and internal waters. Approximately 2% of the GBRWHA is not within the Region or declared as Marine Park.

State Parks, Reserves, Forests and Refuges

The following estates are present on Curtis Island. All are located north of Graham Creek, except for Garden Island Conservation Park which is located approximately four kilometres to the east of the study site (EPA, 2007) and the GBRMP. The marine coast park includes all tidal waters and tidal land between the tip of Cape York to Baffle Creek (north of Bundaberg) and extends approximately three nautical miles seaward from Highest Astronomical Tide (HAT).

- Great Barrier Reef Coast Marine Park;
- Cape Capricorn Conservation Park;
- Curtis Island Conservation Park;
- Curtis Island National Park;
- Curtis Island State Forest;
- North Curtis Island State Forest;
- Curtis Island Nature Refuge; and
- Garden Island Conservation Park.

Further details on the marine parks and associated legislation can be found in Section 8.4.

Nationally Important Wetlands

The Directory of Important Wetlands in Australia (DIWA) lists four nationally important wetlands in the area (DEW, 2005):

- Great Barrier Reef Marine Park;
- Northeast Curtis Island;
- Port Curtis; and
- The Narrows.

Referable Wetlands

A map of referable wetlands under the *Integrated Planning Regulation 1998* (subordinate to the *Integrated Planning Act* 1994) indicates that there are no referable wetlands at or near the study area (EPA, 2008b).

Essential Habitat

RE 12.3.3 (*Eucalyptus tereticornis* woodland to open forest on alluvial plains) within the study area has been mapped by the EPA as Essential Habitat for the koala (*Phascolarctos cinereus*) (EPA, 2008c).

Mainland Section

Conservation and forestry areas located in the vicinity of the mainland gas transmission pipeline corridor are listed in Section 7.11. Those areas directly impacted by the gas transmission pipeline include the Expedition State Forest and the Callide Timber Reserve.

7.4.4.2 Terrestrial Flora

This section documents the flora and vegetation communities of the gas transmission pipeline. Community descriptions and quantitative data, including floristics and structure for each survey site as well as complete flora species list for all taxa identified is provided in Appendix N2.

Species Diversity

The field survey identified the presence of 302 taxa representing 74 families and 210 genera. There was a relatively high diversity of weed species within the gas transmission pipeline study area with 40 exotic taxa identified representing 16 families.

A full flora species list and a list of exotic species are provided in Appendix N2.

Vegetation Communities

Forty-seven REs covering a total of 8,575 ha were described and mapped within the gas transmission pipeline study area, based upon the field survey results and interpretation of aerial photo stereo images. A description of the total area of each community found within the 100 m buffer of the preferred gas transmission pipeline route and the percentage extent of that community as part of the wider bioregion is provided in Appendix N2. Community descriptions including floristics, structure, location, ecological integrity and disturbance notes as well as details figures are also provided in Appendix N2.

The remnant vegetation present within the gas transmission pipeline corridor is largely restricted to the range crossings of the Calliope Range, Callide Range, Dawson Range, Expedition Range and Carnarvon Range. Major watercourses such as the Dawson River have also retained a significant amount of remnant riparian vegetation. The mainland section of the gas transmission pipeline study area supported 47 REs. The Curtis Island section of the gas transmission pipeline study area supported 6 REs. All of the vegetation areas surveyed have been disturbed or modified to some degree by grazing, thinning, clearing for agriculture or weed invasion.

The most common RE within the mainland section of the gas transmission pipeline study area was narrow-leaved ironbark woodland which was recorded along several of the range crossings. This RE (RE 11.11.15) supported a canopy dominated by *Eucalyptus crebra* (narrow-leaved ironbark) with sub-dominant species including *Corymbia erythrophloia* (gum-topped bloodwood).

The second most common RE was lemon-scented gum open forest. This RE (RE 11.10.1) was recorded within several of the range crossings and was characterised by a tall canopy of *Corymbia citriodora* subsp. *citriodora* (lemon-scented gum).

Other common REs occurring on the range crossings included RE 11.10.7 (*Eucalyptus crebra* woodland) and RE 11.10.13 (*Eucalyptus* spp. and/or *Corymbia* spp. open forest).

The majority of the major creek crossings along the gas transmission pipeline corridor supported forest red gum woodland fringing drainage lines (RE 11.3.25).

Within the Curtis Island section of the gas transmission pipeline corridor the hill top and mid-slope areas support open forest dominated by *Corymbia citriodora* subsp. *citriodora* (lemon-scented gum) (RE 12.11.6); and the lower slopes and more flat, coastal areas generally support grassy woodlands dominated by *Eucalyptus tereticornis* (forest red gum) and *Eucalyptus crebra* (narrow-leaved ironbark) (RE 12.11.14). The ground layer of RE 12.11.6 was found to be relatively sparse due to the rocky substrate and shallow soils exhibited on the slopes and hills on the site.

Saltpan (RE 12.1.2 and 11.1.2a) and mangrove (RE 12.1.3 and 11.1.4) communities were present along the sheltered intertidal zones at the western side of Curtis Island (Hamilton Point) and along the mainland route along the western side of The Narrows. Environmental values of the intertidal zone are detailed further in the Marine Flora and Fauna section of the EIS report.

Weeds of Concern

Of the 40 exotic weed species recorded in this survey, 10 are declared species under the Queensland *Land Protection (Pest and Stock Route Management) Act, 2002* (Table 7.4.1). Three of these species (rubber vine, lantana and parthenium) are also listed as Weeds of National Significance (WONS). WONS are exotic weed species identified as causing significant environmental damage on a national scale (Thorp and Lynch, 2000). All exotic weed species identified in this study are listed within the full flora species list in Appendix N2. The locations of declared weeds recorded during the field survey are presented in Appendix N2.

Table 7.4.1 Declared exotic weeds present along gas transmission pipeline

Species	Common Name	State/Federal Declared Status[1]	Regional Ecosystems affected
*Bryophyllum delagoense**	Mother of millions	Class 2	11.3.25
*Celtis sinensis**	Chinese celtis	Class 3	11.3.25
*Cryptostegia grandiflora**	Rubber vine	Class 2/WONS	11.3.25; 12.11.7
*Eriocereus martinii**	Harrisia cactus	Class 2	12.11.6
*Lantana camara**	Lantana	Class 3/WONS	11.12.1; 11.11.3; 11.10.1; 11.3.25; 12.11.6
*Lantana montevidensis**	Creeping lantana	Class 3	11.9.9; 11.10.1; 11.11.15; 11.11.3; 11.12.17; 11.3.25
*Macfadyena unguis-cati**	Cat's claw creeper	Class 3	11.3.25
Opuntia stricta var. *stricta**	Prickly pear	Class 2	11.3.25; 12.11.7; 12.11.14
*Opuntia tomentose**	Velvety tree pear	Class 2	11.3.3; 11.3.4; 11.3.25; 11.9.2; 11.10.11; 11.11.3; 12.11.6
*Parthenium hysterophorus**	Parthenium	Class 2/WONS	11.3.25; 11.3.3; 11.8.5.

[1] Status under the Queensland *Land Protection (Pest and Stock Route Management) Act, 2002* and Weeds of National Significance.

Vegetation of Significance

Conservation Significant Species

The desktop literature review identified 68 flora species of conservation significance as being potentially present along the gas transmission pipeline. Fifteen of the 68 potentially occurring species were considered either 'possible' or 'likely' to be present within the gas transmission pipeline corridor based upon their known distribution or habitat requirements and were targeted as part of the field survey effort.

Two flora species of conservation significance were identified from the field survey: *Cycas megacarpa* and *Acacia pedleyi* (Table 7.4.2). The locations where these two species were recorded are presented in Appendix N2.

Table 7.4.2 Conservation Significant species recorded from gas transmission pipeline

Species Name	NC Act Status	EPBC Act Status
Cycas megacarpa	Endangered	Endangered
Acacia pedleyi	Rare	Not Listed

Cycas megacarpa

The cycad *Cycas megacarpa* is listed as 'Endangered' under both the NC Act and the EPBC Act. *Cycas megacarpa* is endemic to central Queensland although its distribution is restricted, occurring from

Bouldercombe in the north, to near Woolooga in the south, in woodland or open woodland dominated by eucalypts (Queensland Herbarium, 2007). A Central Queensland University investigation (CQU, 2007) recorded four separate communities of *Cycas megacarpa* within the Calliope Ranges, although the study was not extensive throughout the area. The extent of *Cycas megacarpa* populations known from the area based upon HERBRECS data is provided in Appendix N2.

Cycas megacarpa was recorded from three locations within the Callide and Calliope Ranges. 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.

Acacia pedleyi

Acacia pedleyi is a wattle that is listed as 'Rare' under the NC Act but is not listed under the EPBC Act. The species was identified at only one location along the gas transmission pipeline corridor within the Callide Range where it was observed as an uncommon shrub layer species.

Other Potentially Occurring Conservation Significant Species

Cadellia pentastylis (ooline tree) was anecdotally recorded at one property within the Arcadia Valley ("Huntly" property landholder, pers. comm., 2008). The species was identified within the desktop review as being likely within the region but was not observed during the field survey. This species is listed as 'Vulnerable' under the NC Act and EPBC Act.

The exact location of the species within the property is not known, however the gas transmission pipeline is restricted to cleared areas of this property and as such any individuals of this species present will not be affected by the gas transmission pipeline.

In addition to the three conservation significant species discussed above the literature review (Appendix N2) identifies 12 species that are considered 'likely' or 'possible' occurrences within the gas transmission pipeline corridor. 'Likely' occurrences are identified as *Acacia pubicosta, Gossypium sturtianum* and *Macrozamia fearnsidei*. 'Possible' occurrences are identified as *Alyxia sharpei, Apatophyllum teretifolium, Aponogeton queenslandicus, Desmodium macrocarpum*, *Dichanthium queenslandicum*, *Grevillea cyranostigma, Grevillea hockingsii, Homoranthus decasetus,* and *Wahlenbergia islensis*. None of these additional species were recorded during field surveys however their presence cannot be ruled out.

Culturally Significant Species

Within the gas transmission pipeline corridor many flora species of cultural significance were identified including species traditionally utilised for food or medicinal purposes, painting or decoration. Common bush tucker foods identified include *Avicennia marina* (grey mangrove), *Carissa ovata* (currant bush), *Dianella* species, *Eustrephus latifolius* (wombat berry), *Ficus* species, *Lomandra multiflora* (many-flowered mat rush), *Marsilea hirsuta* (short-fruit nardoo), *Melaleuca* species, *Portulaca oleracea* (pigweed) and *Sarcocornia quinqueflora* (bead weed). Species of cultural value to the indigenous traditional owners of the area are discussed within gas transmission pipeline Cultural Heritage Report.

Commercially Significant Species

Many of the woodland species identified within the gas transmission pipeline study area are considered a potential commercial resource and suitable timber for flooring, telephone poles and other wood products. Commercial timber sources found within the study area include *Corymbia citriodora* subsp*. citriodora* (lemon-scented gum); *Eucalyptus crebra* (narrow-leaved ironbark); and *Eucalyptus tereticornis* (forest red gum), (Taylor and Williamson, 2000).

Marine Plants

All areas supporting 'marine plants' are protected under the Queensland *Fisheries Act 1994*. Under this Act, the term 'marine plant' includes plants that usually grow on, or adjacent to tidal lands. For the gas

transmission pipeline this will include all areas of mangrove and saltmarsh communities occurring within the gas transmission pipeline corridor, adjacent to The Narrows, including RE 12.1.2, RE 12.1.3, RE 11.1.2 and RE 11.1.4. This may also include plants such as *Melaleuca* species (paper barks) and *Casuarina* species (she-oaks) that occur in adjoining alluvial REs.

Significant Vegetation Communities

Eighteen vegetation communities recorded within the gas transmission pipeline study area are identified as having either 'Of Concern' or 'Endangered' Vegetation Management Status (VM Status) and 'Of Concern' or 'Endangered' biodiversity status. Nine of these vegetation communities are also listed under the EPBC Act as 'Endangered'. The conservation status of these communities is detailed in Table 7.4.3.

Table 7.4.3 Significant Vegetation Communities recorded within 100 m buffer along gas transmission pipeline

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of Concern	Of Concern	Not Listed
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	Of Concern	Of Concern	Not Listed
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp.	Of Concern	Of Concern	Not Listed
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	Of Concern	Endangered	Not Listed
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	Not Listed
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	Endangered	Endangered	Endangered
11.4.9a	*Acacia harpophylla, Lysiphyllum carronii* ± *Casuarina cristata* open-forest to woodland.	Endangered	Endangered	Endangered
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with Terminalia oblongata on Cainozoic clay plains	Endangered	Endangered	Endangered
11.8.11	*Dichanthium sericeum* grassland on Cainozoic igneous rocks	Of Concern	Of Concern	Endangered
11.9.4	Semi-evergreen vine thicket on fine grained sedimentary rocks	Endangered	Endangered	Endangered
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Endangered	Endangered
11.10.8	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	Of Concern	Of Concern	Not Listed
11.11.18	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands	Endangered	Endangered	Endangered
11.12.3	*Eucalyptus crebra, E. tereticornis*, *Angophora leiocarpa* woodland on igneous rocks especially granite	Not of Concern	Of Concern	Not Listed
11.12.17	*Eucalyptus populnea* woodland on igneous rocks. Colluvial lower slopes	Endangered	Endangered	Not Listed

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status
12.3.1	Gallery rainforest (notophyll vine forest) on alluvial plains	Endangered	Endangered	Not Listed
12.3.3	*Eucalyptus tereticornis* woodland to open forest on alluvial plains	Endangered	Endangered	Not Listed
12.11.14	*Eucalyptus crebra, E. tereticornis* woodland on metamorphics ± interbedded volcanics	Of Concern	Of Concern	Not Listed

7.4.4.3 Terrestrial Fauna

As a result of the literature review 46 conservation significant terrestrial fauna species (31 birds, 9 reptiles and 6 mammals) listed under both state and commonwealth legislation were identified as potentially occurring within the study area. Habitat for these species was targeted for identification during the field survey. A list of the target species and ecological notes for each are provided in Appendix N2.

Curtis Island Fauna Diversity

A total of 51 native and 5 introduced terrestrial vertebrate species were recorded during the field survey within the Curtis Island gas transmission pipeline study area. Native species included 5 reptile, 39 bird and 7 mammal species. A complete fauna species list for all taxa identified on Curtis Island is provided in Appendix N2.

The diversity of fauna found on the site was very low. Many species that typically might be expected to be present utilising the habitat available were not detected. The conspicuous absence of an assemblage of ground dwelling mammals is considered to be due to a number of factors including the degree of disturbance to ground cover from current and historical grazing, presence of exotic flora in the groundcover; the extended drought conditions preceding the survey year, impacts from other historical land use disturbances such as fire, timber felling and thinning, and the high number of feral species known to be active in the locality.

Amphibians

Only one amphibian was recorded during the surveys in the Curtis Island gas transmission pipeline study area; the exotic cane toad (*Bufo marinus*). Whilst common, cane toads were not as obvious within the gas transmission pipeline study area as those found at the adjacent LNG facility site. No native frogs were observed during the survey period, but habitat for common species such as green tree frog green tree frog (*Litoria caerulea*), desert tree frog (*Litoria rubella*), ornate burrowing frog (*Limnodynastes ornatus*) and northern banjo frog (*Limnodynastes terrareginae*) was present and these species would be expected to be readily detectable during periods of more suitable conditions.

Reptiles

Five species of reptile were recorded during the Curtis Island gas transmission pipeline survey, including one gecko (Gekkonidae), three skink (Scincidae) and one colubrid (Colubridae) snake species. This is a lower recorded diversity compared with the adjacent LNG facility site, where twelve species of reptile were recorded.

Birds

Thirty-nine bird species were recorded within the Curtis Island gas transmission pipeline study area. In conjunction with those found at the LNG facility site, a total of 70 birds species were recorded from the south-west coast of Curtis Island during the surveys. Birds were recorded from all feeding groups, especially insectivores, nectarivores, marine raptors and shore/ wading birds.

Mammals

Seven species of native mammals were recorded during the Curtis Island gas transmission pipeline survey, indicating a relatively low diversity of this group. No ground mammals were captured in the Elliott or pitfall traps. Two species of arboreal mammals; the common brushtail possum (*Trichosurus vulpecula*) and squirrel glider (*Petaurus norfolcensis*) were recorded within woodland communities at low densities. The eastern grey kangaroo (*Macropus giganteus*) was commonly observed within the gas transmission pipeline study area. Four species of microbat were positively identified from ultrasonic call analysis.

Including results from the adjacent LNG facility site survey, ten microbat species are utilising the woodlands of the south-west coast of Curtis Island. As there are few rocky outcrops or caves existing in this area, it is apparent that arboreal hollows are an important microbat roost habitat in the area.

Aquatic Fauna

There are no permanent freshwater bodies present within the Curtis Island gas transmission pipeline study area. No water was present within the ephemeral waterways during the study. Even at times of flow, the waterways within the study area would not be expected to support an assemblage of fish species as there are no core populations present in the locality to act as sources for migration and reintroduction of species. Semi-aquatic fauna such as frogs would be present and would utilise ponds in the waterways for breeding. Further details on the aquatic habitat present are presented below.

Curtis Island Habitat Values

The Curtis Island gas transmission pipeline study area is mainly located within a shallow, narrow valley between low metamorphic ranges. Dominant vegetation communities present include lemon-scented gum (*Corymbia citriodora* subsp. *citriodora*) and narrow-leaved ironbark (*Eucalyptus crebra*) woodlands. These are generally found on low hills on skeletal and rocky soils. Most trees are immature; a sign that this community has been subjected to clearing or thinning in the past. A small number of mature trees scattered throughout bear habitat hollows which would support populations of arboreal mammals, microbats and nocturnal birds. Spotlighting in this community detected very low densities of arboreal (tree dwelling) fauna.

Whilst some areas support a dense understory much of the community is devoid of a shrub layer. Similarly, the ground layer is variably dense or sparse depending upon shade and soil depth. There is generally an abundance of ground habitat features such as timber, rocks and clumps of native grasses. Areas supporting a denser mid-storey are attractive to forest birds, whilst honeyeaters and canopy gleaners are active in the canopy.

Within the valleys and gullies, narrow fringing woodland of forest red gum (*E. tereticornis*) is found along the ephemeral watercourses. Trees of this species are generally mature with a large number of habitat hollows. A low tree layer featuring wattles (*Acacia* spp.), sheoak (*Allocasuarina torulosa*) and juvenile *Eucalyptus* and *Corymbia* species is present. The alluvial areas generally possess a denser ground covering due to the moister microclimate and more fertile soils in these areas.

As elsewhere in the area, ground habitat features are abundant and include rank grasses, fallen timber and microhabitat within the creek lines. Field studies confirmed that the high concentration of hollows within the alluvial communities support arboreal fauna such as the common brushtail possum (*Trichosurus vulpecula*) and squirrel glider (*Petaurus norfolcensis*), along with their primary predator, the powerful owl (*Ninox strenua*). The canopy, when in blossom, supports flocks of lorikeets, honeyeaters and insectivores. Where a denser mid-layer is present, insectivorous birds such as the rufous whistler (*Pachycephala rufiventris*), satin flycatcher (*Myiagra cyanoleuca*) and grey fantail (*Rhipidura fuliginosa*) are active.

At Laird Point, mangrove and saltmarsh communities inhabit the intertidal areas. The terrestrial woodland typically merges into grassland dominated by exotic pastures species and then to saltmarsh, claypan and mangroves communities. Spotted mangrove (*Rhizophora stylosa*) is the dominant species, often in association with grey mangrove (*Avicennia marina*) and black mangrove (*Lumnitzera racemosa*). The

littoral communities offer significant feeding resources for shore/ wader birds such as the whimbrel (*Numenius phaeopus*) and beach stone-curlew (*Esacus neglectus*). Mangroves are also productive for members of the swallow, honeyeater and gerygone groups.

The majority of waterways within the gas transmission pipeline study area are ephemeral. An analysis of the physical characteristics shows that while habitat features such as undercut banks, a variety of substrate types and instream debris and plants are present, the ephemeral nature of the watercourses reduces opportunities for aquatic fauna. Even at times of flow, the waterways within the study area would not support fish as there are no populations present to act as sources for reintroduction of species. Semi-aquatic fauna such as frogs would be present and would utilise ponds in the waterways for breeding following rain events.

Mainland Gas Transmission Pipeline Fauna Diversity

Seventy-two native and eight introduced terrestrial vertebrate species were recorded during the field survey of the mainland gas transmission pipeline study area. Native species included two reptile, 64 bird and five mammal species. A complete fauna species list for all taxa identified is provided in Appendix N2.

Fauna surveys of the mainland gas transmission pipeline corridor were primarily based on fauna habitat assessment as opposed to a targeted census of faunal diversity. Diversity of fauna recorded for the gas transmission pipeline is indicative based on opportunistic observational methods. Diurnal birds (active during the day) were usually easily observed directly or from calls during the vegetation surveys. Larger mammals were readily identified from observations or analysis of scats and tracks. Core habitat areas, such as found on the range crossings, were found to support a greater diversity of fauna, as would normally be anticipated.

Amphibians

Only one amphibian was recorded during the surveys along the mainland gas transmission pipeline; the exotic cane toad (*Bufo marinus*). No native frogs were observed. Common species such as the green tree frog (*Litoria caerulea*), desert tree frog (*Litoria rubella*), ornate burrowing frog (*Limnodynastes ornatus*) and northern banjo frog (*Limnodynastes terrareginae*) would be expected to be present within the more integral habitat types and watercourses found along the gas transmission pipeline study area.

Reptiles

Three reptile species were recorded within the mainland gas transmission pipeline study area, including the striped wall skink (*Cryptoblepharus virgatus*), the eastern brown snake (*Pseudonaja textilis*) and the yellow-faced whip snake (*Demansia psammophis*). All are common species, with the striped wall skink constantly encountered on walls, posts and tree trunks. A number of snakes were seen at various times crossing roads or within scrub. These could not be positively identified. As with amphibians, reptiles are typically more diverse in floristically-rich vegetation communities, such as those found in the range crossings along the mainland gas transmission pipeline study area, although will readily utilise pastures seeking prey such as rodents. Riparian vegetation acts as significant hunting and dispersal habitat in such fragmented landscapes.

Birds

Sixty-five species of avian fauna were recorded from sites along the mainland gas transmission pipeline. Birds were recorded from all feeding groups, especially forest gleaners, insectivores, nectarivores and raptors. Whilst rain was recorded during phases of the assessment, there were few ephemeral wetlands with standing water, and therefore waterbirds are poorly represented given the linear extent of the survey.

Mammals

Eleven species of mammal were detected by incidental observations or analysis of signs (e.g. scats, tracks or scratchmarks) during the mainland gas transmission pipeline study. Of the 11 species observed, six are native and the remainder either domestic stock or true feral animals. Macropods,

including the eastern grey kangaroo (*Macropus giganteus*), whiptail wallaby (*Macropus parryi*), red-necked wallaby (*Macropus rufogriseus*) and swamp wallaby (*Wallabia bicolor*) dominate the native species due to their size and the evidence of their presence. The echidna (*Tachyglossus aculeatus*) was mainly detected through location of their distinctive scats along the length of the gas transmission pipeline.

The presence of water rat (*Hydromys chrysogaster*) was perceived from mussel shells left at a 'feeding table' on a low wooden bridge pylon. Whilst platypus (*Ornithorhynchus anatinus*) were not observed during the survey, they are known to be present in many of the creek systems along the gas transmission pipeline including Hutton Creek at the Fairview CSG field (Connell Wagner, 2008).

A range of other native species including members of the rodent, dasyurid, glider, microbat and possum groups would be present in areas along the gas transmission pipeline, especially within core habitat such as on the forested ranges.

Aquatic fauna

Many of the streams and rivers on the mainland that the gas transmission pipeline crosses are permanent or semi-permanent waterbodies. The objective of aquatic surveys within the gas transmission pipeline study area was to characterise in-stream features and aquatic habitat. It is expected that fish such as the silver perch (*Bidyanus bidyanus*), spangled perch (*Leiopotherapon unicolor*), saratoga (*Scleropages leichardti*), bony bream (*Nematalosa erebi*) and freshwater catfish (*Tandanus tandanus*) would be present in many of the larger waterways crossed by the gas transmission pipeline. A variety of turtles would be also expected to utilise waterways along the gas transmission pipeline route, including Krefft's river turtle (*Emydura macquarii krefftii*), broad-shelled river turtle (*Macrochelodina expansa*) and saw-shelled turtle (*Wollumbinia latisternum*).

The 'Vulnerable' (NC Act and EPBC Act) Fitzroy turtle (*Rheodytes leukops*) is restricted to the waterways of the Fitzroy River Catchment. The majority of waterways crossed by the gas transmission pipeline do not satisfy its need for high water clarity and the presence of pool-riffle systems. The platypus (*Ornithorhynchus anatinus*) has been recorded from the Calliope River, Hutton Creek and many other catchments through which the gas transmission pipeline traverses. Being secretive and active at dawn and dusk, it may be present in more waterways than currently acknowledged. Semi-aquatic fauna such as amphibians and the water rat (*Hydromys chrysogaster*) are also present in waterways along the gas transmission pipeline route.

Mainland Gas Transmission Pipeline Habitat Values

The majority of the mainland gas transmission pipeline corridor has been cleared of native vegetation for cropping and grazing. However, several core extents of remnant vegetation, primarily on the ranges (i.e. Calliope, Callide, Dawson, Expedition and Carnarvon), act as valuable habitat for fauna. Most of these areas have experienced impacts from grazing, forestry and other activities. Therefore it is likely that these areas no longer support a diversity of fauna susceptible to disturbance such as small ground mammals and some reptiles. Macropods such as pretty-faced wallabies (*Macropus parryi*) and eastern grey kangaroos (*Macropus giganteus*) benefit from the mosaic pattern of vegetation which provides both shelter and forage opportunities. Conversely, populations of arboreal mammals and hollow nesting birds have been adversely affected in places by the loss of hollow-bearing trees. However, mature trees such as forest red gums (*E. tereticornis*) along creeks and rivers, often the only remnant vegetation in the landscape, provide habitat for arboreal species.

Furthermore, riparian corridors often act as the only opportunity for fauna and flora movement and dispersal in rural areas. Birds, being mobile animals, are generally less impacted by fragmentation of vegetation. Whilst individual habitat and feeding requirements are often disrupted, thus reducing species' distributions, isolated stands of bushland and riparian vegetation enable movement across the landscape. The resilience of birds in particular in this matrix is reflected in the diversity recorded during the survey.

Most aquatic ecosystems found along the mainland gas transmission pipeline are ephemeral and therefore faunal use is generally restricted to episodes of water flow. However, systems such as the

Calliope and Dawson Rivers are permanent or comprise permanent isolated waterholes. Within these systems fish, turtles and platypus populations can exist. Physical features such as undercut banks, in stream timber, overhanging vegetation and deep pools contribute to overall aquatic habitat values.

A summary of the vegetation types, associated habitats and identified fauna species for the Carnarvon Range, Expedition Range, Dawson Range, Callide Range, Calliope Range, riverine vegetation and cleared vegetation are provided in Appendix N2.

Introduced Species - Mainland and Curtis Island

Eight introduced fauna species were recorded during the gas transmission pipeline study. Grazing lands along the gas transmission study area support domesticated horses (*Equus caballus*) and cattle (*Bos taurus*). Cane toads (*Bufo marinus*) were plentiful on Curtis Island, but were less obvious in drier sections on the mainland. Signs of feral pigs (*Sus scrofa*), rabbits (*Oryctolagus cuniculus*) and wild dogs/ dingoes (*Canis lupus dingo*) were locally common in areas along the gas transmission pipeline corridor. The fox (*Vulpes vulpes*) was observed at one site on the mainland, and is expected to be common along the route.

Significant Fauna Species - Mainland and Curtis Island

Significant fauna species include those recognised under various categories of the NC Act or EPBC Act[3]. The potential presence of significant species in a designated area is determined through a search of available databases such as Wildlife Online and the EPBC Protected Matters Report. These searches are very broad and therefore are only useful as a guide to the potential presence of a species. Many species are captured within the databases as rare vagrants or occasional visitors and therefore a listing is not necessarily indicative of habitation, regular usage, or dependence upon that area. Conversely, absence from such a list does not necessarily mean a certain species is not present within the study area.

Forty-six significant fauna species were identified as potentially present along the gas transmission pipeline route as determined by the desktop review of relevant environmental databases (refer to Section 7.4.4.3). Of these, 3 species; squatter pigeon (*Geophaps scripta scripta*), powerful owl (*Ninox strenua*) and glossy black cockatoo (*Calyptorhynchus lathami lathami*) were recorded during surveys for the gas transmission pipeline. The former was only recorded on the mainland, while the latter two were identified on Curtis Island. Notes on all significant species and the likelihood of their presence within the study area as identified during the desktop study are included in Appendix N2.

The powerful owl and glossy black cockatoo are both listed as 'Vulnerable' under the NC Act. Both rely on large arboreal hollows for nesting, a resource in abundance within the study area on Curtis Island. Arboreal hollows are also utilised by mammals such as squirrel gliders (*Petaurus norfolcensis*) and common brushtail possums (*Trichosurus vulpecula*), primary prey items of the powerful owl. The glossy black cockatoo feeds on seeds of the black sheoak (*Allocasuarina littoralis*) and forest oak (*A. torulosa*), both of which are well distributed across Curtis Island.

Essential Habitat Mapping (EPA, 2008b) shows habitat mapped for the koala (*Phascolarctos cinereus*) (southern Queensland bioregion) in RE 12.3.3 and RE 12.3.7 present within the gas transmission pipeline study area. The koala is listed as Vulnerable under the NC Act. Although targeted during the survey, no signs of the presence of koalas were observed during the field survey. Anecdotal evidence from a local landowner in south-west Curtis Island shows that koalas have not been seen for many years in the locality. Additionally, that there are no WildNet database records for this species on Curtis Island reinforces the likelihood that koalas are not currently active in the area.

[3] The NC Act uses the following categories: Extinct in the wild, Endangered, Vulnerable, Near Threatened and Rare.

The EPBC Act uses the following categories: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable and Conservation Dependent.

Migratory Bird Species – Mainland and Curtis Island

The EPBC Act Protected Matters Report (DEWHA, 2008) sourced for the gas transmission pipeline states that 17 terrestrial, wetland and marine migratory birds may occur across the study area. It is not expected that vegetation communities within the mainland gas transmission pipeline study area and the estuarine wetlands on Curtis Island act as critical habitat for any of these species due to levels of disturbance found throughout most habitat types. The Curtis Island gas transmission pipeline survey was undertaken outside of the waterbird migration season (starting late August and September) and therefore the diversity and abundance of migratory wader birds was naturally low. A subsequent study in December 2008 (within the migration period) by BAAM revealed a total of 22 wader and shorebird species identified within or near the study area. Eleven of these species are considered as Migratory species under the EPBC Act. BAAM noted that "Wader/shorebird species were observed in relatively low numbers within the study area. Habitat values appeared to be low for many species due to low foraging potential. There is abundant existing habitat elsewhere on Curtis Island and surrounds. Most of the observed wader species were recorded foraging on more suitable habitat (sand/mudflats) at South End in greater numbers than that seen within the study area" (BAAM, 2008). All waderbirds recorded during studies on Curtis Island are shown in Appendix N2. Potential migratory waderbird habitat in the Port of Gladstone south of The Narrows is generally accepted as degraded and devoid of suitable populations of invertebrate food sources for waderbirds due to industrial land use and petro-chemical impacts.

7.4.5 Potential Impacts and Mitigation Measures

7.4.5.1 Terrestrial Flora

Vegetation Disturbance

The clearance of the gas transmission pipeline right-of-way (ROW) will result in the disturbance of approximately 1,340 ha which will include approximately 258 ha of remnant vegetation. A breakdown of the disturbance to REs as a result of this clearing including the disturbance to each RE as a percentage of the RE within the bioregion is presented in Appendix N2.

Non-remnant areas including improved pastures, cropping land and regrowth vegetation are to be subjected to the majority of proposed disturbance (approximately 1,100 ha). This represents 81 % of the total area of disturbance.

Of the remnant vegetation to be cleared, the vegetation community of *Corymbia citriodora, Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics (RE 12.11.6) is to be subjected to the majority of proposed disturbance (approximately 50 ha). This disturbance represents 0.021 % of this RE within the Brigalow Belt bioregion. This RE has no current conservation significance under state or commonwealth legislation.

Regional ecosystems representing the second and third greatest area of clearance are *Corymbia citriodora* open forest on coarse-grained sedimentary rocks (RE 11.10.1) and *Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics (RE 11.11.15). It is estimated that 25.5 ha and 25.1 ha of these REs is proposed to be cleared respectively. This disturbance represents 0.003 % and 0.005 % of these REs within the bioregion respectively. These communities have no current conservation significance under state or commonwealth legislation.

The RE of *Eucalyptus crebra* woodland on metamorphics ± interbedded volcanics (RE 12.11.7) is subject to the greatest disturbance when viewed as a percentage of the bioregional extent (0.025 %). Approximately 8 ha of this RE is proposed to be cleared. This RE has no current conservation significance under state or commonwealth legislation.

Significant Communities

Of the Endangered REs recorded along the gas transmission pipeline corridor, the RE subjected to the highest amount of clearing is *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks (RE 11.9.5). This RE is listed as 'Endangered' under both the VM Act and EPBC Act.

Approximately 4 ha of this RE will potentially be cleared. This disturbance represents 0.002 % of this RE found within the bioregion.

The second greatest area of clearance of a significant RE will be Semi-evergreen vine thicket on fine grained sedimentary rocks (RE 11.9.4). This RE is listed as 'Endangered' under both the VM Act and EPBC Act. Approximately 2 ha of this RE will potentially be cleared. This disturbance represents 0.004 % of this RE found within the bioregion.

Ecological Integrity of Impacted Communities

Vegetation within the gas transmission pipeline corridor has a long history of disturbance including grazing, thinning and exotic weed invasion. The area supports remnant vegetation, modified woodlands and non-remnant shrubby regrowth and cleared land. All areas of remnant vegetation investigated have been disturbed by human activity to some degree. Despite the high degree of past disturbance, the ecological integrity of remnant communities along the gas transmission pipeline corridor was found to be moderate, with integral ecological processes intact.

The highest levels of ecological integrity occur within the range crossings where the steep terrain has offered some protection to remnant vegetation from repeated clearing. However even within these areas weed species are common and species such as creeping lantana have reduced native species diversity significantly. Creek crossings also generally support higher levels of ecological integrity than surrounding areas, however these crossings are still often degraded by grazing and weed invasion.

Conservation Significant Species

Potential Impacts

The gas transmission pipeline avoids the main populations of *Cycas megacarpa* within the Callide and Calliope Ranges. However, it is likely that a number of individuals will be present within the ROW and would require removal. Given the numbers of species within the local area, combined within the potential for successful relocation of individuals affected, this is not expected to have a significant impact upon the species across the region.

Acacia pedleyi was recorded in low numbers from one location within the study area. The desktop searches conducted indicated the presence of 16 populations of the species within a 5 km buffer of the gas transmission pipeline (Appendix N2), indicating the species is relatively widespread within the area. Therefore it is considered the potential impact to the species from the clearing of this one area is minor.

Mitigation Measures

Further surveys of the areas known to support conservation significant species are proposed to be undertaken as part of the pre-construction surveys. The aims of these surveys will be to gain more accurate data on population size and extent of these species within the area of proposed disturbance.

A clearing permit will be required under the NC Act where clearance of these species cannot be avoided. DEWHA approval will also be required for the removal of *Cycas megacarpa.*

Gas Transmission Pipeline Route Selection

Potential Impacts

A detailed route selection process was undertaken prior to selection of the gas transmission pipeline alignment (refer to Section 2). The potential impacts on environmental values including vegetation were an important component in the selection process.

Mitigation Measures

Where species of conservation significance are likely to be impacted by clearing activities, the final route selection, where possible, will be altered to minimise further potential impacts on these areas.

Clearing Scheme

Areas of vegetation to be cleared will be restricted to the minimum width 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. This work will be appropriately supervised.

Clearing of all remnant REs and particularly 'Of concern' and 'Endangered' will be avoided for ancillary areas including construction camps and vehicle tracks where possible.

Cleared timber will be stick raked into piles to provide fauna habitat and assist revegetation or mulched and spread over the ROW.

All vegetation clearance will be undertaken in accordance with Santos EHS Management System Standard – EHS01 Land Disturbance.

Management of Significant Species

The two species of conservation significance recorded along the gas transmission pipeline will require appropriate management actions. The management priority will be avoidance of impact to these areas where practicable following the actions described below.

Prior to vegetation clearing, all individuals of these species will be flagged to provide an accurate number of individuals to be removed. Individuals of *Cycas megacarpa* have been successfully translocated in similar projects (Queensland Herbarium, 2007) and the option for translocation of individuals will be investigated for this project. For *Acacia pedleyi,* the collection and planting of seed from the species as part of the project's rehabilitation program will be considered to offset any net loss of the species.

Additional management strategies will include:

- Reduce ROW width where possible near areas of conservation significant species;
- Restriction of all construction personnel to within the ROW and designated access points;
- Awareness presentation of conservation significant species to gas transmission pipeline construction crews; and
- Increased monitoring of dust, water movement, and weeds around areas supporting conservation significant species.

River Crossings

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. Horizontal directional drilling (HDD) is proposed to be undertaken at two of the major river crossings (Calliope River and Dawson River crossing near Moura) to minimise disturbance to riparian sections of these rivers.

For minor watercourse crossings, open trenches will be used. Watercourse bed and bank material and trench spoil will be stockpiled separately away from banks to reduce the likelihood of sedimentation from surface runoff. To minimise the period of construction and subsequent environmental disturbance, it is proposed to complete watercourse crossings within the shortest period practicable.

Rehabilitation of Disturbed Areas

A rehabilitation strategy is outlined in Section 7.16.

Weeds

Potential Impacts

Desktop and field studies have confirmed the presence of 10 declared weeds species within the gas transmission pipeline corridor. Of these species, parthenium has the greatest potential to impact upon grazing and ecological values in the area. The majority of the corridor remains free of parthenium. However, the weed could be introduced to new areas through poor weed hygiene practices. Introduction to areas previously free of infestations could cause major impacts including loss of grazing potential, reduction in habitat value and increase in risk to human health.

The declared weeds parthenium (*Parthenium hysterophorus**), velvety tree pear (*Opuntia tomentosa**), prickly pear (*O. stricta**), mother of millions (*Bryophyllum delagoense**), Chinese celtis (*Celtis sinensis**), rubber vine (*Cryptostegia grandiflora**), harrisia cactus (*Eriocereus martinii**), lantana (*Lantana camara**), creeping lantana (*Lantana montevidensis**) and cat's claw creeper (*Macfadyena unguis-cati**) were found within or adjacent to the gas transmission pipeline corridor. Of these species, parthenium has the greatest potential to significantly impact upon grazing and ecological values in the area. The majority of the corridor remains free of parthenium. However, the weed could easily be introduced to new areas through poor weed hygiene practices. Introduction to areas previously free of infestations could cause major impacts including loss of grazing potential, reduction in habitat value and increase in risk to human health.

Mitigation Measures

The introduction of vehicles and heavy machinery may potentially increase the risk of introducing new and declared weeds, and spread existing weeds across the site and its surrounds. Appropriate weed management strategies will be implemented for controlling the spread of weeds. Weeds will be managed by application of the following:

- Effective management strategies to control the spread of declared weed species in keeping with Santos Standards, regional management practice or DNR&W pest control fact sheets;
- Incorporation of the Santos Parthenium Weed Management Plan (URS, 2008);
- Ongoing monitoring of the project site to identify any new incidence of weed infestation;
- Provision of information for project staff on the identification of declared weeds and their dispersal methods; and
- Wash down protocols for any vehicles or machinery entering and leaving site.

Dust

Potential Impacts

Deposition of dust, sand and soil may have potential impacts on vegetation if excessive levels are sustained over extended periods. The potential effects of dust deposition on vegetation are determined by a number of factors including:

- The characteristics of leaf surfaces, such as surface roughness, influencing the rate of dust deposition on vegetation;
- Concentration and size of dust particles in the ambient air and its associated deposition rates; and
- Local meteorological conditions and the degree of penetration of dust into vegetation.

Mitigation Measures

Control measures will be implemented to minimise dust generation during the construction phase of the gas transmission pipeline, and it is not expected that potential effects of dust deposition on vegetation within close proximity to transmission pipeline will be significant.

Fragmentation

Details on fragmentation of native vegetation and its impacts from gas transmission pipeline construction are discussed in Section 7.4.5.1.

Edge Effects

Potential Impacts

The fragmentation and modification of ecosystems following land clearing can lead to changes in physical edge effects (Lindenmayer and Burgman, 2005). These edge effects occur when disturbances to the edge of a habitat or ecosystem result in a change or disturbance to the interior of that area. Examples of edge effects that may be associated with vegetation communities of the gas transmission pipeline include weed invasion and altered micro-climatic conditions.

Mitigation Measures

There is potential for weed invasion to occur as a result of RE clearing for the gas transmission pipeline however this result may be mitigated by the instigation of weed control measures as detailed in the potential weed impacts and mitigation measures section.

Impacts Associated with Changes to Fire Regimes

Potential Impacts

The majority of Australian terrestrial ecosystems and many endemic flora species are threatened by inappropriate fire regimes (Lindenmayer and Burgman, 2005). Changes to the landscape from vegetation clearing could potentially impact the fire regime of the vegetation communities within close proximity to the gas transmission pipeline. These impacts are dependent upon several factors including type of vegetation community, fire history, and weather and rainfall history.

Mitigation Measures

Potential sources for accidental ignition of fires will be managed during the construction and operation of the gas transmission pipeline. This will include restricted access to the gas transmission pipeline to reduce the probability of starting a fire.

Impacts Associated with Erosion and Sedimentation

Potential Impacts

There is potential for erosion on areas disturbed by works associated with the creation of the gas transmission pipeline. Where these activities occur on erosive soils and/ or on slopes, mobilisation of sediment into watercourses can occur. Impacts to aquatic ecosystems can include build-up of sediment in waterholes with a subsequent reduction in available habitat, smothering of aquatic plants and substrate and cumulative downstream impacts on estuarine and offshore marine habitats.

Mitigation Measures

Compliance with the following will ensure appropriate site management is achieved:

- Santos EHS01 Land Disturbance;
- Santos EHSMS09.5 Environmental Impact Assessment and Approvals;
- Santos EHSMS11-11 Decommissioning and Abandonment;
- Santos EHSMS14 Monitoring, Management & Reporting;
- Santos EHS09 Weed and Pest Animal Control; and

- Gas Transmission Pipeline Environmental Management Plan.

Biodiversity Offsetting

Potential Impacts

A program to implement offsetting of cleared vegetation communities will be undertaken as required in accordance with current commonwealth and state legislative criteria for the offsetting of significant vegetation communicates.

Mitigation Measures

A biodiversity offset suitability and management plan will be developed. Criteria for offset suitably will be in accordance with EPA and DEWHA guidelines and best practice.

A biodiversity offset strategy and management plan will be developed in line with the principles and guidelines of the QLD Government Biodiversity Offsets Policy. The plans will include consideration of the following:

- The principles and guidelines of the Queensland Government Biodiversity Offsets Policy;
- Compliance with the requirements of the Policy for Vegetation Management Offsets (DNRW, 2007) and the regional vegetation management codes both for the coastal bioregions and Brigalow Belt Bioregions, under the provisions of the Queensland VM Act (DNRW, 2006a and DNRW 2006b);
- Consideration of existing Santos biodiversity offsets including the Environmental Management Plan for Fairview Project Area offset strategy (Santos, 2008);
- Acquisition of a remnant/regrowth community that is greater in area than that which will be impacted by the project;
- Support of the same suite of plant species contained in RE types being offset;
- Maximising biodiversity gains through site selection;
- Where possible, by ensuring offset locations close to communities impacted by the project;
- Where possible, ensuring offset sites be larger contiguous stands of vegetation with connectivity to other habitat types to increase the viability of ecological processes;
- Placing potential offset(s) parcels under a secure protection such as a conservation covenant to ensure that protection runs with title;
- Inclusion of management measures to ensure offset areas remain viable in perpetuity. Such measures may include the management of supplementary planting, weed, fire, feral animal, livestock management and restriction on access; and
- Monitoring and maintenance activities to measure success and viability of the offset.

7.4.5.2 Terrestrial Fauna

This section outlines the background and baseline work undertaken to identify and map the potential terrestrial and aquatic vertebrate fauna (amphibians, reptiles, mammals and birds) habitat within the gas transmission pipeline study area, with particular reference to the potential occurrence of endangered, vulnerable, rare or significant fauna**.** It also assesses the potential impacts of the proposed works on the identified terrestrial and aquatic vertebrate fauna species and the appropriate mitigation measures.

The key findings of the nature conservation (fauna) assessment for the gas transmission pipeline are described within this section, with a full copy of the assessment report provided in Appendix N2.

The clearing of remnant vegetation within the gas transmission pipeline ROW will provide the greatest impacts to fauna. The gas transmission pipeline ROW width will be 30 m on both the mainland and Curtis Island. The Curtis Island easement will however also accommodate a road increasing the total width to

100 m. Approximately 189 ha of remnant vegetation on the mainland and approximately 70 ha of remnant vegetation on Curtis Island will be cleared during this phase of the project. Approximately 258 ha of remnant vegetation will be cleared for gas transmission pipeline construction overall. The greater proportion of the gas transmission pipeline ROW (approximately 1,085 ha or 81 %) will traverse cleared pasture or non-remnant vegetation within which impacts to fauna and flora will be minimal.

Other areas to be cleared will include main camps, satellite camps, laydown areas and box-outs at crossings as well as valve sites and pig trap stations.

Loss of Habitat

Potential Impacts

The construction of the gas transmission pipeline will involve the loss of habitat through initial site preparation and clearing. This will result in the removal of habitat features such as trees, shrubs, ground cover, rocks and timber within the gas transmission pipeline ROW. Impacts to fauna as a result of these measures may include mortality and loss of habitat and breeding areas. Implementation of appropriate strategies will considerably reduce the potential for fauna mortality. As approximately 81 % of the gas transmission pipeline ROW traverses cleared land or non-remnant vegetation with reduced habitat values the impacts to fauna overall should be low.

During the pipe trenching phase, the open trench may create an obstacle for fauna. The trench acts as a pitfall trap for fauna. Mitigation measures for these potential impacts are discussed below.

Members of all fauna groups may be impacted to some extent by the proposal. Small ground mammals (e.g. rodents and dasyurids), reptiles and amphibians may be disturbed by vehicular movement and groundbreaking activities.

Fauna utilising arboreal hollows and feeding resources such as possums, gliders and many species of birds and insectivorous bats, may be affected by the removal of these habitat features. In addition to the possibility of some fauna mortality during clearing, the loss of nesting resources may affect local prey and predator fauna populations into the future. Avian fauna will be less affected by the proposal due to their ability to easily move from the zone of impact. In addition, while the loss of habitat may affect certain types of birds, the alteration may be beneficial to others. An example, in a woodland area, may be a displacement of forest birds with a subsequent replacement by grassland species in the vicinity of the gas transmission pipeline.

Mortality impacts and predator prey disruption from habitat loss are expected to be relatively low in the context of the overall landscape ecology and there should not be significant long term impacts to overall faunal assemblages and species populations.

Fragmentation and Loss of Movement Opportunities

Potential Impacts

The construction of the gas transmission pipeline may create a barrier to fauna movement within well vegetated portions of the route, particularly in the range sections of the alignment. Fauna such as small mammals and birds may be deterred from crossing 30 m wide cleared zones such as created by the ROW. In addition, the crossing of open areas can increase the potential for predation by native and introduced predators. The movement of gliders through the bushland particularly on Curtis Island could be effected by the ROW clearing.

The fragmentation of remnant vegetation can result in a reduction of functional habitat. Habitat alteration may potentially result in certain species abandoning the area. Edge effects compound the impacts of fragmentation so that functional habitat is further reduced. Reduced buffers to core habitat will result in disturbances to fauna and a further reduction in habitat quality. The disturbance of soil and increased light levels will potentially enhance conditions for weed infestations.

Fragmentation and loss of movement opportunity impacts are not expected to have significant long term impacts to overall faunal assemblages and species populations in the context of the overall landscape ecology.

Mitigation Measures for Loss of Habitat and Fragmentation and Loss of Movement Opportunities

Where habitat is to be cleared, the following mitigation measures will be implemented:

- Restriction of the amount of vegetation to be cleared to minimise the footprint required (clearly marking vegetation to be retained);
- Design of the route so that trees possessing habitat hollows and other habitat features are avoided wherever practicable;
- Retention of habitat trees within the ROW, where practicable as dictated by construction constraints;
- Salvage of timber and rocks for later placement as habitat features on the ROW;
- Progressive rehabilitation following gas transmission pipeline construction;
- Clearing near any waterways or riparian areas will include adequate sedimentation fencing to ensure sediment impacts to waterways are restricted;
- Implementation of a protocol to ensure fauna spotters are present during clearing of woodland vegetation and any other areas of faunal habitat; and
- A program for offsetting cleared vegetation communities is also to be developed in accordance with current commonwealth and state legislative criteria for the offsetting of significant vegetation communities and habitat.

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 habitat is not unduly affected. HDD is proposed to be undertaken at two of the major river crossings (Calliope River and Dawson River crossing near Moura) to minimise disturbance.

For minor watercourse crossings, open trenches will be used. Where possible existing gaps in the canopy will be utilised and mature trees will be avoided to minimise impacts to aquatic communities. Watercourse bed and bank material and trench spoil will be stockpiled separately, away from banks to reduce the likelihood of sedimentation from surface runoff. To minimise the period of construction and subsequent environmental disturbance, it is proposed to complete watercourse crossings within the shortest period practicable.

Specific mitigation measures for potential direct impacts to fauna species include:

- Consideration will be given for the installation of nest boxes adjacent to sections of the gas transmission pipeline where trees containing habitat hollows have been identified and are to be cleared, such as on Curtis Island;
- Provision for glider movement across the ROW on the Curtis Island section will be considered. This will incorporate suitable poles in the mid-section of the ROW to enable passage from vegetated areas on either side;
- The gas transmission pipeline trench is to be left open for as short a time as possible. Where applicable, the following will be implemented: in sections left open, shade and shelter facilities (eg wet sacks for snake shelter); ramps out of the trench will be constructed at regular intervals to enable fauna to escape; and the trench will be checked regularly for fauna;
- Placement of salvaged habitat material (logs, rocks etc) within the ROW following completion of works to enhance fauna movement; and

- The encouragement of suitable natural groundcover regeneration or sowing of pasture species (grasses and forbs only) within the ROW to assist in habitat or grazing re-establishment where appropriate.

Maintenance and Management of Habitat

An Environmental management plan (EMP) is to be developed for the gas transmission pipeline that addresses the potential impacts identified above. The EMP is also to include an effective monitoring and control plan for declared pest animals and weed species. Weed control shall be in accordance with the recommendations outlined within Appendix N2.

EHSMS Implementation

Compliance with the following will ensure appropriate site management is achieved:

- Santos EHS01 Land Disturbance;
- Santos EHSMS09.5 Environmental Impact Assessment and Approvals;
- Santos EHSMS11-11 Decommissioning and Abandonment;
- Santos EHSMS14 Monitoring, Management & Reporting;
- Santos EHS09 Weed and Pest Animal Control; and
- Gas Transmission Pipeline Environmental Management Plan.

Noise and Vibration

Potential Impacts

Secondary impacts to fauna include disturbance from noise and vibration during construction. Fauna will generally move away from the source to avoid these impacts. It is not expected that significant impacts to fauna will occur from noise and vibration. Construction related noise and vibration impacts will be of a temporary nature, and will not be an issue.

Mitigation Measure

All equipment and machinery used during construction will be maintained in good working order.

Pests

Potential Impacts

Biting pests such mosquitoes can rapidly build-up populations when appropriate breeding conditions are provided. The pooling of water in depressions resulting from earthworks can exacerbate this problem. Appropriate site management is recommended to reduce this possibility.

As populations of foxes, pigs, feral cats and dogs and cane toads (among others) already populate areas in which the gas transmission pipeline traverses, it is highly unlikely that the proposed works will result in a proliferation of these species.

The introduction of exotic ant fauna is a potential risk. Yellow crazy ants (*Anoplolepis gracilipes*) and fire ants (*Solenopsis invicta*) are exotic ants that have the potential to seriously impact on native flora, fauna and ecological communities. They are capable of being transported from infested sites to new construction sites on equipment or within materials. Whilst many colonies of both species have been eradicated elsewhere in Queensland, there remains a slight chance of spreading ants to new areas.

Mitigation Measures

- Adoption of appropriate site management practices to reduce the availability of breeding habitat for biting insects such as infilling of depressions to reduce retention of breeding habitat;

- Precautions and actions should be consistent with the various regional council pest management plans and DNRW to ensure a consistent approach;
- Inclusion of a pest and weed management plan in the EMP;
- Equipment and materials will be thoroughly inspected for pest animals and weeds according to Santos EHS09 Weed and Pest Animal Control, prior to being shipped to the gas transmission pipeline area; and
- Consideration will be given to the construction of wash down bays at various points along the gas transmission pipeline.

Environmentally Sensitive Areas

The impacts of the construction of the gas transmission pipeline on Port Curtis and the Great Barrier Reef Coast Marine Park are discussed in Section 8.7.

7.4.5.3 Cumulative Impacts

Section 1 identifies 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.

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 gas transmission 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.

Table 7.4.4 provides a summary of potential terrestrial ecology impacts and mitigation measures for the gas transmission pipeline.

Table 7.4.4 Potential Terrestrial Ecology Impacts and Mitigation Measures

Aspect	Potential Impact	Mitigation Measures	Objective
Construction			
Flora, fauna and vegetation communities.	Loss or disturbance of approximately 258 ha of remnant vegetation.	• Gas transmission pipeline route selection to avoid remnant vegetation and habitat where practicable. • Areas cleared restricted to minimum required. • Use of tape, pegs etc to delineate areas to be cleared. • Appropriate erosion and sediment mitigation measures undertaken.	To minimise loss or disturbance to remnant vegetation.
	Loss or disturbance to Endangered/Of Concern RE.	• Biodiversity offset for unavoidable loss of Endangered/Of Concern REs.	To minimise loss or disturbance to endangered / of concern REs.
	Impact to threatened flora species.	• Pre-construction surveys in areas known or expected to support threatened species. • Investigate translocation or rehabilitation of species where practicable.	To minimise the impact to threatened flora species.
	Loss or fragmentation of fauna habitats, reduction in movement opportunities and increased edge effects.	• Retain habitat hollows and other habitat features wherever practicable. • Clearing near any waterways or riparian areas should include adequate sedimentation fencing to ensure sediment impacts to waterways are restricted. • Salvage of habitat material (e.g. logs and rocks) from within the ROW prior to trenching. • Cleared vegetation is to be selectively placed over the gas transmission pipeline during rehabilitation to provide habitat to small mammals and reptiles. Vegetation will be placed in a manner that still allows gas transmission pipeline surveillance activities to occur. • Strategies will be implemented to reduce impacts to	To minimise the loss or fragmentation of fauna habitats.

Aspect	Potential Impact	Mitigation Measures	Objective
		fauna from gas transmission pipeline trenches being left open. • Investigation of installation of glider poles within the Curtis Island gas transmission pipeline ROW to assist in reducing impacts of fragmentation on gliders.	
Dust effects on vegetation	Deposition of dust, sand and soil may have potential impacts on vegetation if excessive levels are sustained over extended periods.	• Implementation of dust control measures, such as watering.	To minimise the dust impacts on vegetation.
Noise, vibration and lights	Disturbance to fauna from noise and vibration during gas transmission pipeline construction.	• All equipment and machinery used during construction will be maintained in good working order, and where possible shielded to minimise noise emissions.	To minimise disturbances to fauna from noise and vibration.
Spread of weeds	Introduction of vehicles and heavy machinery may potentially introduce new and declared weeds, and increase the risk of spreading existing weeds along the gas transmission pipeline and its surrounds.	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control. • Effective management strategies to control the spread of declared weed species in keeping with regional management practices or DNRW pest control fact sheets. • Monitoring of the gas transmission pipeline to identify any new incidence of weed infestation. • Provision of information for project staff on the identification of declared weeds and their dispersal methods. • Wash down protocols for vehicles or machinery entering and leaving site.	To minimise the spread of weeds.

7.4.6 Summary of Findings

7.4.6.1 Terrestrial Flora

The desktop assessment identified 68 significant flora species as potentially present within the gas transmission pipeline corridor. Of these identified taxa, two species (*Cycas megacarpa* and *Acacia pedleyi*) were located during the field surveys.

The field survey identified the presence of 47 Regional Ecosystems within the gas transmission pipeline corridor including 18 listed as 'Endangered' or 'Of Concern' under the VM Act and/or EPBC Act.

The field survey also identified 302 taxa of plants, representing 210 genera from 74 families. Forty exotic plant species were recorded during the flora survey. Of these, 10 are listed as declared weed species under the Queensland *Land Protection (Pest and Stock Route Management) Act,* 2002.

The clearing of remnant vegetation (approximately 258 ha) within the gas transmission pipeline ROW (approximately 1, 343 ha) will provide the greatest impacts to flora. Impacts to remnant vegetation will be minimised by the alignment of the gas transmission pipeline adjacent to the existing QGP for approximately 300 km of the 435 km corridor. This clearing will result in the loss of a small area of some REs listed as 'Endangered' and 'Of Concern' under the VM Act and EPBC Act. This vegetation clearing may also potentially impact upon the two significant flora species recorded. A number of mitigation measures will be implemented including gas transmission pipeline route selection, weed control, rehabilitation and biodiversity offsetting.

7.4.6.2 Terrestrial Fauna

A desktop assessment identified fauna potentially present in the gas transmission pipeline corridor, including significant species listed under the NC Act and the EPBC Act. Forty-six significant species were identified as potentially present. Of these, only the powerful owl (*Ninox strenua*), squatter pigeon (southern form) (*Geophaps scripta scripta*) and glossy black cockatoo (*Calyptorhynchus lathami lathami*) were located during the surveys.

A total of 50 native and 5 introduced terrestrial vertebrate species were recorded during the field survey for the Curtis Island section. Native species included 5 reptile, 37 bird and 7 mammal species including 4 species of microbat with another 5 tentatively identified. Seventy-two native and 8 introduced terrestrial vertebrate species were recorded during the field survey of the mainland gas transmission pipeline. Native species included 2 reptile, 64 bird and 5 mammal species.

The clearing of remnant vegetation within the gas transmission pipeline ROW will provide the greatest impacts to fauna and its habitat. This will result in the removal of habitat features such as arboreal hollows, dense vegetation and fallen timber. The construction of the gas transmission pipeline will not present long-term impacts to fauna as rehabilitation will allow for fauna habitation and usage following completion of works.