7 TERRESTRIAL ECOLOGY

7.1 INTRODUCTION

Chapter 7 provides a summary of the environmental values, potential impacts, and mitigation measures for terrestrial ecology within the Gas Field Component of the Queensland Curtis LNG (QCLNG) Project. Detailed reports are provided in *Appendix 3.2.*

7.2 PROJECT ENVIRONMENTAL OBJECTIVE

The Project environmental objective for terrestrial ecology is to undertake Project activities such that impacts on abundance and distribution of terrestrial flora, fauna and ecological communities are minimised.

7.3 METHODOLOGY

The Project environmental objectives for this chapter are based on:

- the protection of flora and fauna diversity
- ensuring endangered species are protected through management and mitigation measures in developing the Gas Field
- ensuring any development actions do not promote or introduce the establishment of pest species.

Impacts on fauna and flora have been assessed after reviewing published studies, government investigations and reports, and field surveys including:

- relevant published literature for the wider area such as the Commonwealth Department of Environment, Water Heritage and the Arts' *Matters of National Environmental Significance* (NES) guidelines and *Directory of Important Wetlands* (Environment Australia 2001)
- latest available Queensland Herbarium vegetation mapping
- maps and satellite imagery to identify habitat connectivity, particularly results from Department of Environment and Resource Management (DERM), Biodiversity Assessment and Mapping Methodology (BAMM)
- databases such as Queensland Herbarium HERBRECS and CORVEG
- DERM Biodiversity Planning Assessment (2008) which identifies ecological features and values of local, regional and state significance as recognised by DERM, Queensland Museum, Birds Australia and Wildnet
- review of the DERM Biodiversity Assessment and Mapping Methodology (BAMM) (EPA 2008a)
- review of the DERM Environmentally Sensitive Areas Mapping (ESAs)

- reconnaissance of the area and groundtruthing by flora and fauna ecologists (126 sites investigated; 17 July to 9 September, 2008; 22 to 23 January, 2009)
- detailed fauna surveys of representative habitats in the Gas Field (27 October to 2 November, 12 to 18 November and 3 to 9 December, 2008) that included pit-fall trapping, spotlighting, bird transects, camera traps, bat trapping and bat ultrasonic recording, road kill inspections and incidental observation.

In addition to the ongoing above searches and fieldwork, ecologists have consulted with:

- DERM staff
- Queensland Herbarium
- Department of Employment, Economic Development and Innovation (DEEDI)
- landholders.

7.4 DESCRIPTION OF ENVIRONMENTAL VALUES

7.4.1 Flora

7.4.1.1 Survey Methodology

The flora desktop studies and field surveys:

- examined the structural and species composition of native remnant vegetation in the Gas Field as well as in the broader environment so potential impacts associated with proposed activities could be considered in the local, regional and state contexts
- identified the presence/absence or likely presence/absence of Endangered, Vulnerable or Rare (EVR) flora species and communities identified in commonwealth and state legislation
- groundtruthed Herbarium regional ecosystem (RE) mapping
- identified the distribution and relative abundance of environmental and declared weed species.

7.4.1.2 Flora Description

The Gas Field encompasses vegetated and cleared grazing land, cropping land, roadside and travelling stock reserves, council lands, state forests and resource reserves.

The State Forests or parts thereof that occur within the Gas Field are set out in *Figure 3.7.1*. These include:

- Quandong
- Barakula
- Kurambilla
- Condamine
- Vickory
- Daandine
- Braemar
- Gurulmundi
- Cherwondah
- Hinchley
- Mt Organ
- Weranga.

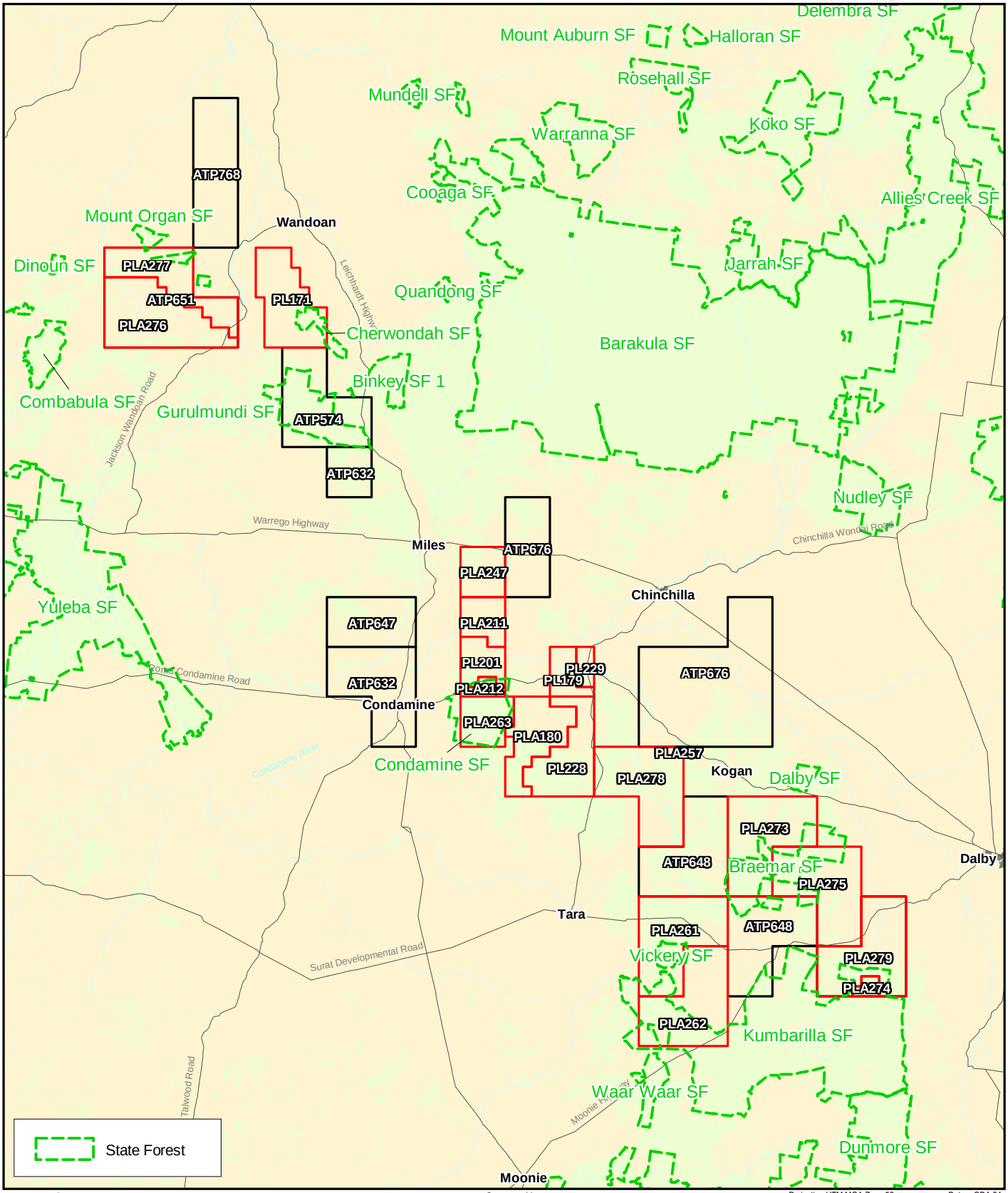
Based on the Queensland Herbarium RE mapping, approximately 297,445 ha of the total 468,700 ha Gas Field area is cleared. The remnant vegetation in the Gas Field equates to 171,255 ha and consists of approximately:

- 149,414 ha of eucalypt woodlands
- 975 ha of acacia woodlands
- 3,617 ha of brigalow/belah woodlands
- 621 ha of semi-evergreen vine thicket
- 6,693 ha of riparian eucalypt woodlands
- 9,824 ha of shrubland on scalds
- 111 ha of wetlands.

National and State Significant Vegetation Communities

The Gas Field contains two threatened ecological communities listed as Endangered under the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (*Figure 3.7.2* and *Figure 3.7.3*). These are represented by described Regional Ecosystems (RE), namely:

- brigalow woodland/open forest communities – REs 11.3.1, 11.4.3, 11.4.7, 11.4.10, 11.9.5, and 11.9.6
- semi-evergreen vine thicket (SEVT) communities – RE 11.8.3 and RE 11.9.4.



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QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: **State Forests**
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: Mipela	Volume: 3 Figure: 3.7.1	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
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The six brigalow communities occur on fertile soil areas that have largely been cleared of their original ecological communities. The brigalow remnants are almost always small and narrow fragments which have been left along fence lines, creeks and roadsides. Two slightly larger patches occur north-west within the Gas Field in Cherwondah State Forest. These patches have been degraded by edge effects including weed invasion and fire damage. There are some relatively high-quality but small patches of brigalow that occur in Braemar and Condamine State Forests.

The SEVT communities occur on deep red soils with clay subsoil and are confined to the northern part of the Gas Field. The SEVT remnants are typically small fragmented patches, although two larger ones were identified through Queensland Herbarium mapping and satellite imagery. The small patches are degraded by edge effects including weed invasion and fire damage.

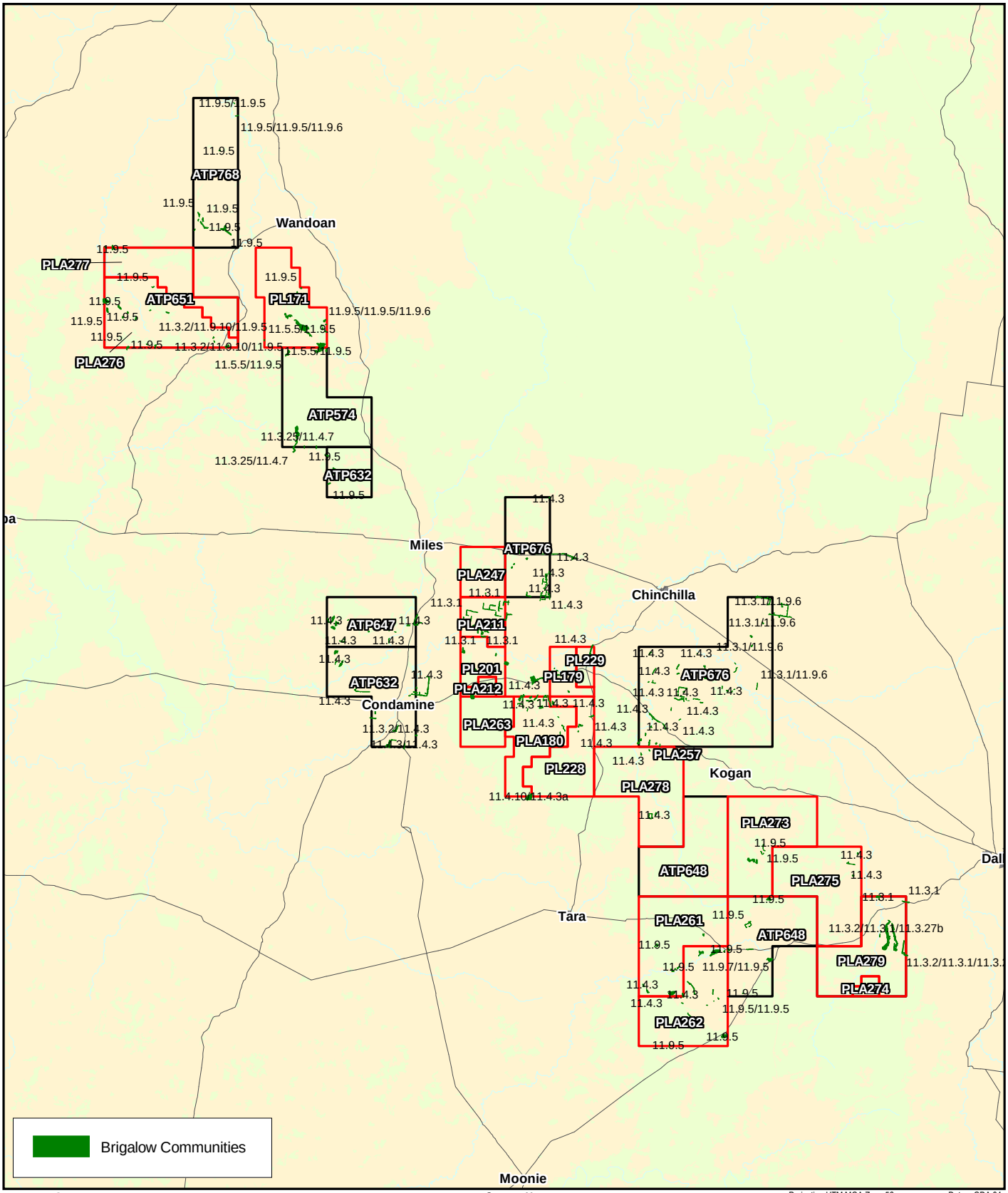
All of the six *Environment Protection and Biodiversity Conservation Act 1999* (Cth)(*EPBC Act)* listed brigalow REs in the Gas Field are also listed as Endangered under the *Vegetation Management Act 1999* (Qld) (*VM Act*). SEVT (RE 11.9.4) mapped as present in the Gas Field is also listed as Endangered under the *VM Act*. In addition to these, the Gas Field contains only one RE that is listed as Endangered under the *VM Act* (RE 11.4.12 – *Eucalyptus populnea* woodland on Cainozoic clay plains). Only a few small patches of this RE occur within the central part of the Gas Field (*Figure 3.7.4*).

Field surveys of one of these mapped fragments found it to be degraded as a result of edge effects which included severe weed invasion.

Six of concern REs occur within the Gas Field (i.e. REs 11.3.2, 11.3.3, 11.3.4, 11.3.17, 11.9.7, and 11.9.10) (*Figure 3.7.5*).

These are all eucalypt woodland communities and occur in linear strips throughout the Gas Field.

According to Herbarium mapping, the area of these REs found within the Gas Field is a small proportion of that which is found in the bioregion (i.e. <1 per cent). Of the communities that were assessed, condition varied from degraded to very good. The community considered to be in very good condition was a fragment of RE 11.3.2 found within the Wieambilla Creek area. This area was found to have minimal weed species present and was thought to provide potential habitat for the vulnerable species, *Acacia wardellii*.



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Project	Queensland Curtis LNG Project	Title	Brigalow Woodland / Open Forest Communities
Client	QGC - A BG Group business		
Drawn	Mipela	Volume 3	Figure 3.7.2
Approved	CDiP	File No:	QC02-T-MA-00032
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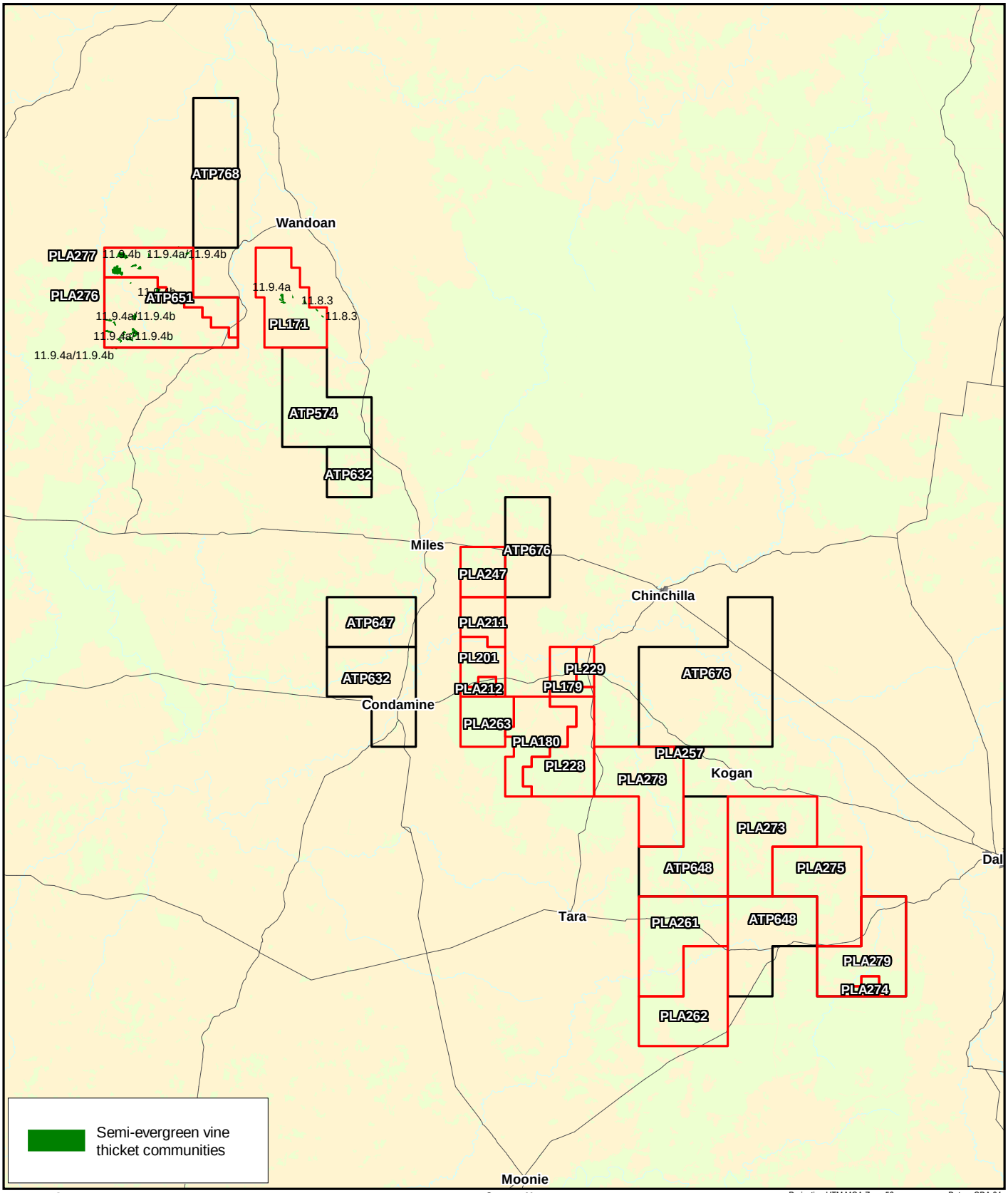

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	Client: QGC - A BG Group business		
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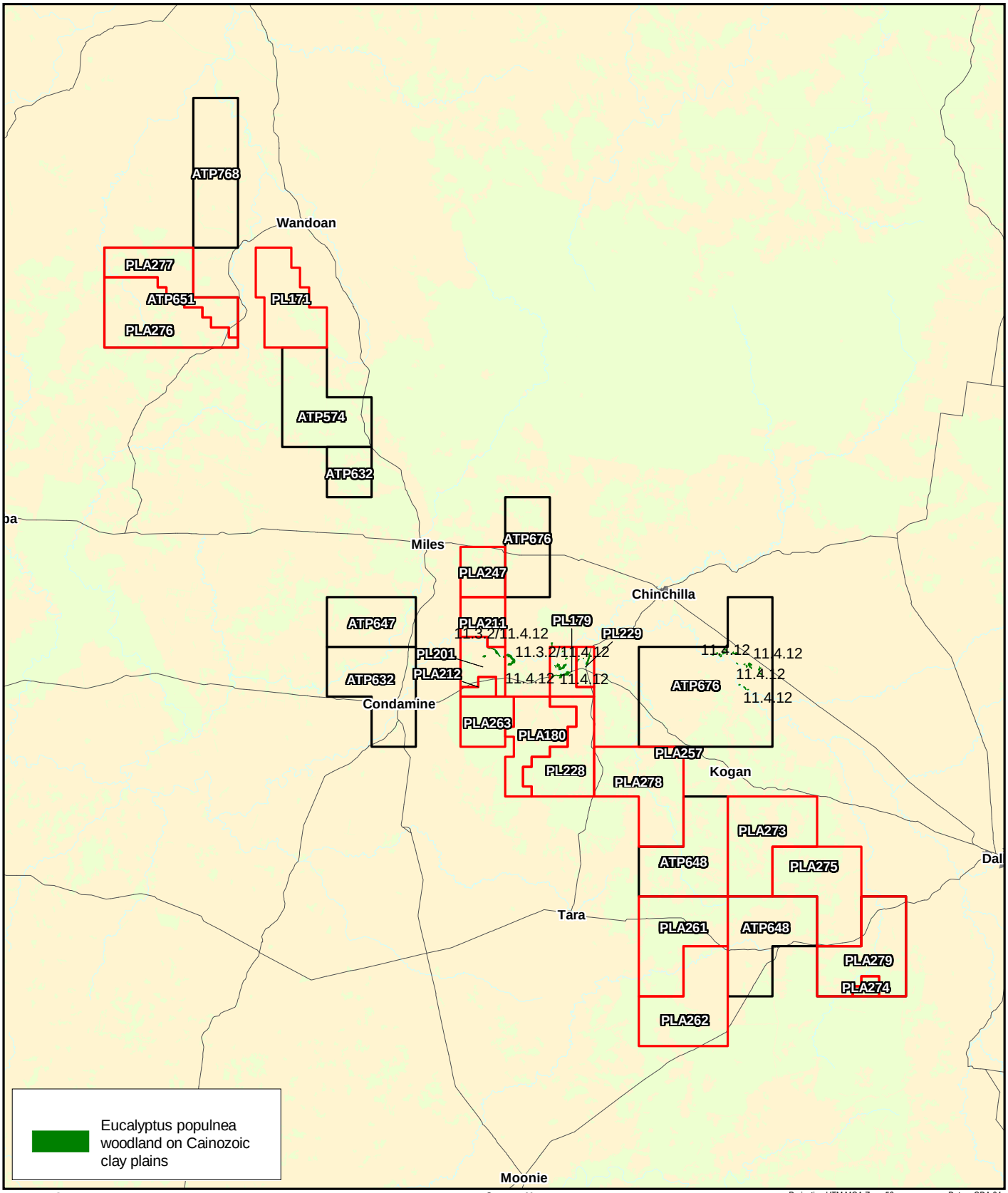

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Project: Queensland Curtis LNG Project

Client: QGC - A BG Group business

Title: *Eucalyptus populnea* Woodland on Cainozoic Clay Plains

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Approved	CDiP	File No:	QC02-T-MA-00034
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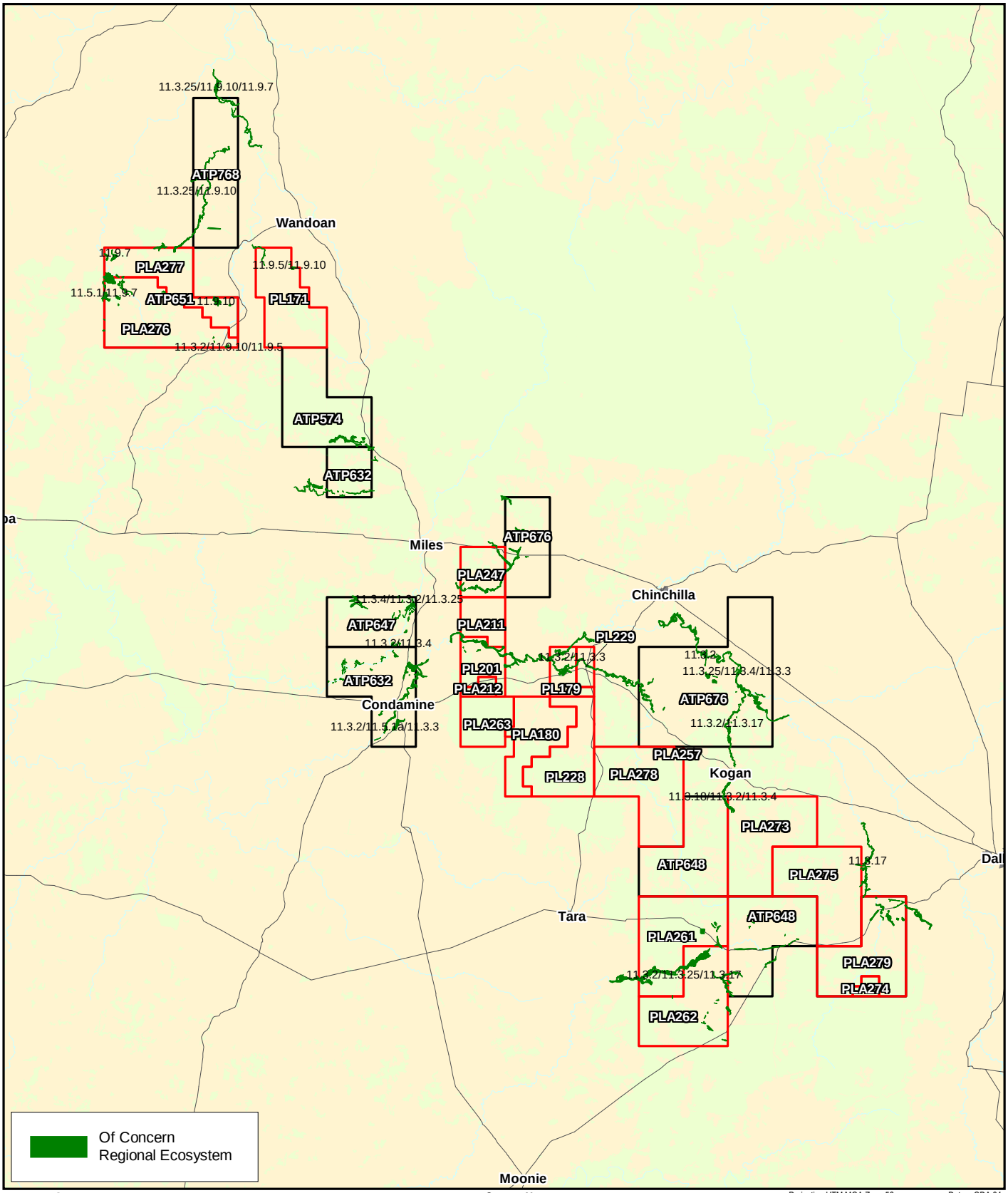

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Client	QGC - A BG Group business
Title	**Of Concern Regional Ecosystems**

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Endangered, Vulnerable or Rare (EVR) Species

Review of the Queensland Herbarium HERBRECS, Wildnet and the *EPBC Act* Protected Matters databases for the study area identified 48 EVR plant species known to occur in or have ranges that overlap with the Gas Field. These include:

- 44 species listed under the provisions of the *Nature Conservation Act 1992* (Qld) (*NC Act*), including six Endangered, 20 Vulnerable, and 18 Rare species
- 24 species listed under the provisions of the *EPBC Act*, including three Endangered and 21 Vulnerable species.

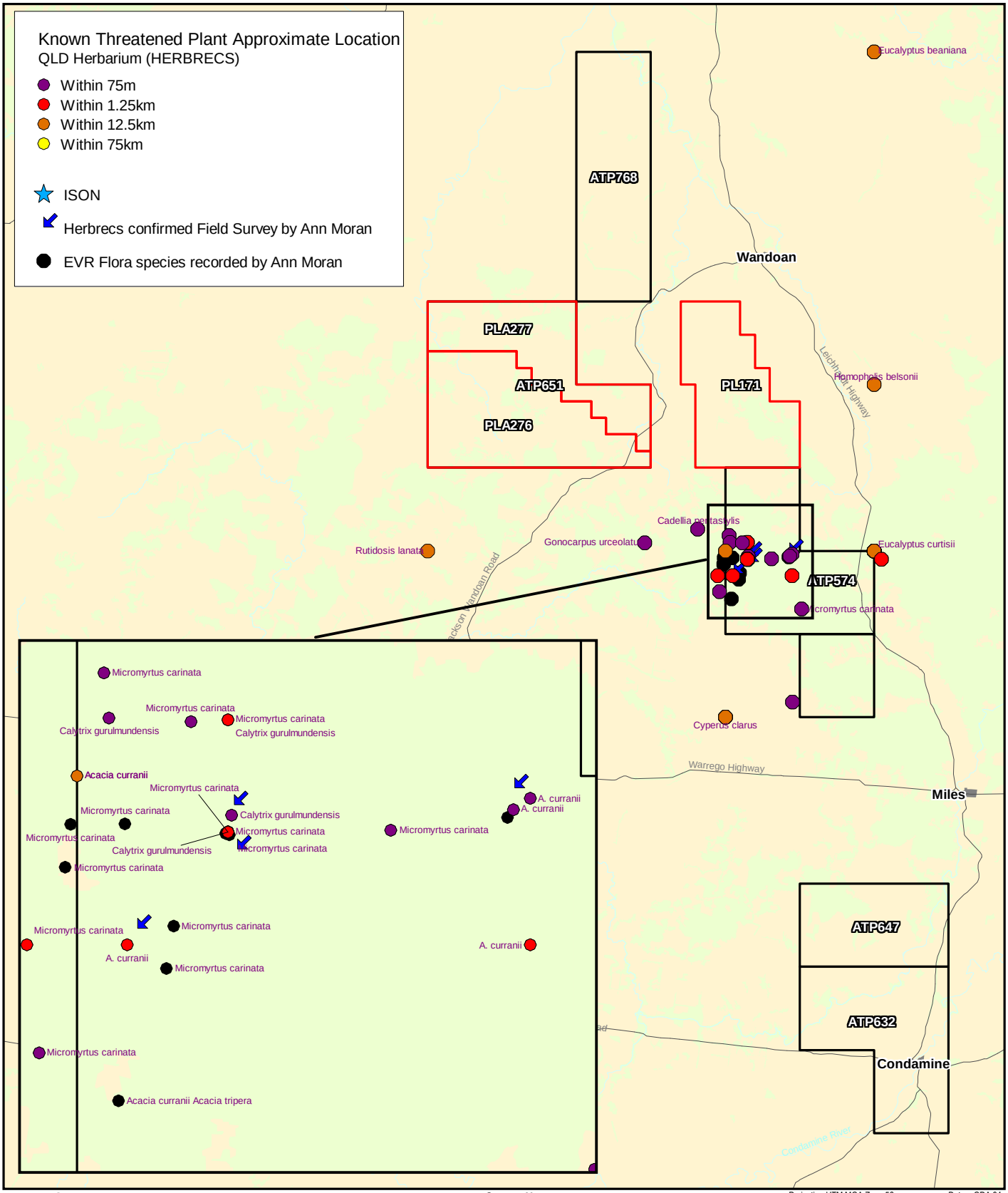
These species and their preferred habitats were targeted during the field survey work. Of these:

- Eight EVR flora species have been recorded within the Gas Field by HERBRECS and the field assessment (*Figure 3.7.6* and *Figure 3.7.7*). These eight and 25 additional species are considered to have preferred habitat within the Gas Field (refer to *Table 3.7.1*)
- 15 are considered unlikely to occur based on the absence of their preferred habitat.

Regionally Significant Flora

In addition to the EVR flora species, four Regionally Significant flora species are known to occur within the Gas Field. These species have not been listed as being EVR under the *EPBC Act* or *NC Act,* but have been identified by the DERM as non-EVR priority taxa for the Brigalow Belt Bioregion. These are:

- *Acacia aprepta* (Miles mulga) – dominant in patches with scattered distribution in the central portions of the Gas Field around Miles. The distribution of this species extends well outside of the Gas Field.
- *Acacia shirleyi* (lancewood) – scattered distribution, widespread and common. The distribution of this species extends well outside of the Gas Field.
- *Corymbia bloxsomei* (yellow bloodwood) – occasionally along edges of RE 11.7.5 in the northern part of the Gas Field in Gurulmundi State Forest (Site M1). The distribution of this species extends well outside of the Gas Field.
- *Dodonaea macrossanii* (hop bush) – widespread and common around the Condamine area, particularly in RE 11.5.1. Occurs often along roadsides and is often heavily grazed by kangaroos and wallabies down to stump level. The distribution of this species also extends well outside of the Gas Field.



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QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project	Title: Known EVR Locations - North West Tenements	
	Client: QGC - A BG Group business		Map 1 of 2
ERM Environmental Resources Management Australia Pty Ltd	Drawn: Mipela	Volume: 3	Figure: 3.7.6
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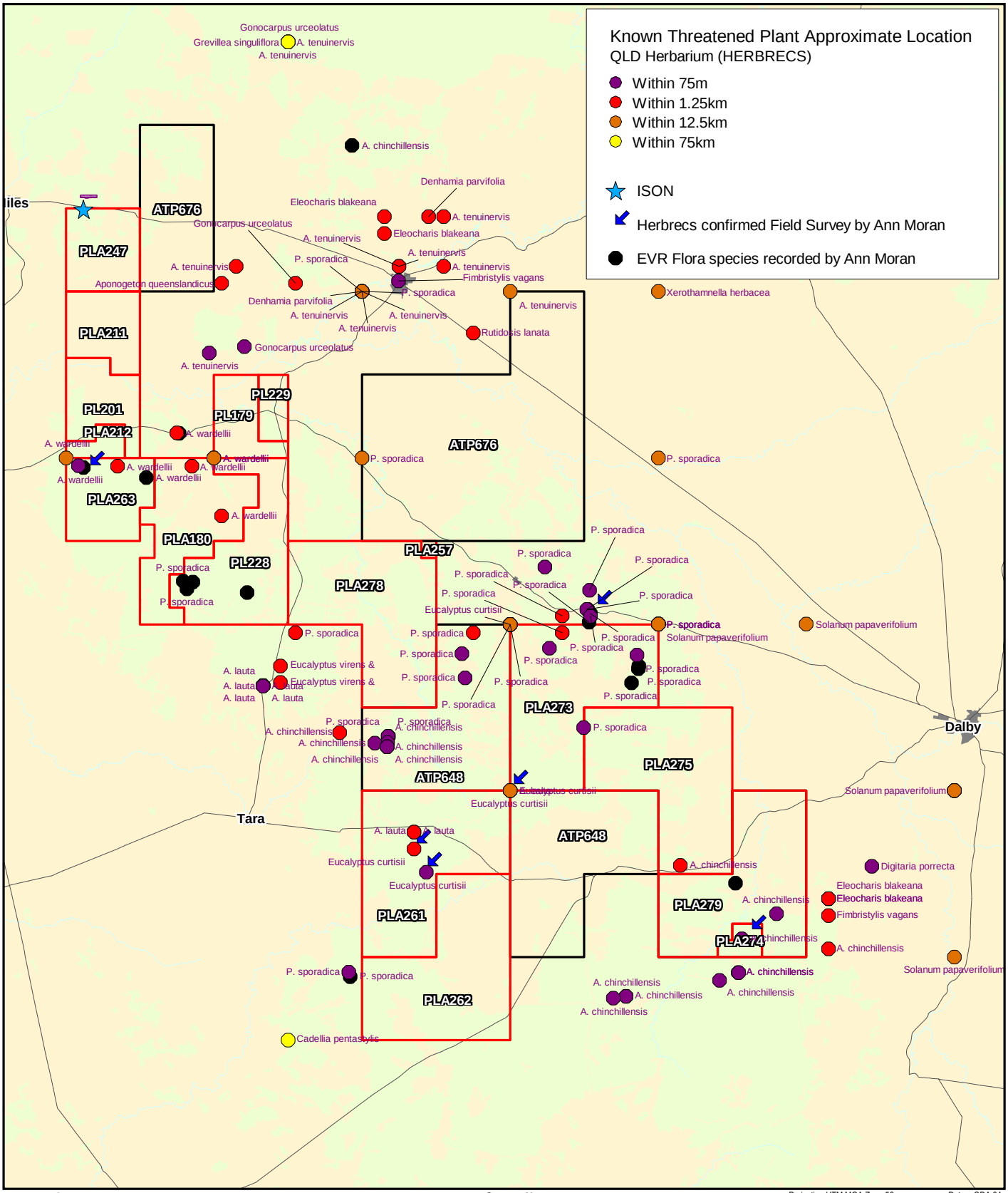

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QUEENSLAND CURTIS LNG
A BG Group business

Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business

Title **Known EVR Locations - Central and South East Tenements**

Map 2 of 2

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Drawn	Mipela	Volume 3	Figure 3.7.7
Approved	CDiP	File No:	QC02-T-MA-00054
Date	10.06.09	Revision	A

Table 3.7.1 EVR Flora with Preferred Habitat in the Gas Field

Common Name	*Scientific Name*	Status
Waajie Wattle	*Acacia barakulensis*	V[2]
Brown Wattle	*Acacia brunioides*	R[2]
None known	*Acacia chinchillensis*	V[1 and 2]
Curly-bark Wattle	*Acacia curranii*	V[1 and 2]
Tara Wattle	*Acacia lauta*	V[1 and 2]
None known	*Acacia tenuinervis*	R[2]
None known	*Acacia wardellii*	V[1 and 2]
Queensland Lace Plant	*Aponogeton queenslandicus*	R[2]
Ooline	*Cadellia pentastylis*	V[1 and 2]
None known	*Calytrix gurulmundensis*	V[1 and 2]
None known	*Commersonia sp.(G.P. Guymer 1642)*	V[1]
None known	*Cryptandra ciliata*	R[2]
Small-leaved Denhamia	*Denhamia parvifolia*	V[1 and 2]
None known	*Diuris tricolor (sheaffiana)*	V[1]
Blake's Spikerush	*Eleocharis blakenea*	R[2]
Plunkett Mallee	*Eucalyptus curtisii*	R[2]
Pumpkin Gum	*Eucalyptus pachycalyx*	R[2]
None known	*Eucalyptus rubiginosa*	R[2]
Shiny-leaved Ironbark	*Eucalyptus virens*	V[1 and 2]
None Known	*Fimbristylis vagans*	R[2]
None known	*Gonocarpus urceolatus*	V[2]
None known	*Grevillea singuliflora*	R[2]
None known	*Homopholis belsonii*	E[2]V[1]
None known	*Homoranthus decumbens*	V[1 and 2]
None known	*Melaleuca groveana*	R[2]
Gurulmundi Heath-myrtle	*Micromyrtus carinata*	E[2]
None known	*Micromyrtus patula*	E[2]
None known	*Notelaea pungens*	R[2]
None known	*Philotheca sporadica*	V[1 and 2]
None known	*Rutidosis glandulosa*	R[2]
None known	*Rutidosis lanata*	E[2]
None known	*Solanum papaverifolium*	E[2]
None known	*Solanum stenopterum*	V[2]

Status: [1]: EPBC (Cth) listed: EX = Extinct; CE = Critically Endangered; E = Endangered; V = Vulnerable

[2]: NC Act (Qld) listed: EX = Presumed Extinct; E = Endangered; V = Vulnerable; R = Rare.

Declared and Environmental Weeds

The field survey detected only two declared weeds within the Gas Field:

- mother of millions (*Bryophyllum delagoense*)
- prickly pear (*Opuntia species*.)

Numerous environmental weeds were also recorded during field surveys. Species that may impede rehabilitation works following construction include:

- maynes pest (*Verbena tenuisecta*)
- mimosa bush (*Acacia farnesiana*)
- exotic pasture and roadside grasses, such as:
  - african love grass (*Eragrostis curvula*)
  - buffel grass (*Cenchrus ciliaris*)
  - guinea grass (*Megathyrsus maximus* – synonymous with *Panicum maximum*).

Many REs have been substantially degraded by buffel grass and guinea grass, both of which have the capacity to displace native ground-storey species and alter fire regimes irrevocably. Buffel grass is now recognised as an emerging environmental weed of considerable importance (Best 1998; Clarke et al. 2005; Greenfield 2007). It is also widely used in the region as a pasture grass.

7.4.2 Fauna

7.4.2.1 Survey Methodology

The fauna desktop study and field surveys:

- compiled an inventory of fauna for the area and detailed overall distributions and habitat preferences in the Gas Field as well as in the broader environment so that potential impacts associated with proposed activities could be considered in a local, regional and state context
- identified the presence/absence or likely presence/absence of EVR fauna species identified in commonwealth and state legislation
- identified the distribution and relative abundance of feral species.

7.4.2.2 Fauna Description

Vegetation-based descriptions of habitats have been described above in *Section 7.4.1.2*. Fauna habitats on most rural lands and roadside verges in the Gas Field are fragmented and substantially degraded. Most areas have a long history of grazing, timber removal and invasion by environmental weeds. Nevertheless, some areas, particularly riparian zones, have significant fauna habitat values with a relatively high percentage of hollow-bearing trees, moderate to high levels of under-storey vegetation and leaf litter.

The relatively moist riparian environments also support more regular and heavy flowering eucalypt communities which are important food sources for many bird species. Two Little Red Flying Fox (*Pteropus scapulatus*) colonies were also found in the area at the time of the field surveys and were observed to be feeding principally along these riparian areas.

EVR Species

Database searches identified 33 fauna species listed as EVR under the *EPBC Act* and/or the *NC Act* and of these 28 were considered to potentially occur in the area (refer to *Table 3.7.2*). These include:

- two Endangered, nine Vulnerable and four Rare under the *NC Act*
- four Endangered, 12 Vulnerable, 11 Migratory and six Marine under the *EPBC Act*.

Table 3.7.2 EVR Species Likely to Occur in the Gas Field

Common Name	Scientific Name	Status
Imperial Hairstreak Butterfly	*Jalmenus evagoras eubulus*	V[2]
Brigalow Scaly-foot	*Paradelma orientalis*	V[1 and 2]
Dunmall's Snake	*Furina dunmalli*	V[1]
Yakka Skink	*Egernia rugosa*	V[1 and 2]
Five-clawed Worm Skink	*Anomalopus mackayi*	V[1]/E[2]
Grassland Earless Dragon	*Tympanocryptus pinguicolla*	E[1]
Golden-tailed Gecko	*Strophurus taenicauda*	R[2]
Red Goshawk	*Erythrotriorchis radiatus*	V[1]/E[2]
Glossy Black Cockatoo	*Calyptorhynchus lathami*	V[2]
White-throated Needletail	*Hirundapus caudacutus*	Mi
Rainbow Bee-eater	*Merops ornatus*	Mi
Rufous Fantail	*Rhipidura rufifrons*	Mi
Great Egret	*Ardea alba*	Mi, Ma
Cattle Egret	*Ardea ibis*	Mi, Ma
Lathams Snipe	*Gallinago hardwickii*	Mi, Ma
Australian Cotton Pygmy-goose	*Nettapus coromandelianus albipennis*	Mi
Painted Snipe	*Rostratula benghalensis*	Mi/V[2]
Fork-tailed Swift	*Apus pacificus*	Mi, Ma
Magpie Goose	*Anseranus semipalmata*	Ma
Freckled Duck	*Stictonetta naevosa*	R[2]
Swift Parrot	*Lathamus discolour*	E[1]
Regent Honeyeater	*Anthochaera Phrygia*	E[1], Mi
Paradise Parrot	*Psephotus pulcherrimus*	EX[1 and 2]
Australian Painted Snipe	*Rostratula australis*	V[1]
Black-breasted Button-quail	*Turnix melanogaster*	V[1 and 2]
Eastern Long-eared Bat	*Nyctophilus timoriensis*	V[1 and 2]
Large-eared Pied Bat	*Chalinolobus dwyeri*	V[1]/R
Little Pied Bat	*Chalinolobus picatus*	R[2]

Status: [1]: *EPBC Act* (Cth) listed: EX = Extinct; CE = Critically Endangered; E = Endangered; V = Vulnerable; Mi = Migratory Species, Ma = Marine Species.
[2]: *NC Act* (Qld) listed: EX = Presumed Extinct; E = Endangered; V = Vulnerable; R = Rare.

Regionally Significant Fauna

According to database searches 11 Priority Species listed under the BAMM Assessment for the Brigalow Belt South (Criteria H) (EPA 2008c) may potentially occur within or in the broad vicinity of the Gas Field. Nine of these species were identified during detailed field surveys and are presented in *Table 3.7.3* below. Species not identified by the field surveys but according to Queensland Herbarium records could still potentially occur, are the Bush Thick-knee (*Burhinus grallarius*) and the Hooded Robin (*Melanodryas cucullata*).

Table 3.7.3 Regionally Significant Fauna

Common Name	Scientific Name	No. records
Salmon-striped Frog	*Lymnodynastes salmini*	2
Speckled Warbler	*Chthonicola sagittata*	3
Brown Treecreeper	*Climacteris picumnus*	1
Barking Owl	*Ninox connivens*	2
Koala	*Phascolarctos cinereus*	2
Yellow-bellied Glider	*Petaurus australis*	10
Narrow-nosed Planigale	*Planigale tenuirostris*	1
Common Brushtail Possum	*Trichosurus vulpecula*	1
Eastern Pebblemound Mouse	*Pseudomys patrius*	1

7.4.2.3 Introduced Fauna

Eleven terrestrial, introduced species have been recorded within the Gas Field (refer to *Table 3.7.4*). These include one amphibian, three birds and seven mammals.

Table 3.7.4 Introduced Fauna

Common Name	Scientific Name
Cane Toad	*Rhinella marina*
House Sparrow	*Passer domesticus*
Common Starling	*Sturnus vulgaris*
Domestic Pigeon	*Columbia livia*
European Fox	*Vulpes vulpes*
Feral Pig	*Sus scrofa*
Domestic Dog	*Canis familiaris*
Feral Cat	*Feils catus*
European Rabbit	*Oryctolagus cuniculus*
House Mouse	*Mus musculus*
Feral Goat	*Capra hircus*

7.4.3 Wetlands

The Condamine and Balonne Rivers drain the region of the Gas Field towards the southwest. These rivers flow intermittently after rain and normally consist of a series of isolated waterholes of varying sizes. The larger waterholes are used frequently for recreational fishing.

Outside of the Gas Field, there are several nationally significant wetlands located on the lower Balonne River system including the Ramsar-listed Narran Lake Nature Reserve (which includes Back and Clear Lakes) which is part of large terminal wetlands of the Narran River at the end of the Condamine system flowing out of Queensland. The Narran Lake Nature Reserve is approximately 450 km south-west of the Gas Field, in New South Wales.

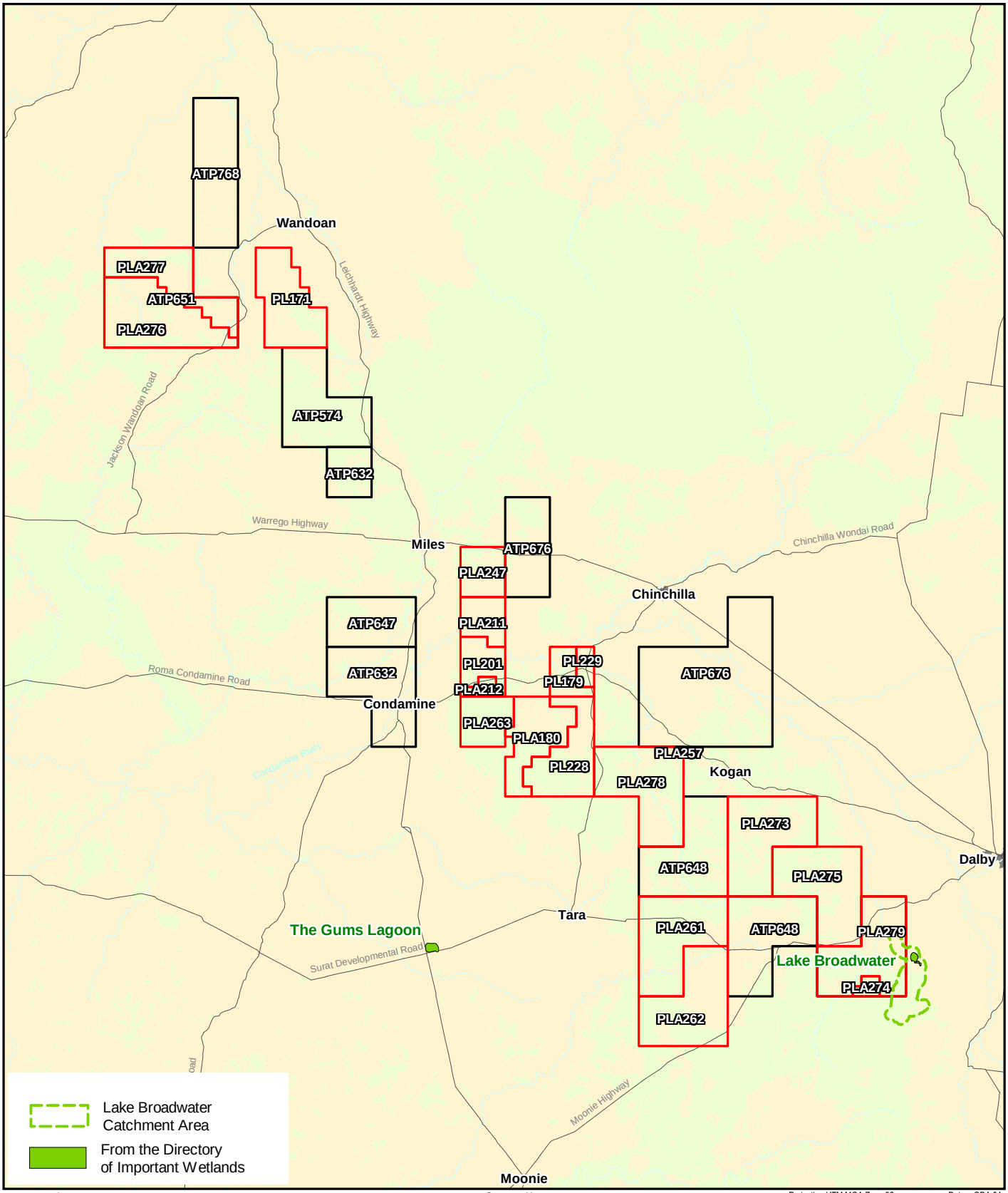
In addition to the Narran Lake Nature Reserve there are two major wetlands within the Condamine catchment: Lake Broadwater Conservation Park and Resources Reserve 25 km south-west of Dalby on the eastern boundary of Petroleum Lease (PL) 279; and The Gums Lagoon 26 km, south-west of Tara outside the western boundary of Petroleum Lease Application (PLA) 261 (*Figure 3.7.8*).

Lake Broadwater is classified as a Palustrine system with Lacustrine wetlands on the outskirts, and supports four wetland communities: open water communities, lake edge communities, marsh communities, riparian communities.

The Gums Lagoon is classified as a palustrine system with a relatively undisturbed wooded swamp in a small reserve of similarly undisturbed woodlands and open forest (Queensland National Parks and Wildlife Service [QNPWS] 2005). The Gums Lagoon supports 79 identified species of birds some of which are afforded special status under the bilateral Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA) and Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA). These agreements provide for the conservation of terrestrial, water and shorebird species that migrate between Australia and the respective countries.

The Gas Field area also contains a number of small areas mapped by the Queensland Herbarium as wetlands (*Figure 3.7.9*). They are mapped as Not of Concern RE 11.3.27 (i.e. Palustrine wetland).

These wetlands were not able to be accessed in the field due to landholder constraints but interpretation of satellite imagery shows that they are all small ephemeral wetlands, in most cases closely associated with, and in close proximity to, significant watercourses. Aerial photographic interpretation indicates that most are subject to grazing and in a degraded to average condition.



Legend:

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- Gas Fields - Authority to Prospect

Source Note:

1:250,000 Topographic Vector copyright Geoscience Australia
Important Wetlands copyright Department of Primary Industries
Coastal Wetland Vegetation

Projection UTM MGA Zone 56 Datum GDA 94

0 10 20 30 40

Kilometres

N

QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: **Important Wetlands Areas**
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: Mipela	Volume: 3 Figure: 3.7.8	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data may not be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: CD	File No: QC02-T-MA-00020	
	Date: 06.07.09	Revision: A	

7.4.4 Assessment of Conservation Values

Conservation values across the Gas Field vary markedly as a result of past and present land uses, the intensity of current rural residential zones, and cropping and grazing regimes. In this assessment, conservation values have been appraised in accordance with BAMM and take into account Environmentally Sensitive Areas as defined by DERM in its guideline, Assessment and Approval Process for Environmental Authorities for Petroleum Activities.

Incorporated in BAMM is a requirement for the appraisal of habitat for EVR taxa, ecosystem values, RE status *(VM Act)* which incorporates threatened ecological communities *(EPBC Act),* the size of remnant vegetation tracts, relative ecosystem size, ecosystem diversity, the connectivity and buffering of REs, habitat for BAMM priority taxa, special biodiversity values and threatening processes.

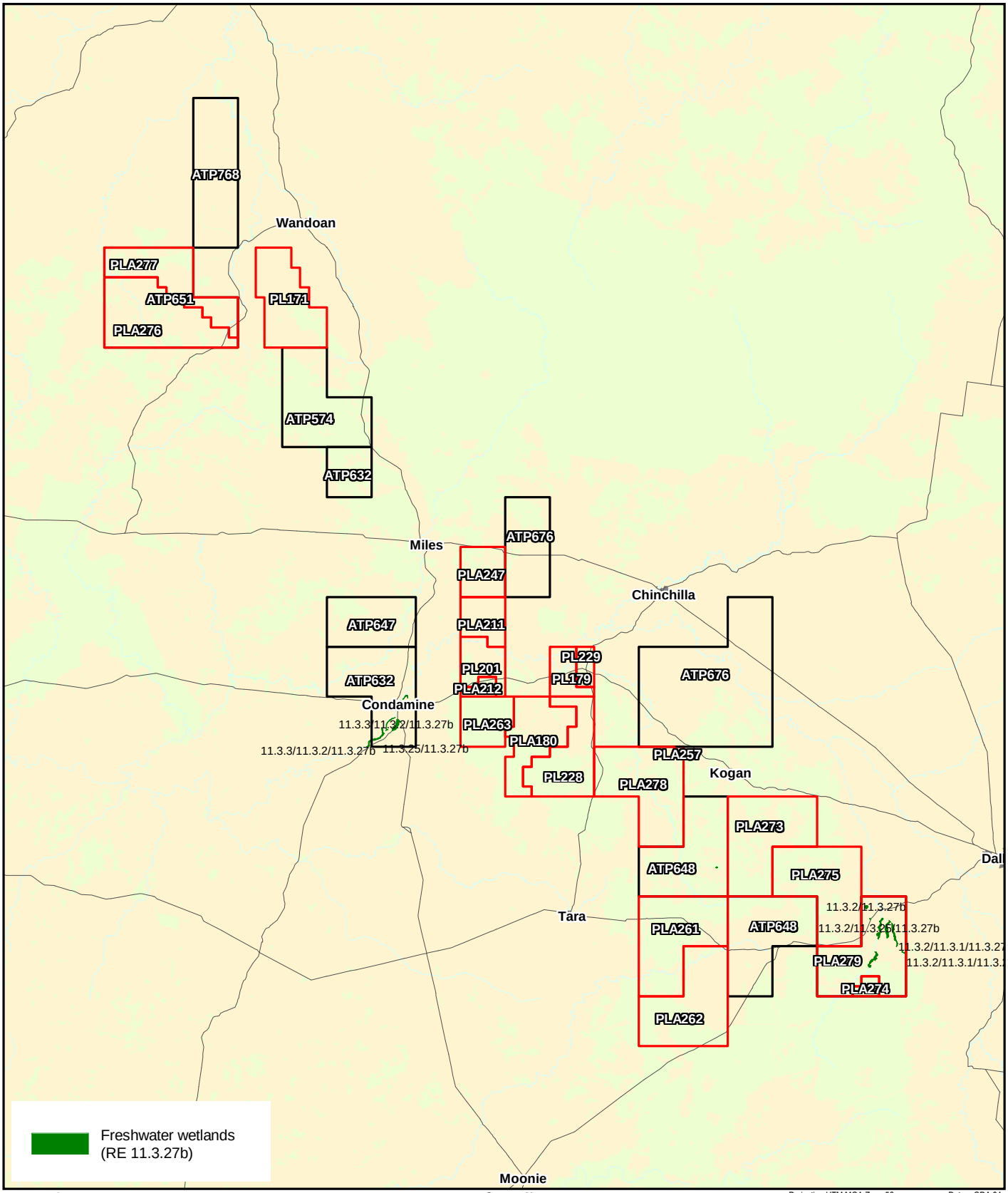
Seven of the BAMM criteria (A to G) are assessed through appraisal of a combination of criteria derived from geographic information systems (GIS) spatial data. The BAMM criteria (H to K) are assessed through consultation with expert panels, the members of which have specific expertise in various taxa occurring in the bioregion.

Field surveys of flora and fauna conducted as part of the impact assessment for this EIS resulted in the provision of additional site records and information relevant to these criteria. These records included EVR and priority taxa (BAMM criteria A and H respectively) and the identification of special biodiversity value areas (criteria I):

7.4.4.1 *Flora*

Areas with additional flora values identified within the Gas Field include:

- All areas of remnant vegetation in ironstone jumpups (exposed and shallowly covered duricrusts) within the Gas Field are of particular importance since they contain a significantly larger number of EVR taxa located in the Gurulmundi area and in the southern areas of the Gas Field where it supports *Philotheca sporadica* and other EVR plants. These ironstone jumpups comprise open gravelly hilltops (lateritic duricrust) and gravel is frequently extracted from these areas.
- Parts of Mardela State Forest mapped as RE 11.3.2 are in fact RE 11.3.1 and have been afforded the elevated status of endangered.
- Condamine State Forest, which contains several EVR species, is considered an area with high species richness.
- Braemar State Forest, appraised as being in an average condition due to impacts from fire and to a lesser extent from logging and recreational vehicle usage, contains high-quality examples of Endangered REs and very few weeds. These factors, together with the relatively large size of the State Forest, qualify it as a refugia area.



Legend:

- Gas Fields - Petroleum Lease/Petroleum Lease Application
- Gas Fields - Authority to Prospect

Source Note:

1:250,000 Topographic data copyright Commonwealth of Australia
Regional Ecosystem v5.0 copyright Queensland Herbarium

Projection UTM MGA Zone 56 Datum GDA 94

0 10 20 30 40
Kilometres

N

QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: **Freshwater Wetlands (RE 11.3.27b)**
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: Mipela	Volume: 3 Figure: 3.7.9	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: CDiP	File No: QC02-T-MA-00038	
	Date: 28.05.09	Revision: A	

- Semi-evergreen vine thicket protected under EPBC Act and VM Act is exceedingly rare in the Gas Field, occurring only in the northern parts of the Gas Field (*Figure 3.7.3*). These areas have additional values as they contain taxa at their southern geographical extent.
- It is assumed areas mapped as ephemeral wetlands (RE 11.3.27) have extant values. However they remain unassessed in the field due to landholder constraints.

7.4.4.2 Fauna

Areas with additional fauna values identified within the Gas Field include:

- Many small creeks and floodout areas, some of which provide native, well-vegetated riparian corridors, exist within the tenements. They include the environs of Wambo Creek, Wilkie Creek, Moramby Creek, Braemar Creek and the Condamine River. These areas contain a high proportion of hollow trees which are important in providing dry-season refuges and breeding areas.
- Gurulmundi State Forest has significant escarpments above steep boulder-strewn creek lines which provide important refugia and habitat for uncommon species. Within the Gas Field, this was the only area where the east coast wallaroo (*Macropus robustus*) was found.
- In the Gurulmundi area, recorded bat calls may be those of the large-eared pied bat (*Chalinolonbus dwyeri*) and footprints seen in several caves may be those of the northern quoll (*Dasyusus hallucatus*). Further survey effort would be required to confirm these records but based on a precautionary approach it is assumed for the purposes of this impact assessment that these species occur in this area.

7.4.5 Conservation Values Mapping

Priority areas for nature conservation in the Gas Field were spatially analysed by allocating numerical values to:

- BAMM criteria
- Environmentally Sensitive Areas
- additional values identified during the field surveys.

Figure 3.7.10 below provides a composite Environmentally Sensitive Areas map for the Gas Field and surrounding areas which takes into consideration the identified conservation values overlaid against RE polygons and their conservation status as defined under the *VM Act* (Qld) and DERM's Biodiversity Status.

This mapping provided the basis for developing a zoning scheme that prescribes different levels of environmental constraint (guidelines), depending on the overall conservation value of an area (*Figure 3.7.11*). The zoning provides for:

Zone 1) Minimal Ecological Constraints

Zone 2) Medium Ecological Constraints

Zone 3) High Ecological Constraints

Zones 4a) and 4b) Very High Ecological Constraints.

This zoning-based approach to managing environmental impacts was taken into account when assessing the likelihood and magnitude of environmental impacts, and in formulating mitigation measures for flora and fauna located within the Gas Field.

7.5 POTENTIAL IMPACTS

7.5.1 Clearing of Remnant Vegetation

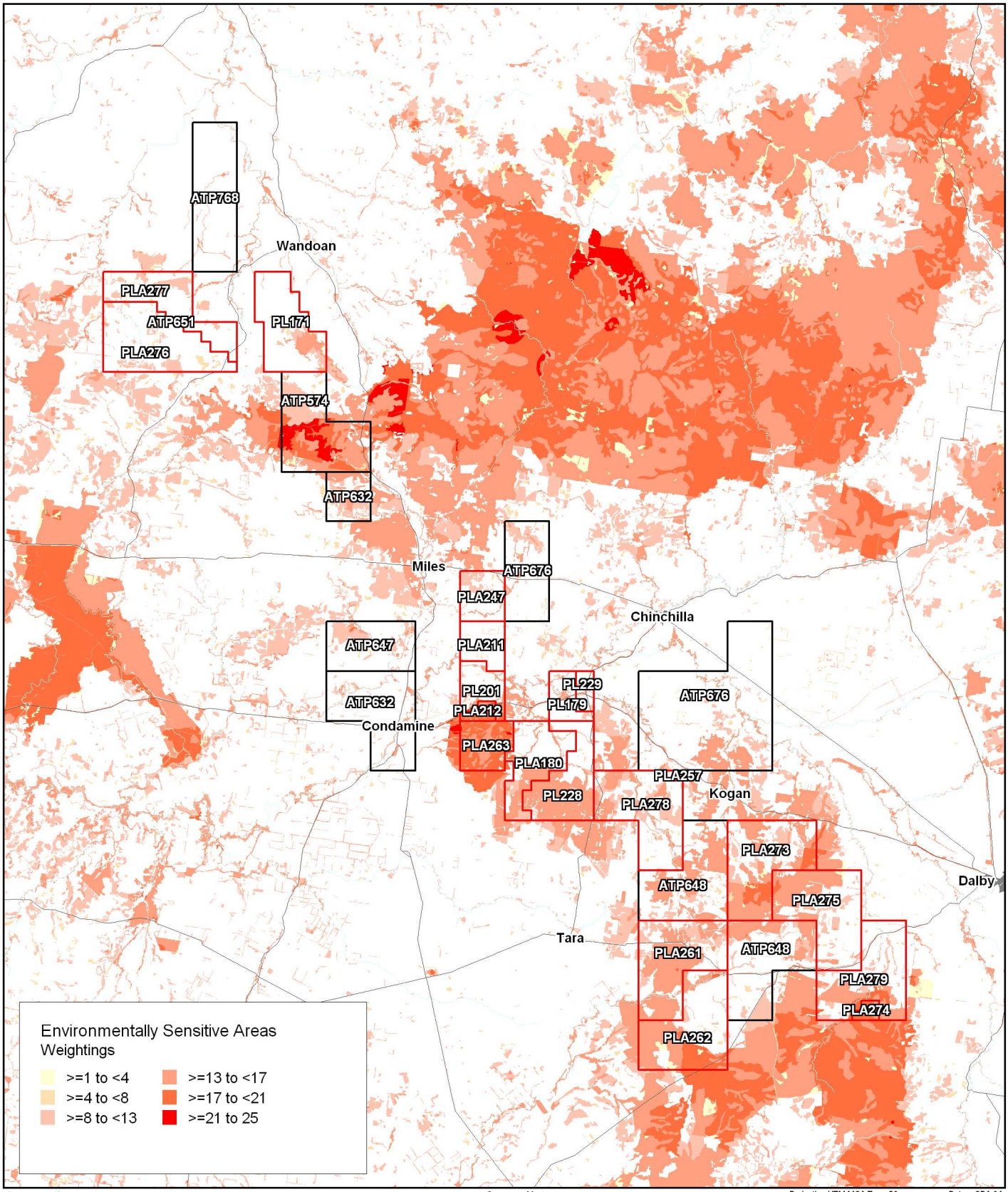
Regional ecosystem mapping by DERM indicates that approximately 50 per cent of the Gas Field supports remnant vegetation. The majority of this consists of eucalypt woodlands and forests with very minor, fragmented stands of brigalow which often occur on roadside verges or as wind breaks along the margins of pasture or cropping paddocks.

Some clearing of these remnant ecological communities will be required. Mostly, this will involve the clearing of relatively narrow, linear corridors and well pad footprints in eucalypt communities.

In order to ascertain the clearing related impacts that may occur within the Project area and to place this in a bioregional perspective the following has been analysed:

- the total mapped area of EPBC-listed ecological communities within the Gas Field and the extent of area and percentage of area that may be impacted (This estimate coincides with and is not additional to the areas estimated for endangered, of concern and not of concern REs under the *VM Act*.)
- the total mapped area of *VM Act* Endangered REs within the Gas Field and the extent of area, and percentage of area that may be impacted
- the total mapped area for of concern REs within the Gas Field and the extent of area, and percentage of area that may be impacted
- the total mapped area for not of concern REs within the Gas Field and the extent and percentage of area that may be impacted
- the overall extent of these RE categories within the bioregion.

These estimates are provided in *Table 3.7.5*. These are worst case vegetation loss scenarios. Actual loss is likely to be far less than this when mitigation measures proposed in *Section 7.6* are implemented. Note that the calculations set out in *Table 3.7.5* are based on the assumption that any unavoidable clearing of endangered and of concern RE (likely to be of a very minor extent) will be compensated for through environmental offsets.



Legend:

Gas Fields - Petroleum Lease/Petroleum Lease Application

Gas Fields - Authority to Prospect

Source Note:

Biodiversity Assessment data copyright of Queensland Environmental Protection Agency

Projection UTM MGA Zone 56 Datum GDA 94

0 10 20 30 40

Kilometres

N

QUEENSLAND CURTIS LNG
A BG Group business

ERM
Environmental Resources Management Australia Pty Ltd

Project	Queensland Curtis LNG Project	Title	**Environmentally Sensitive Areas (Weighted)**
Client	QGC - A BG Group business		
Drawn	Mipela	Volume 3	Figure 3.7.10
Approved	CDiP	File No:	QC02-T-MA-00021
Date	10.06.09	Revision	A

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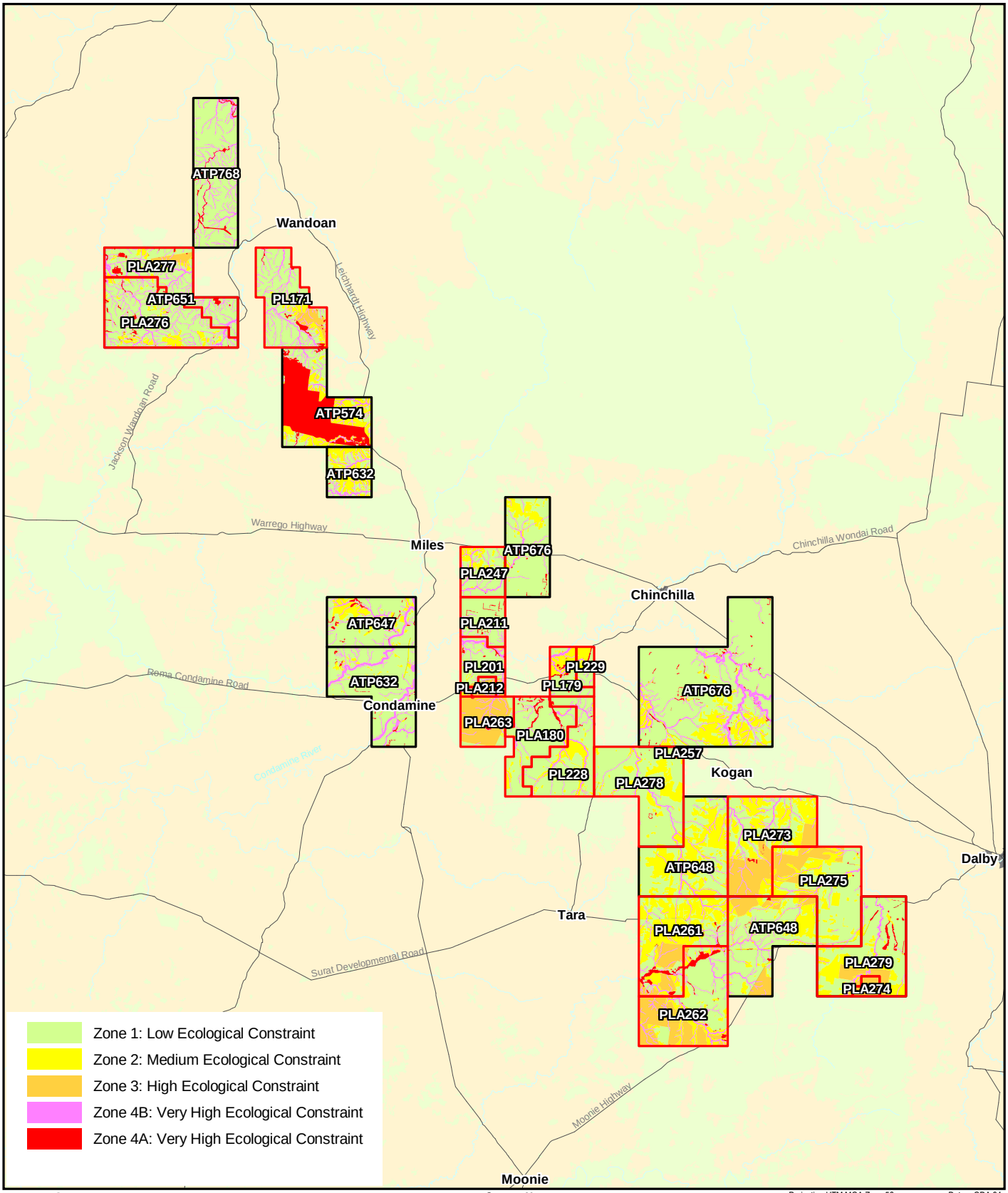

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0 10 20 30 40

Kilometres

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QUEENSLAND CURTIS LNG
A BG Group business

Project: Queensland Curtis LNG Project

Client: QGC - A BG Group business

Title: **Gas Fields - Ecological Constraints Zones**

ERM
Environmental Resources Management Australia Pty Ltd

Drawn	Mipela	Volume 3	Figure 3.7.11
Approved	CDiP	File No:	QC02-T-MA-00040
Date	10.06.09	Revision	A

Table 3.7.5 Worst-case Vegetation Loss

RE Status	Estimated extent within the Gas Field (ha)	Worst-case vegetation loss (ha)	Estimated extent remaining (ha)	Estimated % cleared in the Gas Field	Estimated % cleared in the bioregion
EPBC-listed*	4,039	0#	4,039	0	0
Endangered	4,415	0#	4,415	0	0
Of Concern	7,403	0#	7,403	0	0
Not of Concern	159,434	4,624^	154,811	<3	0.1
TOTAL	171,253	4,624^	166,415	<3	0.03

* EPBC-listed ecological communities coincide with (and are not additional to) VMA Endangered, Of Concern and Not of Concern REs.

\# Including offset activities where clearing unavoidable (very minor extent)

^ Excluding consideration of offset activities

Conservation-focused offsets and land management initiatives associated with the Project will contribute to protecting and improving environmental values in these threatened communities and RE.

7.5.2 Other Impacts

Other potential detrimental impacts on biodiversity include:

- the movement of machinery and vehicles between areas, which has the potential to spread weeds including a number of environmental and declared noxious species, such as buffel grass, parthenium weed and giant rat's tail grass
- the introduction or proliferation of pest fauna species
- the activities of machinery and construction operations which may increase the likelihood of bushfires
- uncontrolled release of Associated Water, which is mildly saline (generally 2,000 to 5,000 ppm), from initial drilling and water storage activities
- accidental release of Associated Water with higher levels of salinity from evaporation ponds or other Associated Water infrastructure.

7.5.3 Assessment of Significance of the Impact for EPBC-threatened Ecological Communities

The Commonwealth Department of the Environment, Water, Heritage and the Arts provides administrative guidelines to assist in determining whether the impact of an action on any Matter of National Environmental Significance is likely to be significant.

Criteria provided for endangered ecological communities are:

"An action has, will have, or is likely to have a significant impact on an endangered ecological community if it does, will, or is likely to:

- *lead to a long-term adverse effect on an ecological community*
- *reduce the extent of a community*
- *fragment an occurrence of the community*
- *adversely affect habitat critical to the survival of an ecological community*
- *modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival*
- *result in invasive species that are harmful to the critically endangered or endangered community becoming established in an occurrence of the community, or*
- *interfere with the recovery of an ecological community."*

The total known area of EPBC Act Listed Ecological Communities in the CSG Field is estimated to be 4,039 ha, including approximately 3,418 ha Brigalow Communities and 621 ha of Semi-evergreen Vine Thicket (SEVT). These are represented by eight Regional Ecosystems, namely: Brigalow woodland / open forest communities – REs 11.3.1, 11.4.3, 11.4.7, 11.4.10, 11.9.5, and 11.9.6, and Semi-evergreen vine thicket communities – RE 11.8.3 and RE 11.9.4. The proportion of each of the Brigalow and SEVT REs which occur within the CSG Field is less than 13% of that found in a 200 km x 200 km area centred on the CSG Field and less than 2.4% of that found in the Bioregion. An exception to this is RE 11.4.10 for which the area contained in the CSG Field represents approximately 20% of that which occurs in the broader 200 km x 200 km buffer.

The worst case (unmitigated) clearing scenario would amount to the removal of approximately 117 ha, which equates to approximately 0.009% of the Threatened communities found within the Bioregion. Avoidance of these areas by excluding non-linear infrastructure would reduce the clearing scenario to an estimated maximum of 36 ha (30 ha Brigalow and 6 ha SEVT). Total avoidance will not be practicable as linear infrastructure, namely pipelines (and potentially access tracks) will occasionally need to transect narrow linear remnants which follow creeklines, fences and roads. All unavoidable and minor clearing of all Brigalow and SEVT communities are proposed to be offset (with a ratio of at least 1:1.5) and be in accordance with the DEWHA's Draft *Policy Statement: Use of Environmental Offsets under the Environment and Protection and Biodiversity Conservation Act 1999* (See *Section 7* of *Annex 13.1*).

In summary, due to the small area to be cleared relative to that to be contained in the local area and the fragmented and degraded nature of these remnants, it is considered that the proposed clearing will not have a significant impact on any Threatened Ecological Communities.

7.5.4 EVR Flora

All EVR flora species identified in the Gas Field may be subject to some of the potential impacts described in the previous section, including the following:

- flora may be cleared for the construction of roads and pads for gas drilling and extraction
- the activities of machinery and construction operations may increase the likelihood of wildfires
- there is higher potential for clearing activities within ironstone jumpups (exposed and shallowly covered duricrusts) to impact particular EVR flora species (i.e. *Acacia curranii*, *Calytrix gurulmundensis, Eucalyptus curtisii, Micromyrtus carinata* and *Philotheca sporadica*)
- additionally, the aquatic EVRs, *Aponogeton queenslandicus, Eleocharis blakeana* and *Fimbristylis vagans,* while not recorded in the Gas Field, have the potential to occur within temporary waterbodies. These species have the potential to be impacted by:
  - any sedimentation or eutrophication of watercourses
  - inadvertent release of saline waters (initial drilling and gas extraction activities may result in the release of Associated Water which is mildly saline, generally 2,000 to 5,000 ppm)
  - accidental release of Associated Water with higher levels of salinity from evaporation ponds or other Associated Water infrastructure.

It is noted that changes to surface water-level tables are unlikely to occur as a result of the Gas Field and pipeline development (Golder, 2009a and b).

The potential for weed species to significantly impact any of EVR flora species within the Gas Field is considered to be low due to the fact that either:

- the niches in which they occur are generally not suitable for the establishment of significant populations of exotic species, or
- where this is not the case, the preferred habitats are generally already dominated by buffel grass, green panic or other pasture grasses.

However, a weed and pest management plan as been developed as part of both the construction and operational Environmental Management Plans (EMP). These EMPs ensure that steps are undertaken by QGC and any contractors to prevent the spread of environmental and declared weeds during the life of the Project.

7.5.5 Potential Impacts to Regionally Significant Flora

There are four Regionally Significant flora species known to occur within the Gas Field. These are:

- Miles mulga *(Acacia aprepta)*
- lancewood (*Acacia shirleyi)*
- hop bush *(Dodonaea macrossanii)*
- yellow bloodwood *(Corymbia bloxsomei)*.

The first three are relatively widespread and common in the area. As such the proposed clearing is unlikely to have any significant effect on local or regional populations of these species.

Corymbia bloxsomei was only observed in smaller numbers fringing the ecotone around RE 11.7.5 within the Gurulmundi State Forest. A number of mitigation measures have been proposed by QGC and detailed in this EIS to prevent the potential for clearing of areas where this species is located. There may be significant impact on this species if it is not managed.

Potential Impacts to EVR Fauna

There are a number of ways that EVR fauna could potentially be impacted by the proposed development including:

- removal of habitat such as mature vegetation, hollow-bearing trees and fallen logs may result in loss of nesting, shelter and foraging resources
- fragmentation of habitat due to gathering line and access road construction, may result in these features acting as movement barriers, particularly to fossorial[1] species, thereby altering movement patterns. They may also limit access to dry-season fauna refuges associated with riverine environments
- predators may gain access. Dingoes and to a lesser extent foxes and cats are known to follow roads and tracks as they provide easy-access paths. This may open up new habitats and expose fauna to elevated predation risks
- the establishment of environmental weeds, particularly buffel grass, has the potential to destroy natural fauna habitats through altered fire regimes and removal of fauna food resources
- noise and increased human activity, particularly during site development, may restrict species movements and limit access to food or other resources
- the potential for road kills along access tracks will elevate mortality risks for some species
- runoff may result in sedimentation and eutrophication of aquatic habitats
- Associated Water with higher levels of salinity from evaporation ponds or other Associated Water infrastructure may be accidentally released.

Project infrastructure locations including wells will be selected to avoid areas that have been identified with Significant Environmental Values regarding the conservation of biodiversity. QGC has developed stringent environmental guidelines to ensure that these potential impacts do not occur unnecessarily.

1 Burrowing

7.5.6 Potential Impacts to Regionally Significant Fauna

Regionally Significant fauna encompasses a broad range of species groups and life forms and so, to some extent, will be potentially impacted by the factors listed in preceding sections. However, habitat for these taxa has been explicitly identified through field surveys and DERM mapping. Key habitats have been identified in the preparation of this impact assessment and incorporated in the mapping assessment of Environmentally Sensitive Areas.

In most cases these habitats have been avoided in the development proposal or are subject to stringent operational guidelines as described below under *Section 7.6, Mitigation and Rehabilitation*. Thus potential impacts on these taxa are considered to be minimal.

As with EVR species, these habitats may be specifically targeted in any offsets initiative that is adopted in the course of the Gas Field development.

7.5.7 Potential Impacts to Wetlands

The only internationally recognised wetland is the Ramsar-listed Narran Lake Nature Reserve which is approximately 450 km south-west of the Gas Field. Due to the distance between the Gas Field and the Narran Lake Nature Reserve, no impact upon this wetland is envisaged.

There are no major wetlands which occur within the Gas Field. There are two wetland areas that are located immediately outside the Gas Field. These are:

- Lake Broadwater Conservation Park and Resources Reserve
- The Gums Lagoon.

Lake Broadwater is located downstream of the Gas Field (PLA 279). Consequently, without appropriate mitigation measures, there could potentially be some impacts from nutrient and sediment flows or accidental releases of Associated Water. However, the mitigation measures for sediment and erosion controls, coupled with the mitigation measures adopted for Associated Water, make it highly unlikely that there will be any adverse effect on the Lake Broadwater Conservation Park and Resources Reserve as a result of the Gas Field development.

The Gums Lagoon is not downstream of the Gas Field and therefore this wetland is not expected to be directly or indirectly impacted by the proposed developments.

Due to their sensitivity, areas mapped as ephemeral wetlands within the tenements could, if coal seam gas (CSG) activities were conducted in close proximity, be potentially impacted through sedimentation, eutrophication and accidental release of Associated Water. However, the Gas Field construction and operations will be located outside these areas as detailed in the following section.

7.6 MITIGATION AND REHABILITATION

7.6.1 General Mitigation Guidelines

In addition to the protection measures which are already part of the existing Environmental Management Plan (e.g. weed washdowns, water disposal, audits) (see *Attachment 3 of Appendix 3.2 (The Upstream Flora and Fauna Report)*), the following mitigation measures will be implemented to ensure that significant impacts on biodiversity are avoided where possible and otherwise minimised:

- Infrastructure will be located away from remnant vegetation areas whenever possible. This includes roadside verges, travelling stock routes and similar areas that may have so far escaped clearing in otherwise cleared and developed areas
- The clearing or disturbance of all EPBC-listed Ecological Communities and Endangered and Of Concern REs (with these REs as either dominant or sub-dominant components) will be avoided whenever possible
- An offset strategy will be developed and implemented which compensates for all unavoidable clearing of Endangered and Of Concern RE
- The clearing or disturbance of all other RE will be minimised where possible
- Individual site pre-clearance surveys will be undertaken for each proposed road, well pad and pipeline (and other infrastructure), as is currently the practice, to enable detection and avoidance of flora and fauna values whenever possible, but should be expanded to include:
    - recording of the presence or absence of EPBC listed communities (including the Weeping Myall Open Woodland Community) and species
    - identification of potential microhabitat for fauna (e.g. hollow-bearing trees) and fauna habitat, which will require fauna handlers to be present at clearing
    - confirmation of the results of EVR flora field clearance searches and fauna microhabitat features
    - compulsory answers/options providing a clear action path stemming from each answer
    - identification of permitting requirements
    - noting the presence or absence of declared weed species in order to develop site-specific weed management options (control, vehicle and machinery washdowns)
- A clearing database will be maintained to record the areas of each RE cleared for CSG activities/infrastructure
- Good weed hygiene practices will be adopted to minimise the introduction or spread of declared, agricultural and environmental weeds in the Gas Field. These will include regular ongoing monitoring of areas disturbed by CSG activities

- Declared, agricultural and environmental weeds will be controlled throughout the construction, operational and decommissioning phases of the Project. In relation to the construction footprint and areas of disturbance, environmental weeds, such as buffel grass (*Cenchrus ciliaris*), castor oil (*Ricinus communis*), Mexican poppy (*Argemone ochroleuca*), mimosa bush (*Acacia farnesiana*) and guinea grass/green panic (*Megathyrsus maximus*) will also be managed, particularly during the construction phase and subsequent rehabilitation works. Rehabilitation of disturbed areas may also benefit from control of other exotic grasses; however, landholders may request that these species are retained for grazing purposes
- Fire fuel loads will be monitored and vehicle activities will be restricted to roads, access tracks and hardened surfaces to reduce the possibility of wildfire. Fire-fighting equipment will be fitted in vehicles and also be available at construction sites
- Fauna handlers will be present to survey for, and as necessary relocate, wildlife immediately prior to and during clearing activities in all locations identified as containing suitable fauna habitat during the pre-clearance surveys
- Road kills will be monitored in areas of high conservation and response strategies (e.g. reduced speed zones) will be developed where required
- Vegetated creek lines, fence lines and road reserves will be crossed at approximately 90 degrees and whenever possible located to limit the extent of clearing
- Measures will be taken to avoid placing water storage facilities in the Lake Broadwater catchment area (Broadwater Gully) which occurs in the south-eastern corner of PLA 279. This may help reduce the potential for nutrient, sediment and Associated Water (accidently released) flows entering Lake Broadwater Conservation Park.

7.6.2 Zone-based Mitigation Measures

Ecological constraints mapping has been developed based on Environmentally Sensitive Areas mapping to formulate a zoning system so that more stringent environmental conditions can be applied to areas of high conservation value and less stringent conditions where conservation values are lower.

The mapping is primarily based on RE polygons and tenure considerations. Inorder to translate this into workable constraints zones for field operations, the mapping has been simplified and four constraints zones have been recommended. They are:

- Zone 1 Minimal Ecological Constraints (63 per cent of Gas Field)
- Zone 2 Medium Ecological Constraints (18 per cent)
- Zone 3 High Ecological Constraints (8 per cent)
- Zone 4a and Zone 4b Very High Ecological Constraints (11 per cent).

Mitigation and rehabilitation recommendations have been presented for each of these zones.

These zones are those shown in *Figure 3.7.11.*

7.6.2.1 Zone 1 Minimal Ecological Constraints

These areas are substantially altered habitats with existing pastures of predominantly non-native species, cropping lands, intensively grazed and rural-residential areas. Some unmapped remnant vegetation may occur along the margins of paddocks or in roadside reserves and may be of moderate to high conservation value but are relatively small in extent and managed in the overall context of the predominant land use of the area.

Since the majority of this zone is privately owned and managed for primary production, the wishes of the landholder will be a primary factor in determining the placement and management of infrastructure, subject to the general guidelines above as they relate to flora and fauna of least concern, EVR species, Ecological Communities/REs and weeds.

Final rehabilitation requirements for sites in this zone will be negotiated with the landholder. In most cases they would provide for the return of areas to productive agricultural land.

7.6.2.2 Zone 2 Medium Ecological Constraints

Zone 2 areas include all mapped remnant vegetation that is not classified as a Zone 3 or Zone 4 area. In addition to the general guidelines, the following mitigation measures are recommended when in Zone 2 areas:

- Infrastructure and access lines will be located along existing easements where possible
- Vegetative waste as a result of clearing will be mulched or distributed across adjacent areas where it may provide refuge for terrestrial species. Felled vegetation will not be burnt (except where directed by regulatory authorities in response to heavily infestation of weed species)
- Linear features such as roads and pipelines will be built to allow for their intended purpose but should allow revegetation as much as possible to minimise impact on terrestrial fauna movements.

7.6.2.3 Zone 3 High Ecological Constraints

Zone 3 (High Ecological Constraints) areas include all State Forests (excluding Gurulmundi State Forest). For these areas, the following recommendations are made in addition to those identified in *Section 7.6*:

- site access will be only along existing cleared tracks, fire trails and easements. Where this is not possible, access is to be negotiated with DERM state forest management staff

- DERM and/or independent flora and fauna consultants will be involved in detailed pre-clearance surveys as part of early planning for infrastructure locations
- in order to minimise fragmentation effects well pads for gas extraction will be of a minimum safe area and placed against the edge of existing easements where possible
- "Best Available Technology" will be used to minimise clearing requirements
- access tracks will be incorporated into well pad clearance areas where possible to minimise total clearing requirements
- extraction methodologies that minimise the density of well pads in these areas (e.g. horizontal drilling) will be investigated and used where practicable
- vehicles and machinery will require washdown before entering state forests, if they have come from Zone 1 areas or known weed areas. The control of buffel grass is a key consideration in this zone
- access tracks will be regularly inspected for weeds and control measures employed where serious environmental or declared weeds are identified. It is recognised that some weed species may have been established in areas prior to the Project's commencement, and so less emphasis will be placed on these. The primary objective of this recommendation is to control spread of weeds that may occur as a direct result of the Gas Field development.

7.6.2.4 Zone 4a and 4b Very High Ecological Constraints

Zone 4a and b areas have the highest ecological values and have the potential to be significantly impacted by Gas Field Component activities. It is therefore recommended that all non-linear Gas Field infrastructure be excluded from these areas as identified in *Figure 3.7.11*. The construction of gathering systems and access tracks should follow the criteria in Zone 3 throughout the areas, with avoidance of new disturbance being the primary objective.

Zone 4a areas are considered to have higher conservation values than Zone 4b. They are distinguished from each other only for the purpose of enabling planning for linear infrastructure to avoid Zone 4a areas in preference to Zone 4b areas in locations where such areas are unavoidable.

Areas within Zone 4a include:

- Gurulmundi State Forest and the Environmentally Sensitive Area immediately north west of the state forest. The location of linear infrastructure (e.g. pipelines and access tracks) through this area will be determined by ecologist field studies at the detailed design stage to follow existing tracks and previously disturbed areas where possible and to avoid or minimise disturbance of highest value areas (e.g. EVR plant populations, high quality fauna habitats, steep terrain). QGC will not undertake drilling or development of non-linear infrastructure in this area prior to government endorsement of detailed development plans showing proposed production

techniques and infrastructure locations. Such a plan would be based on detailed ecological investigations within this area and would aim at ensuring that any such development would be undertaken in an ecologically sustainable and acceptable manner.

- EPBC Act listed Ecological Communities
- DERM defined Category B Environmentally Sensitive Areas which, in the Gas Field, include:
  - VM Act Endangered RE
  - additional RE classified as Endangered under DERM's Biodiversity Status

Areas within Zone 4b include:

- RE 11.3.27 (ephemeral wetlands)
- Buffer zones adjacent to watercourses in accordance with the Environmental Authority conditions for QGC's existing operations, namely:
  - 50 m from Stream Order 1 and 2 watercourses
  - 100 m from Stream Order 3 and 4 watercourses
  - 200m from Stream Order 5-8 watercourses.

In a small number of instances, it will be unavoidable that linear infrastructure (e.g. collection lines, pipelines and access tracks) transects linear remnants and watercourses of very high ecological value (i.e. Zone 4a and b areas). Provided such unavoidable impacts are minimised and compensated for by offset initiatives, the proposed activities will not have a significant impact on the conservation values of these areas.

7.6.3 Rehabilitation

Rehabilitation will be negotiated with the landholder as applicable. Unless roads and well pads are to be retained for other use, areas will be ripped and allowed to naturally revegetate. Hardened road surfaces will be removed or re-graded to restore the original land surface as much as possible.

A re-seeding plan will be developed based on soil types, existing local vegetation characteristics and landholder preferences along the alignment. In areas of native vegetation, revegetation will be allowed to occur naturally without re-seeding.

Where re-seeding is considered necessary to avoid erosion or other environmental damage, local provenance native seed will be used for regeneration if available. If local provenance seed cannot be collected or purchased, native seed from other parts of central Queensland should be purchased from commercial operators and re-spread in these locations.

Monitoring and control of weeds will be ongoing during the life of the Project. A weed management plan that addresses the construction, rehabilitation and operation phases of the Project will be prepared prior to construction.

This plan will include hygiene protocols to minimise the likelihood of introduction and spread of environmental, agricultural and declared weeds.

Vegetative waste as a result of clearing will be mulched or distributed across adjacent areas where it may provide refuge for terrestrial species. Such wastes will not be burnt.

Rehabilitation will be monitored on a monthly basis for six months after works are completed and then bi-annually for two years.

In areas zoned as High Constraint, rehabilitation will occur in close liaison with DERM staff and restoration will aim to restore or maintain biological processes and natural systems.

7.7 *ENVIRONMENTAL OFFSETS*

An environmental offsets strategy will be developed prior to the commencement of the Project. That strategy will identify the environmental offset activities which will be established to compensate for the unavoidable clearing of ecologically significant areas (e.g. Endangered/Of Concern RE, wetland areas, EVR flora/fauna habitat and fauna movement corridors). It is envisaged that there will be opportunities to undertake most offset activities within or in close proximity to the Gas Field (as opposed to removed locations).

To the greatest practicable extent the offset activities will address both Commonwealth and Queensland Governments' offsets legislation and policy, including Part 9 of the *EPBC Act* (in particular s. 134 and 136), and the Queensland Government's Environmental Offsets Policy (QGEOP) (EPA 2008). As such, the offset activities will incorporate the following principles:

- Offsets should only be utilised in situations where impacts on environmental values are unavoidable
- The offset must directly relate to the environmental value that will be impacted, often referred to as the "like for like" principle
- The offset may be either direct or indirect actions. A direct action usually requires the on-ground maintenance and/or improvement of the protected matter. An indirect action, however, includes a wide range of actions that improve the knowledge and understanding of a protected matter in order to facilitate its conservation
- The implementation of the offset must be timed to minimise the time lag between the impact and the delivery of the offset
- Where possible the offset will be located in the vicinity of the impact
- Mechanisms will be put in place to ensure that the offset is enforceable, monitored and audited.

The flora assessments and detailed fauna surveys have noted the relatively degraded state of many environments in the Gas Field. Historic and existing stressors identified include inappropriate fire regimes, environmental and declared weed invasions, feral animals and grazing pressure from stock.

Through its investment in the region, QGC will provide opportunities to manage some of these environmental issues and thus realise local environmental benefits. QGC has invested significantly in fencing and gates to control stock movements, improved access tracks and increased environmental personnel in the region, all of which can assist in fire prevention and limit weed propagation. Areas dedicated as environmental offsets, would provide further opportunities for enhanced environmental management through the dedication of special purpose conservation areas and may improve the connectivity between these environments.

It is preferable that offsets are protected for the long term by purchasing land or establishing covenants on title (e.g. *VM Act* covenants). As such, selection of offset sites will also depend on a number of non-environmental factors including:

- land tenure – tenure needs to enable purchase or covenants on title
- landholder preferences – it will be necessary to find willing landholders to sell or covenant land
- land use – (e.g. alienation of GQAL constraints and possible synergies and constraints relating to CSG activities and other land uses)

Priority offset areas from an environmental perspective are identified as:

- Matters of National Environmental Significance
- endangered REs
- of concern REs
- any REs where clearing may be considered as a significant impact
- particular EVR fauna habitats
- EVR flora-rich areas
- connections/corridors
- riparian areas
- areas containing wetlands (RE 11.3.27)
- areas linking/adjoining areas of:
    - any of the above
    - state-significant areas as identified by DERM Biodiversity Mapping Methodology for the Brigalow Belt South Bioregion and/or
    - Sensitive Environmental Areas.

The environmental management of these areas may encompass:

- fire management planning and activities (e.g. firebreak grading, fire mapping, fire response planning)
- livestock exclusion (e.g. fencing)
- weed control
- feral animal control activities (e.g. fox and rabbit baiting)
- flora and fauna monitoring in order to assess implemented management strategies.

The offset strategy will set out an ongoing process for identifying landholders within offset priority areas during the life of the Project. In the first instance, sites should be identified on the basis of their conservation values and their similarity to those areas likely to be impacted ("like for like").

Where offset areas are established, management and monitoring plans will be developed in order to guide the strategic development of these areas, identifying key values, threats and the environmental management strategies required to achieve the appropriate conservation outcomes.

7.8 CONCLUSION

Clearing for the proposed infrastructure represents less than 3 per cent of the existing vegetation. Gas Field Component activities will be carefully managed within the most environmentally sensitive areas with the highest conservation values.

As such, with the implementation of appropriate mitigation and rehabilitation measures, there is low potential for the Project to have a significant impact on the ecological features and values of the Gas Field or adjoining areas. A summary of the impacts outlined in this chapter is provided in *Table 3.7.6* below.

Table 3.7.6 Summary of Impacts for Terrestrial Ecology

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Long term
Impact extent	Regional
Impact likelihood	High

Overall assessment of impact significance: minor.

The nature of the Gas Field development means that areas of significant environmental value can in most cases be avoided. Also, proven mitigation measures, as described in this chapter, can be incorporated into the detailed design and subsequent development of the Gas Field.