

Jemena Northern Gas Pipeline Pty Ltd

Northern Gas Pipeline

Draft Environmental Impact Statement

APPENDIX G – THREATENED SPECIES SURVEY REPORT

Public

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Threatened Species Survey Report for NGP

Jemena



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EXECUTIVE SUMMARY

The Northern Gas Pipeline (NGP) involves the construction of 622 km of pipeline linking existing gas pipelines in the Northern Territory and Queensland. The pipeline will extend from approximately 45 kilometres north-east of Tennant Creek adjacent to an existing gas compressor station facility near Warrego, and will terminate at its gas delivery station adjacent to the existing Mount Isa Mica Creek Power Station. The Project footprint constitutes construction ROW, access tracks, compressor stations, temporary camps, temporary workspaces, vehicle turnarounds, and low consequence water storage dams.

This Project requires assessment under the *Environmental Assessment Act (Northern Territory)* at the level of an Environmental Impact Statement (EIS). The NGP has also been declared a 'controlled action' by the Commonwealth Minister for the Environment and, as such, it requires assessment and a decision about whether approval for it should be given under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. To inform these, Jemena (the proponent) commissioned EcOz Environmental Consultants (EcOz) conducted surveys and assessments that meet the requirements of both the abovementioned approval documents. This document is a report of that survey and is an appendix to the main EIS.

General scope

The main purpose of this report is to:

- a) Describe the methodology and results of surveys undertaken to determine the likelihood that threatened species occur within the Project footprint
- b) Identify whether each threatened species that occurs, or is likely to occur, does so in an 'important population' as defined in the *EPBC Significant Impact Guidelines 1.1* (DOE 2013).

The survey program was designed to target threatened species considered to have potential to occur within the Project footprint. Survey methodology was tailored to align with standard Northern Territory survey guidelines and, where applicable, to meet Commonwealth survey guidelines for nationally-listed species.

This report also provides assessment of nationally-listed migratory species, habitat types, sensitive vegetation types, and threatening processes (such as pests, weeds and fire) specifically related to the habitat suitability of threatened species with the Project footprint.

Habitat mapping

Habitat mapping of the Project footprint was undertaken at a scale of 1:10 000 to spatially determine the area and location of habitat that may be (generally) suitable for threatened species. Separate maps and descriptions were made for the Northern Territory and Queensland due to different attributes (and scales) within existing datasets. The Northern Territory Project footprint intersected five broad habitat types (alluvial floodplains, clay plains, desert sandplains, lateritic plains and rises, and sandstone plain and rises) which consisted of 11 smaller landform units. The Queensland Project footprint intersected six broad habitat types (alluvial areas, clay plains, loamy sand plains, ironstone jump-ups, hills and lowlands on metamorphic rocks, and hills and lowlands on granitic rock).

Sensitive vegetation types

An assessment of sensitive vegetation types was undertaken for the Northern Territory Project footprint (as Queensland assessment will be undertaken in separate approval documentation, alongside regional ecosystem mapping). Two sensitive vegetation types were identified within the region of the Project footprint – 'riparian vegetation' and 'wetlands'.

Riparian vegetation occurs along the larger creeks and rivers, of which all are located within the Mitchell Grass Downs bioregion (i.e. black soil plains) and were considered to be in relatively poor ecological condition (due to presence of erosion, weeds, and cattle). Four intersection points along the construction

ROW were identified (associated with Ranken River, James River, Georgina River and Blue Bush Creek) as well as several minor crossings associated with access tracks.

Seasonal lakes and swamps (i.e. wetlands) occur in the region of the Project footprint; however, none are intersected or are expected to be impacted upon by construction activities.

No threatened ecological communities (as listed under the *EPBC Act*) occur within the project area.

Threatened species

A preliminary assessment of threatened species occurrence determined that nine threatened species (relevant to Northern Territory and/or Commonwealth) had potential to occur within the region of the Project footprint. Of these, targeted field surveys and/or habitat suitability assessment determined the following:

- Two threatened species were recorded within the Project footprint:
 - Carpentarian Antechinus (*Pseudantechinus mimulus*) (relevant to Queensland)
 - Tobermorey Melon (*Austrobryonia argillicola*) (relevant to Northern Territory).
- Two threatened species were not identified within the Project footprint; however, were considered likely to occur within the Project footprint:
 - Grey Falcon (*Falco hypoleucos*) (relevant to Northern Territory)
 - Plains Death Adder (*Acanthophis hawkei*) (relevant to Northern Territory and Queensland).
- Five threatened species were considered unlikely to occur within the Project footprint:
 - Gouldian Finch (*Erythrura gouldiae*)
 - Painted Honeyeater (*Grantiella picta*)
 - Brush-tailed Mulgara (*Dasycercus blythi*)
 - Latz's Grass (*Sporobolus latzii*)
 - Greater Bilby (*Macrotis lagotis*).

Recognised experts from the Northern Territory Department of Land Resource Management (DLRM), as well as specialist scientists for some threatened species, were consulted throughout the survey program to ensure that methods and interpretation of results were sound.

Carpentarian Antechinus (Vulnerable under the *TPWC Act* and *EPBC Act*) occurs within rocky habitat in the eastern section of the Queensland Project footprint (identified at three sites during targeted surveys). This represents a range extension to the south and south-west of other known occurrences. It is expected that the species occur in rocky outcrops, boulder piles or rocky ridges between KP 609.5 and KP 620.5, and that they are part of one population. Habitat mapping determined that a total of 1.04 ha will be directly disturbed during construction works. The population of Carpentarian Antechinus within the Project footprint is considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*). Acknowledging the many uncertainties associated with determining the area of occupancy of this population, a conservative estimate of suitable habitat in the local region is 4 369 ha.

Tobermorey Melon (Vulnerable *TPWC Act*) was recorded within clay plains drainage habitat (Mitchell Grass Downs bioregion) of the Northern Territory Project footprint. Records of the species were spread across four catchments of the Ranken River, James River, Georgina River and Blue Bush Creek, and were considered part of one regional population. It is estimated that approximately 106.7 ha of suitable habitat that will be temporarily disturbed by construction works (no permanent disturbances will occur within drainage habitat). Survey results suggest that Tobermorey Melon is likely to be widespread in drainage habitat within the Mitchell Grass Downs bioregion, but is scarce (i.e. occurs in low densities) at each location. The criteria for that population being 'important' (as defined in the *EPBC Significant Impact Guidelines 1.1*) are not satisfied.

Grey Falcon (Vulnerable *TPWC Act*) or potential nests were not identified within the Northern Territory Project footprint during field surveys (or in Queensland); however, the species was incidentally observed (foraging or flying over) on three occasions during field surveys outside the Project footprint confirming their current presence in the region. Grey Falcon could conceivably nest within the Project footprint; however, its preference for tall trees means that – regionally – suitable nesting habitat will be restricted to watercourses

(or telecommunication towers). The Northern Territory Project footprint intersects 3.7 ha of drainage system habitat considered as potential nesting habitat for the species (note: nesting habitat for Queensland Project footprint is not part of report). The limited number of watercourse crossings, relatively narrow construction ROW and short construction timeframe, all combine to suggest there is a low likelihood that a nest site would occur directly in the Project footprint. The occurrence of a few individuals of this species within the Project footprint is not considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*).

Plains Death Adder (Vulnerable *TPWC Act* and under the *EPBC Act*) habitat is present within the Project footprint (broadly) within the Mitchell Grass Downs bioregion (clay plains), which falls between KP 355 and KP 561 (plus approximately 108 km of existing access tracks that will require 5 m widening) (equates to approximately 820.1 ha). Targeted field surveys were not conducted for this species for various reasons. Nevertheless, the presence of regional records of the species and the fact that suitable habitat is traversed by the Project footprint indicates a reasonable likelihood that Plains Death Adder will be present. It is assumed that, if extant, occurrences of Plains Death Adder within the Project footprint would constitute a separate population to the numerous records 100 km north. A population of the species within the Project footprint will be considered near the limit of the species' known (south-western) range and, as such, necessary for maintaining the species genetic diversity. Subsequently, the likely population of this species within the Project footprint is considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*).

After due assessment, important populations of two threatened species are considered to occur, or likely to occur, within the Project footprint:

- Carpentarian Antechinus (rocky refuge habitat between KP 609.5 & KP 620.5)
- Plains Death Adder (clay plains between KP 355 & KP 561).

Migratory-listed species

Six EPBC-listed migratory bird species were determined as having a high chance of occurring within the Project footprint; however, no 'important' habitat sites for these species will be intersected by the Project footprint. It is not likely that nationally-listed migratory species will trigger the *EPBC Act*.

- Fork-tailed Swift (*Apus pacificus*)
- Rainbow Bee-eater (*Merops ornatus*)
- Oriental Plover (*Charadrius veredus*)
- Oriental Pratincole (*Glareola maldivarum*)
- Great Egret (*Ardea alba*)
- Cattle Egret (*Ardea ibis*).

Existing threatening processes

Four main threatening processes were relevant to the Project footprint in regards to potential impacts on habitat suitability for flora and fauna (in particular threatened species).

- Pests – Seven introduced fauna species occur in the region of the Project footprint, of which Feral Cat (*Felis catus*), Red Fox (*Vulpes vulpes*), Domestic Cattle (*Bos taurus*) and One-humped Camel (*Camelus dromedarius*) were confirmed as present within the Project footprint during field studies.
- Weeds – A complete weed survey of the Project footprint was not part of the scope of this report; however, incidental and opportunistic weed records made during fieldwork noted that the following weeds (of potential management significance) were present within (or close to) the Project footprint.
 - Noogoora Burr (*Xanthium strumarium*) (declared species)
 - Parkinsonia (*Parkinsonia aculeata*) (declared species)
 - Mesquite (*Prosopis pallida*) (declared species)
 - Annual Mission Grass (*Pennisetum pedicellatum*) (declared species)
 - Buffel Grass (*Cenchrus ciliaris*) and Kapok Bush (*Aerva javanica*) (non-declared species)

- Fire in the region of the Project footprint is strongly associated with presence and extent of spinifex-dominated landscapes (i.e. hummock grasslands). Fire mapping indicates that approximately half of the Project footprint has burnt 2 to 3 times between 2003 and 2016. This is on the higher scale of burning frequency for central Australia. The most significant fire period for the Project region (in recent years) was in 2011, when the majority of the western half (KP 0 – KP 354) of the Project footprint was burnt. In that year, several large-scale, spinifex-fuelled fires swept through the region. These fires burnt large areas of long unburnt (> 13 years) and previously burnt (with < 7 years) vegetation communities. The black soil plains between KP 353 and KP 561 generally experienced no fires between 2003 and 2016 – likely due to cattle grazing (fuel-load reduction) and perhaps the lack of spinifex-dominated grasslands (Figure 2-9).
- Pastoralism – The construction ROW crosses pastoral leases for 99% of the Queensland length and 50% of the Northern Territory length. The level of impacts from pastoral activities on threatened species will be dependent on the management of station (i.e. stocking rates, provision of artificial water points and prescribed burns), and on the sensitivity of vegetation communities to grazing. Observations of pastoral impacts within the Project footprint were collected during field studies as part of determining the habitat suitability for targeted threatened species.

TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Project description.....	1
1.2	Context.....	1
1.3	Purpose.....	5
1.4	Report structure	5
2	EXISTING ENVIRONMENT	6
2.1	Climate	6
2.2	Bioregions	7
2.3	Landforms & Landsystems	9
2.4	Vegetation communities.....	11
2.5	Sensitive vegetation types	14
2.5.1	Riparian vegetation	14
2.5.2	Wetlands	14
2.6	Existing threatening processes	17
2.6.1	Fire.....	17
2.6.2	Weeds.....	19
2.6.3	Introduced fauna	22
2.6.4	Pastoralism	24
3	RECONNAISSANCE SURVEY	26
4	HABITAT MAPPING.....	30
4.1	Purpose.....	30
4.2	Method	30
4.2.1	Northern Territory.....	30
4.2.2	Queensland.....	31
4.3	Results	32
4.3.1	Northern Territory habitat mapping	32
4.3.2	Queensland habitat mapping	34
5	THREATENED SPECIES SURVEYS	38
5.1	Context.....	38
5.2	Desktop 'Likelihood of Occurrence' Assessment	39
5.2.1	Background.....	39
5.2.2	Procedure	39
5.2.3	Assessment results	40
5.3	Specifics	42
5.3.1	Personnel.....	42
5.3.2	Permits.....	43
5.3.3	Nomenclature.....	43

5.4	Latz's grass (<i>Sporobolus latzii</i>)	44
5.4.1	Conservation status	44
5.4.2	Background information	44
5.4.3	Survey context	45
5.4.4	Survey methodology	45
5.4.5	Results	47
5.4.6	Discussion	49
5.5	Tobermorey melon (<i>Austrobryonia argillicola</i>)	52
5.5.1	Conservation status	52
5.5.2	Background information	52
5.5.3	Survey context	53
5.5.4	Survey methodology	53
5.5.5	Results	55
5.5.6	Discussion	59
5.6	Plains Death Adder (<i>Acanthophis hawkei</i>)	61
5.6.1	Conservation status	61
5.6.2	Background information	61
5.6.3	Survey context	63
5.6.4	Survey methodology	63
5.6.5	Results and discussion	63
5.7	Carpentarian Antechinus (<i>Pseudantechinus mimulus</i>)	67
5.7.1	Conservation status	67
5.7.2	Background information	67
5.7.3	Survey context	68
5.7.4	Survey methodology	68
5.7.5	Results	71
5.7.6	Discussion	73
5.8	Greater Bilby (<i>Macrotis lagotis</i>)	80
5.8.1	Conservation status	80
5.8.2	Background information	80
5.8.3	Survey context	82
5.8.4	Survey methodology	82
5.8.5	Results	87
5.8.6	Discussion	94
5.9	Brush-tailed Mulgara (<i>Dasymercus blythi</i>)	97
5.9.1	Conservation status	97
5.9.2	Background Information	97
5.9.3	Survey context	98
5.9.4	Survey methodology	98
5.9.5	Results	100
5.9.6	Discussion	102
5.10	Gouldian Finch (<i>Erythrura gouldiae</i>)	105
5.10.1	Conservation status	105
5.10.2	Background information	105
5.10.3	Survey context	106
5.10.4	Survey methodology	106
5.10.5	Results	108
5.10.6	Discussion	113

5.11 Painted Honeyeater (<i>Grantiella picta</i>).....	115
5.11.1 Conservation status	115
5.11.2 Background information	115
5.11.3 Survey context	116
5.11.4 Survey methodology	116
5.11.5 Results	118
5.11.6 Discussion.....	119
5.12 Grey Falcon (<i>Falco hypoleucos</i>).....	121
5.12.1 Conservation status	121
5.12.2 Background information	121
5.12.3 Survey context	121
5.12.4 Survey methodology	122
5.12.5 Results	122
5.12.6 Discussion.....	123
6 MIGRATORY SPECIES.....	126
6.1.1 Fork-tailed swift (<i>Apus pacificus</i>)	127
6.1.2 Rainbow Bee-eater (<i>Merops ornatus</i>)	127
6.1.3 Oriental Plover (<i>Charadrius veredus</i>).....	127
6.1.4 Oriental Pratincole (<i>Glareola maldivarum</i>)	127
6.1.5 Egret species (<i>Ardea alba</i> & <i>Ardea ibis</i>)	127
7 SUMMARY OF THREATENED SPECIES	128
8 ASSESSMENT OF SIGNIFICANCE	130
8.1 Importance of threatened species' populations.....	130
8.1.1 Plains Death Adder (<i>Acanthophis hawkei</i>)	130
8.1.2 Carpentarian Antechinus (<i>Pseudantechinus mimulus</i>).....	131
8.1.3 Grey Falcon (<i>Falco hypoleucos</i>)	132
8.1.4 Tobermorey Melon (<i>Austrobryonia argillicola</i>).....	132
8.1.5 Conclusion	133
8.2 Importance of migratory species' populations.....	133
8.3 Sensitive vegetation (Northern Territory only).....	134
9 REFERENCES.....	135

***** Please note that this report is formatted for double-sided printing *****

Tables

Table 2-1. Bioregions intersected by the Project footprint	7
Table 2-2. Description of major landforms and land systems traversed by the Project footprint	9
Table 2-3. MVS descriptions and area intersected by the Project footprint	11
Table 2-4. Declared weed species recorded within bioregions intersecting the Project footprint	20
Table 4-1. Habitat mapping categories – Northern Territory.....	31
Table 4-2. Habitat mapping categories – Queensland.....	32
Table 4-3. Habitat mapping summary of the Project footprint within the Northern Territory	33
Table 4-4. Habitat mapping Northern Territory – temporary and permanent disturbance area (ha)	34
Table 4-5. Habitat mapping summary of the Project footprint within Queensland	35
Table 4-6. Habitat mapping Queensland – temporary and permanent disturbance area (ha)	35
Table 5-1. Desktop threatened species' likelihood of occurrence assessment.....	40
Table 5-2. Tobermorey Melon sites surveyed along the construction ROW	56
Table 5-3. Potential habitat extent for Plains Death Adder within the Project footprint (NT).....	64
Table 5-4. Potential habitat extent for Plains Death Adder within the Project footprint (Qld)	64
Table 5-5. Carpentarian Antechinus survey sites	71
Table 5-6. Rocky refugia habitat intersected by the construction ROW – Carpentarian Antechinus	72
Table 5-7. Greater Bilby track-plot summary results.....	91
Table 5-8. Greater Bilby sites within each habitat type (specific to bilby survey).....	92
Table 5-9. Summary of tree morphometrics from the six Gouldian Finch transects	110
Table 5-10. Summary of hollow characteristics from each of the six Gouldian Finch transects	110
Table 5-11. Wet season Gouldian Finch foraging habitat survey sites	111
Table 5-12. Dates of targeted Painted Honeyeater surveys	117
Table 5-13. Honeyeater species & Mistletoebird records during targeted Painted Honeyeater surveys	118
Table 5-14. Potential nesting habitat for Grey Falcon within the Project footprint	123
Table 6-1. Summary of migratory species analysis	126
Table 7-1. Post-survey threatened species 'likelihood of occurrence' within the Project footprint	128

Figures

Figure 1-1. Map of the Project location.....	2
Figure 1-2. Map of the Project footprint	3
Figure 1-3. Threatened species impact assessment process.....	4
Figure 2-1. Map of climate zones in Australia.....	6
Figure 2-2. Temperature and rainfall graph for Tennant Creek, Camooweal and Mount Isa.....	7
Figure 2-3. Map of bioregions intersected by the Project footprint	8
Figure 2-4. Map of major landforms and land systems within the region of the Project footprint	10
Figure 2-5. Map of vegetation communities proximate to Project footprint (Northern Territory)	12
Figure 2-6. Map of vegetation communities proximate to the Project footprint (Queensland)	13
Figure 2-7. Photographs of riparian vegetation on Ranken and Georgina Rivers	15
Figure 2-8. Photographs of Frewena Marsh, wetland of regional significance near Project footprint	16
Figure 2-9. Map of fire frequency in the region of the Project footprint between 2003 and 2016.....	18
Figure 2-10. Map of declared weed records in the region of the Project footprint	21
Figure 2-11. Map of known extent and potential distribution of Cane Toad.....	23
Figure 2-12. Map of pastoral properties (and other tenure types) within the Project footprint	25
Figure 3-1. Photographs (aerial) of swamps within the region of the Project footprint.....	26
Figure 3-2. Photographs (aerial) of the 'type locality' for Latz's Grass (<i>S. latzii</i>), March 2016.....	27
Figure 3-3. Map of reconnaissance survey flight paths	29
Figure 4-1. Map of habitat mapping survey results for the Northern Territory Project footprint	36
Figure 4-2. Map of habitat mapping survey results for the Queensland Project footprint	37
Figure 5-1. The IUCN red list categories of risk for threatened species	38
Figure 5-2. Map of existing threatened species records for the region surrounding Project footprint	41

Figure 5-3. Photograph (aerial) of the Latz's Grass site SL5.....	49
Figure 5-4. Photographs (on-ground) of the Latz's Grass site SL5	50
Figure 5-5. Map of Latz's Grass habitat assessment and field survey.....	51
Figure 5-6. Photographs of Tobermorey Melon taken during field survey	57
Figure 5-7. Photographs of suitable habitat for Tobermorey Melon.....	58
Figure 5-8. Map of Tobermorey Melon habitat assessment and field survey	60
Figure 5-9. Map of extent of occurrence and area of occupancy for Plains Death Adder, super-imposed on 2008 distribution of Cane Toad (from TSSC 2012).....	62
Figure 5-10. Photographs of potential habitat (clay plains) for Plains Death Adder.....	65
Figure 5-11. Map of Plains Death Adder potential habitat and existing records	66
Figure 5-12. Photographs of Carpentarian Antechinus trapped at site CA1	74
Figure 5-13. Photographs of Carpentarian Antechinus Elliott capture sites.....	75
Figure 5-14. Photographs of habitat at KP 617 that is likely occupied by Carpentarian Antechinus.....	76
Figure 5-15. Photograph of camera-detected Carpentarian Antechinus at site CA4	77
Figure 5-16. Photograph of boulder pile where Carpentarian Antechinus was detected at site CA4.....	77
Figure 5-17. Map of Carpentarian Antechinus preliminary assessment	78
Figure 5-18. Map of Carpentarian Antechinus field survey and regional rocky refuge habitat.....	79
Figure 5-19. Photographs of a putative goanna sign observed during the Greater Bilby aerial survey	86
Figure 5-20. Photograph of 'Putative Greater Bilby sign' observed during the aerial survey	90
Figure 5-21. Photographs (selection only) of examples of high value Greater Bilby habitat.....	93
Figure 5-22. Map of Greater Bilby habitat assessment and field survey.....	96
Figure 5-23. Photographs of habitat considered as suitable for Brush-tailed Mulgara.....	103
Figure 5-24. Map of Brush-tailed Mulgara habitat assessment and field survey	104
Figure 5-25. Photographs of typical habitat within survey sites for Gouldian Finch breeding habitat	109
Figure 5-26. Photographs of typical habitat at survey sites for Gouldian Finch foraging habitat	112
Figure 5-27. Map of Gouldian Finch habitat assessment and field survey	114
Figure 5-28. Photograph of most suitable Painted Honeyeater survey site	119
Figure 5-29. Map of Painted Honeyeater habitat assessment and field survey	120
Figure 5-30. Photographs of potential Grey Falcon nesting habitat along rivers and creeks.....	124
Figure 5-31. Map of Grey Falcon habitat assessment and records	125
Figure 7-1. Map of records and suitable habitat for threatened species of significance to NGP project.....	129

Appendices

- A. Landform mapping descriptions (Northern Territory)
- B. Land zone mapping descriptions (Queensland)
- C. EPBC Protected Matters Search Tool report (9 May 2016)
- D. Northern Territory NRM INFONET threatened species report (8 June 2016)
- E. Threatened species likelihood of occurrence assessment
- F. Latz's Grass habitat descriptions of survey sites
- G. Tobermorey Melon habitat descriptions of ROW survey sites
- H. Tobermorey Melon habitat descriptions of access track survey sites
- I. Carpentarian Antechinus habitat descriptions of survey sites
- J. Greater Bilby habitat descriptions of track-plot sites
- K. Greater Bilby track-plot survey photographs
- L. Gouldian Finch site descriptions of breeding sites
- M. Gouldian Finch site descriptions of feeding sites
- N. Painted Honeyeater habitat descriptions of survey sites
- O. Bird list (surveys and incidental)
- P. Migratory species likelihood of occurrence assessment

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1 INTRODUCTION

1.1 PROJECT DESCRIPTION

The Northern Gas Pipeline (NGP) is a gas pipeline Project involving the construction of 622 km of pipeline linking the existing gas pipelines in the Northern Territory and Queensland. The pipeline will extend from approximately 45 kilometres north-east of Tennant Creek beside an existing gas compressor station facility near Warrego, and will terminate at its gas delivery station adjacent to the existing Mount Isa Mica Creek Power Station (see Figure 1-1). Jemena is the proponent of this NGP Project.

This Project requires assessment under the *Environmental Assessment Act (Northern Territory)* at the level of an Environmental Impact Statement (EIS). The NGP has also been declared a 'controlled action' by the Commonwealth Minister for the Environment and, as such, it requires assessment and a decision about whether approval for it should be given under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

The 'Project footprint' is shown in Figure 1-2 and comprises:

- The 30 m wide Right Of Way (ROW) within which the pipeline will be buried.
- Temporary construction camps
- Compressor stations and ancillary infrastructure
- Establishment of new access tracks
- Widening of existing access tracks
- Access tracks (disturbance area)
- Temporary work spaces
- Vehicle turnarounds
- Low consequence water storage dams for construction and hydrostatic pressure testing (12ML).

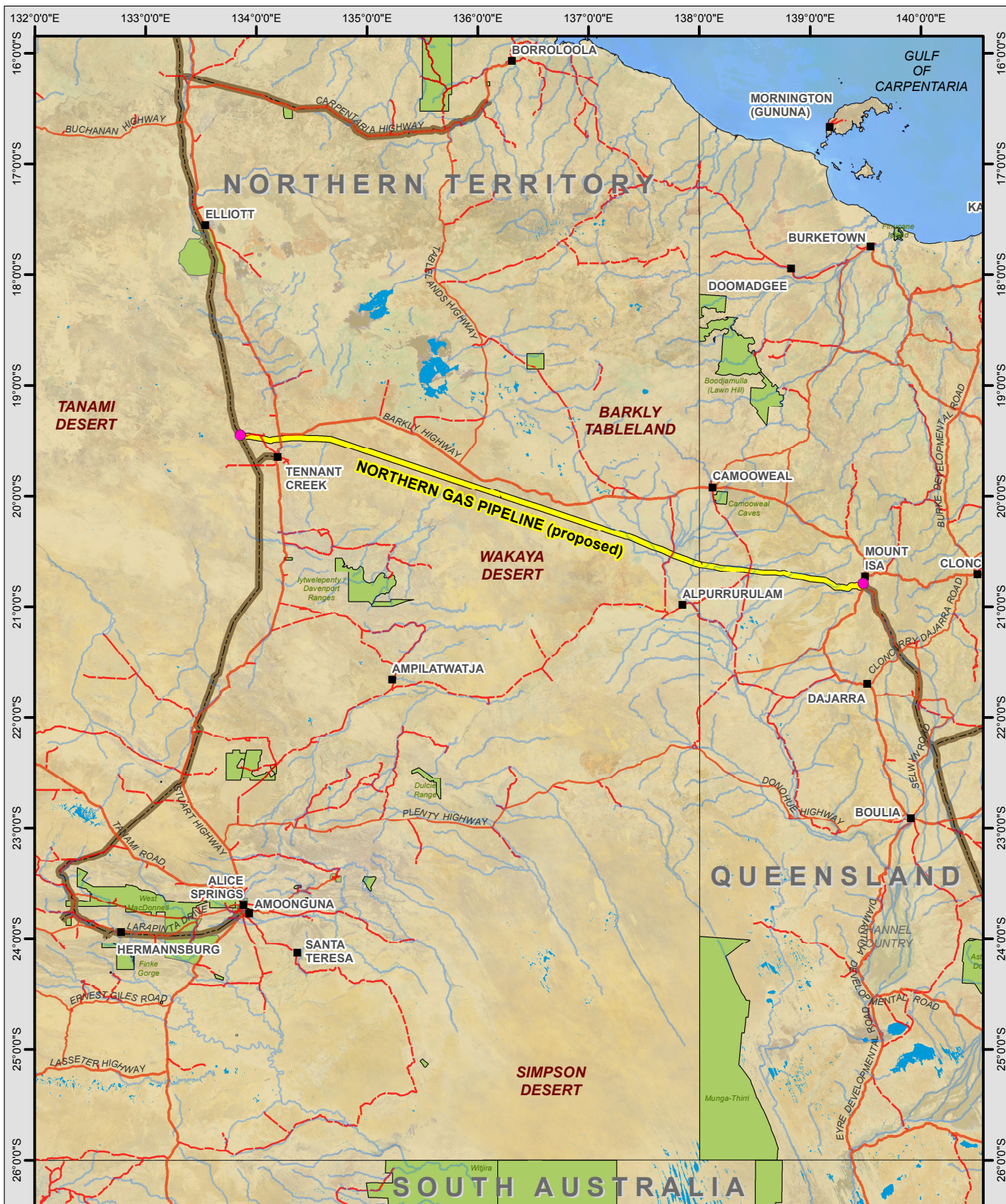
1.2 CONTEXT

Preliminary analysis undertaken for the Notice of Intent and EPBC Referral for the NGP Project indicated it is possible that threatened species occur within the Project footprint. Therefore, Project activities could have an impact on these species if present (or adjacent to) the Project footprint. For species within the Northern Territory that are listed as threatened under the *Territory Parks & Wildlife Conservation Act (TPWC Act)*, and for species (within the Northern Territory and/or Queensland) listed under the *EPBC Act*, the concern is whether there is an important population (as defined by DoE 2013) occurring within the Project footprint that is likely to be impacted upon by Project activities. If an important population occurs or is likely to occur, the impact assessment must then consider whether, after mitigation and management, the Project is likely to cause a significant impact on that population. This will inform decision-making as to whether approval should be granted and what, if any, conditions are required. It will also inform offset calculations for any matters protected under the *EPBC Act*.

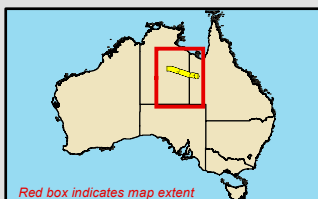
Threatened species listed under Queensland legislation only are not addressed in this report.

Preliminary analysis indicated there are no threatened ecological communities within the Project footprint.

The process that was adopted for threatened species impact assessment as part of the NGP Project EIS and EA compliance is illustrated in Figure 1-3.



Project Location



Red box indicates map extent

EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use. EcOz provides this map without any warranty, either express or implied.

Topographic data

- Town
- Major watercourse
- Principal Road
- Secondary Road
- - - Minor Road
- Existing gas pipeline
- Parks & Reserves
- Lake

NGP Project components

- Compressor station
- Pipeline alignment



0 35 70 140
Kilometres



MAP INFORMATION

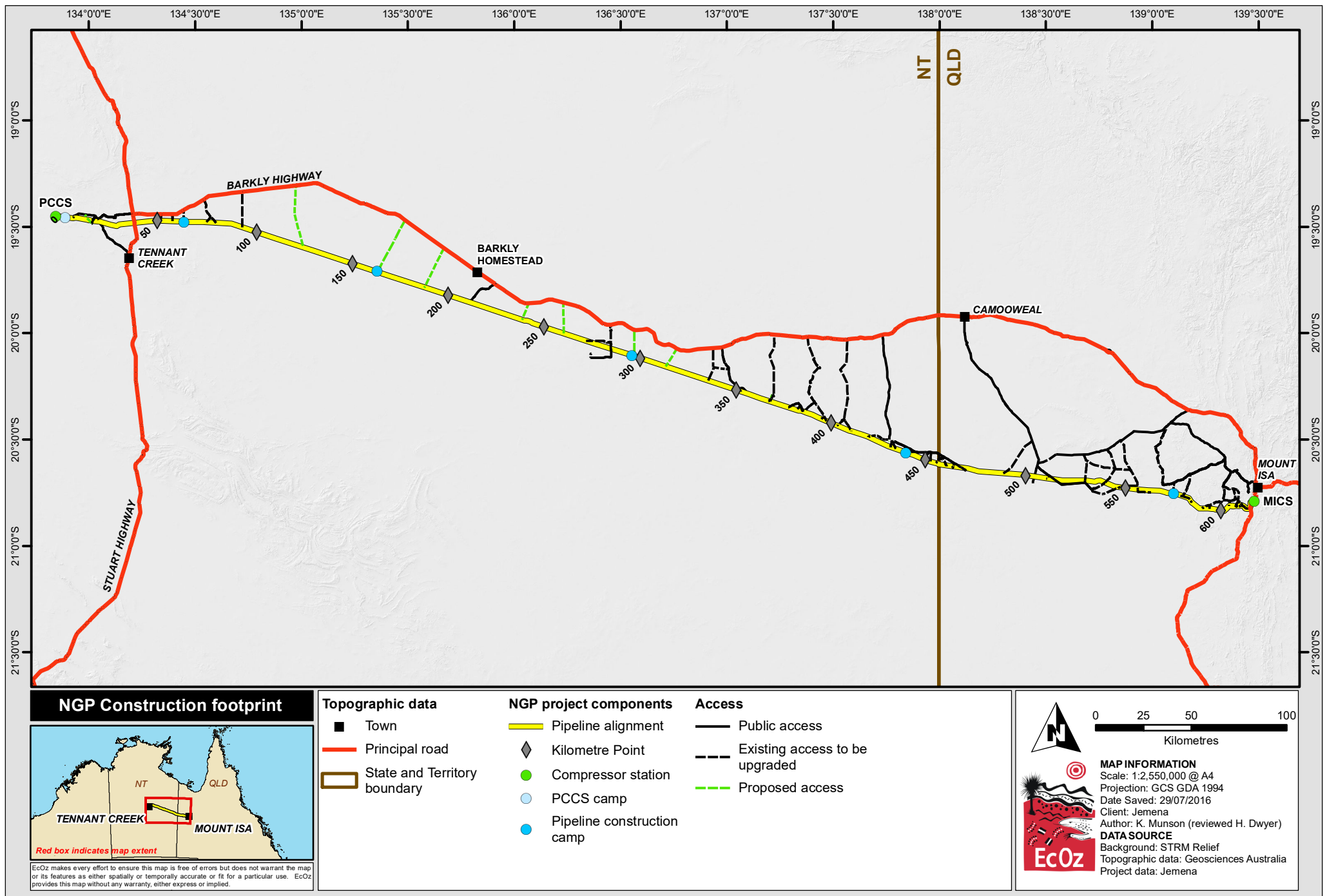
Scale: 1:5,500,000 @ A4
Projection: GCS GDA 1994
Date Saved: 8/08/2016
Client: Jemena

Author: T. Reilly (reviewed G. Ewers)

DATA SOURCE

NGP Project components: Jemena
Topographic data: GeoScience Australia
Imagery: LandSat (transparent)

Figure 1-% Map of location of NGP Project



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Figure 1-& Map of Project footprint components

In this report

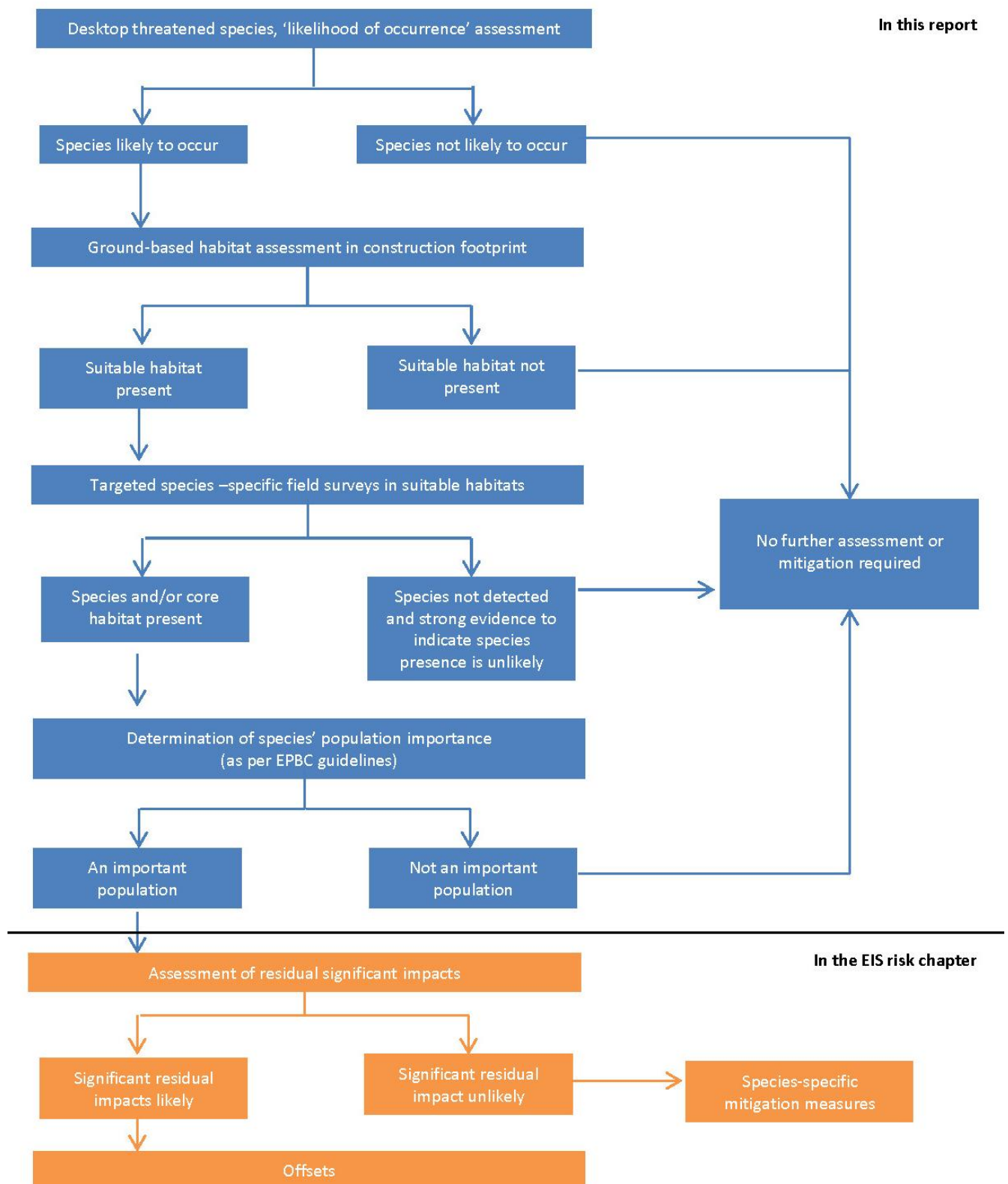


Figure 1-3. Threatened species impact assessment process

1.3 PURPOSE

In the context presented above, the purpose of this report is to:

- c) Describe the methodology and results of surveys undertaken to determine the likelihood that threatened species occur within the Project footprint, and
- d) Identify whether each threatened species that occurs, or is likely to occur, does so in an 'important population' as defined in the *EPBC Significant Impact Guidelines 1.1* (DOE 2013).

1.4 REPORT STRUCTURE

- Section 1 Introduction.
- Section 2 Desktop review of the existing environment (climate, bioregions, land types, vegetation communities and threatening processes).
- Section 3 Description of the preliminary aerial survey and resultant high-resolution footage.
- Section 4 Habitat mapping of the Project footprint to an approximate scale of 1:25 000.
- Section 5 'Likelihood of occurrence' assessment using desktop information to determine which threatened species have a reasonable likelihood of occurring within the Project footprint.
Methods and results of targeted threatened species surveys within the Project footprint to identify the presence (or likely presence) of threatened species.
- Section 6 'Likelihood of occurrence' assessment using desktop information to determine which migratory species have a reasonable likelihood of occurring within the Project footprint.
- Section 7 Summary of threatened species survey results.
- Section 8 A qualitative assessment of the importance of threatened and migratory species populations identified as occurring (or likely to occur) within the Project footprint.
- Section 9 References.

2 EXISTING ENVIRONMENT

2.1 CLIMATE

In general, the climate of the Project footprint can be described as hot and moderately arid with infrequent and highly unpredictable heavy rainfall. It is positioned on the edge of 'arid zone' and 'summer dominant' climatic classes (as shown in Figure 2-1), which results in summer-dominated rainfall (on average) due to monsoonal influences from the north rather than winter dominant influences from southern Australia (see Figure 2-2).

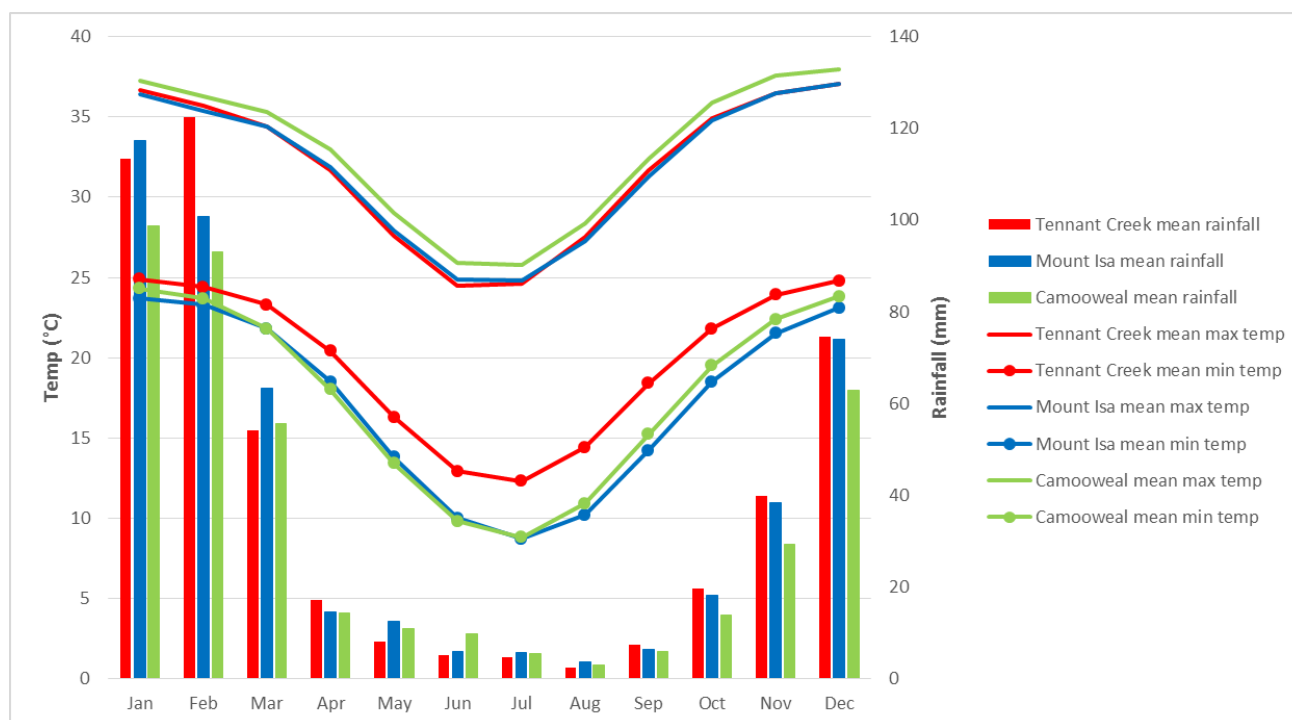
Although average climate statistics for the region indicates summer dominated rainfall (see Figure 2-2), there can be high variability in annual rainfall volumes from year to year. For example, the annual average rainfall in Mount Isa ranges between 93 mm (recorded in 2013) and 1 092 mm (recorded in 2011). This variability in annual rainfall is typical of the arid (and semi-arid) zone. The seasonality and volume of rainfall heavily influence the ecology, surface water flows and watercourse characteristics in the region. Watercourses in the region only flow (and may flood) after heavy rainfall, and can be dry for several years. For this reason, wetlands and watercourses are generally termed ephemeral in the region of the Project footprint.

Temperatures follow the seasonal patterns typical of northern and central Australia (see Figure 2-2), with the hottest average daily maximums occurring in January. The Project footprint is north of the 'frost zone'. Evapo-transpiration is high, with annual evaporation far exceeding annual rainfall.



Construction ROW depicted by yellow line

Figure 2-1. Map of climate zones in Australia



Graph was plotted using data from Australian Bureau of Meteorology (sourced March 2016)

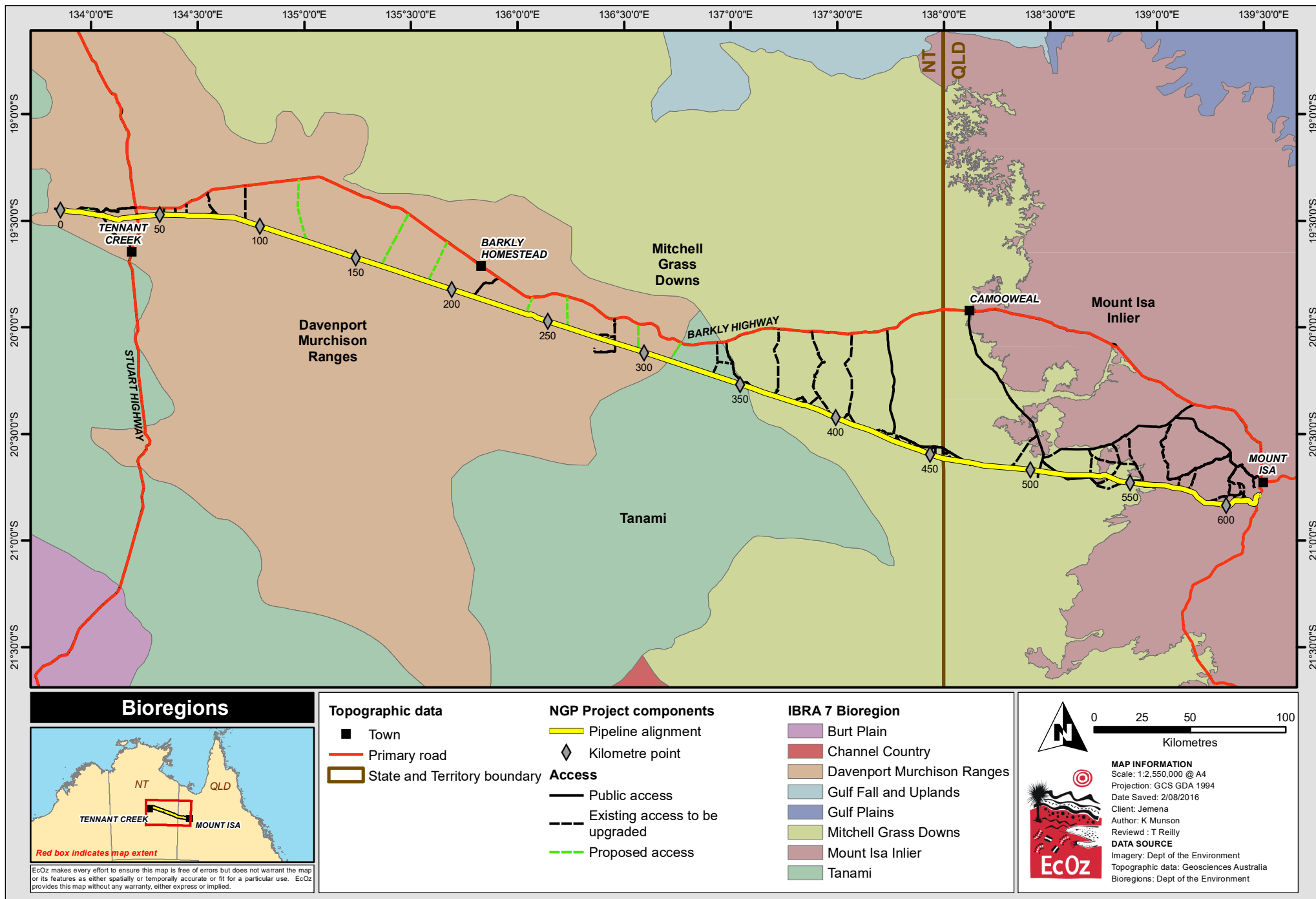
Figure 2-2. Temperature and rainfall graph for Tennant Creek, Camooweal and Mount Isa

2.2 BIOREGIONS

A bioregion is an area of land with common climate, geology, landform, native vegetation and species (DOE 2009). The Project footprint intersects four bioregions as per Interim Biogeographic Regionalism for Australis (version 7) (also referred to as IBRA7) (DOE 2012). These are described in Table 2-1 and shown in Figure 2-3 .

Table 2-1. Bioregions intersected by the Project footprint

Section of NGP	Bioregion	Sub-bioregions	Characteristics
KP 0 – KP 313	Davenport and Murchison Ranges	<ul style="list-style-type: none"> Ashburton Range Barkly 	<ul style="list-style-type: none"> Low, rugged rocky hills with hummock grasslands and low open woodland dominated by <i>Acacia</i> species.
KP 313 – KP 353	Tanami	<ul style="list-style-type: none"> Sandover 	<ul style="list-style-type: none"> Sand plains bisected by hills and rocky ranges with hummock grasslands and <i>Acacia</i> shrub lands on the rocky ranges.
KP 353 – KP 561	Mitchell Grass Downs	<ul style="list-style-type: none"> Barkly Tableland 	<ul style="list-style-type: none"> Grassland plains on cracking clay soils, with some intermittent lakes. Vegetation includes a variety of grasslands dominated by Mitchell Grasses (<i>Astrelba</i> species).
KP 561 – KP 622	Mount Isa Inlier	<ul style="list-style-type: none"> South-western Plateaus and Flood-outs 	<ul style="list-style-type: none"> Rugged hills and ranges bisected by undulating valleys. Vegetation is primarily open woodland with a spinifex hummock grassland understory.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-1. Map showing the bioregions intersected by the Project footprint.mxd

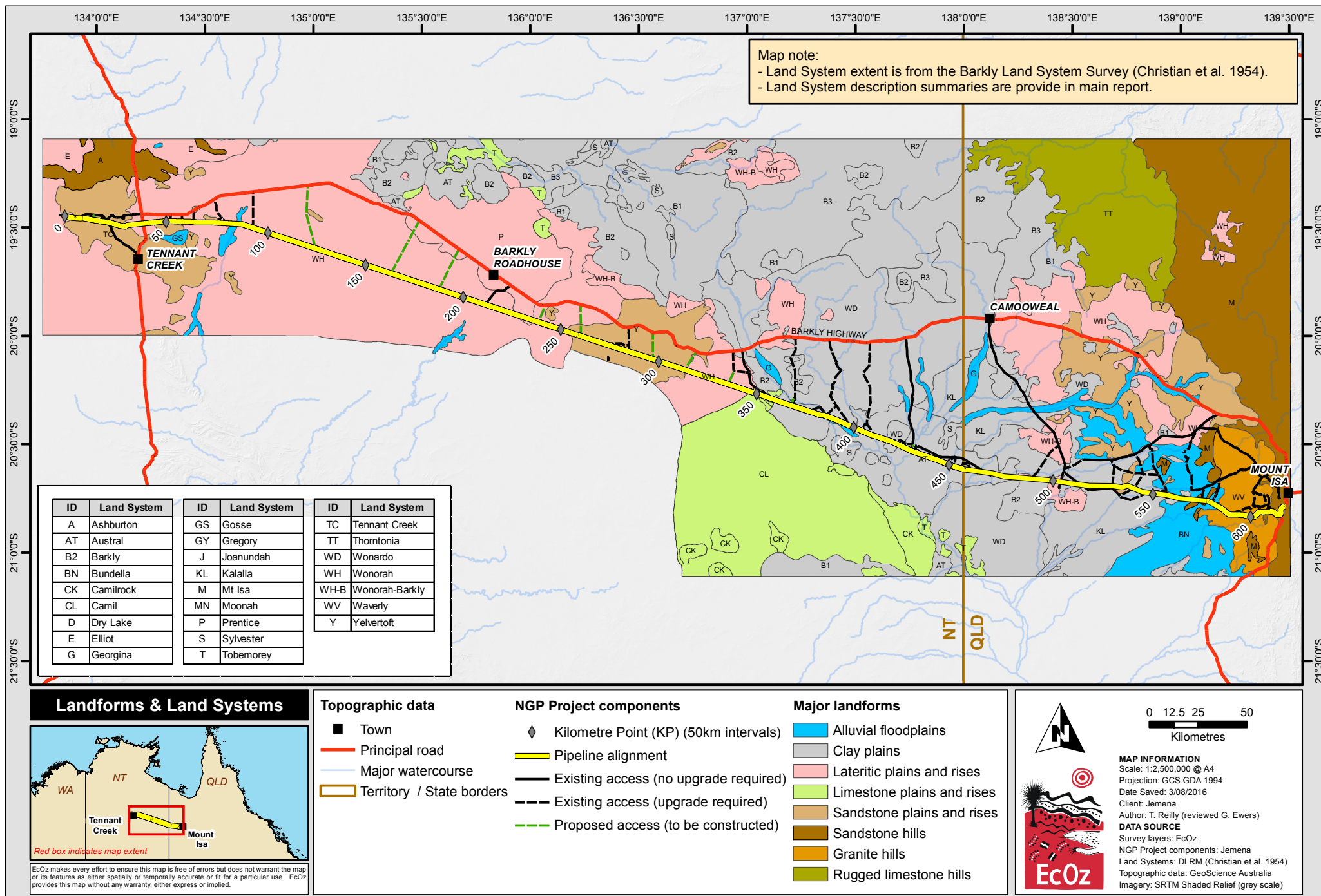
Figure 2-3. Map of bioregions intersected by the Project footprint

2.3 LANDFORMS & LANDSYSTEMS

Seven major landforms and 15 land systems are traversed by the Project footprint as mapped in Figure 2-4 and described in Table 2-2.

Table 2-2. Description of major landforms and land systems traversed by the Project footprint

Major landform Land system	General description (based on Land Survey of the Barkly Region, Christian et al. 1954)
ALLUVIAL FLOODPLAINS	River plains, swamps and alluvial fans formed on Quaternary alluvium
Georgina	Gently undulating 'black-soil' plains cut by braided streamlines; heavy grey pedocals; <i>Astrebla pectinata</i> grassland (Mitchell Grass).
Gosse	Flats; soils of the 'Desert' distributary complex; <i>Eucalyptus dichromophloia</i> Woodland, <i>E. pruinosa</i> or <i>E. argillacea</i> – <i>E. terminalis</i> shrub woodland.
Bundella	Undulating; 'Bundella' soils; <i>Eucalyptus argillacea</i> – <i>E. terminalis</i> shrub woodland.
CLAY PLAINS	Broad level plains (black soil) plains; cracking clay soils
Austral	Very gently undulating; heavy grey pedocals and heavy brown pedocals; <i>Astrebla pectinata</i> grassland (Mitchell Grass) and <i>Acacia georginae</i> – <i>Astrebla pectinata</i> woodland.
Barkly	Very gently undulating; heavy grey pedocals; <i>Astrebla pectinata</i> grassland.
Kallala	Very gently undulating 'black-soil' plains; heavy brown pedocals; <i>Astrebla pectinata</i> grassland (Mitchell Grass) and <i>Acacia georginae</i> – <i>Astrebla pectinata</i> woodland.
Wonardo	'Black-soil' plains; heavy grey pedocals or heavy brown pedocals; <i>Astrebla pectinata</i> grassland (Mitchell Grass).
LATERITIC PLAINS & RISES	Plains and rises on weathered sedimentary rocks; red clayey sands, red earths and texture contrast soils
Prentice	Gently undulating, with low limestone rises; calcified lateritic soils; <i>Eucalyptus argillacea</i> – <i>E. terminalis</i> shrub woodland.
Wonorah	Gently undulating; lateritic red earths; <i>Eucalyptus brevifolia</i> woodland or <i>Eucalyptus</i> spp. (low Mallee) – <i>Acacia</i> spp. shrubland.
LIMESTONE PLAINS & RISES	Plains, rises and plateaux on dolomite, limestone, chalcedony, shale and sandstone; red clay sand, calcareous earth and outcrop with shallow stony soil
Camil	Gently undulating; tertiary non-lateritic soils; <i>Triodia pungens</i> shrub grassland.
Camilrock	Gently undulating; tertiary non-lateritic soils and many limestone outcrops; <i>Triodia pungens</i> shrub grassland.
SANDSTONE PLAINS & RISES	Plateaux, plains and rises on sandstone, claystone, shale and limestone; outcrop with shallow stony soils
Tennant Creek	Flat-topped hills and broad valleys; skeletal and alluvial soils; <i>Eucalyptus brevifolia</i> woodland.
Yelvertoft	Undulating; mostly skeletal soils or truncated gravelly lateritic red earths; <i>Eucalyptus brevifolia</i> or <i>Eucalyptus dichromophloia</i> woodlands.
SANDSTONE HILLS	Stony plateaux, tablelands and hills on sandstone, quartzite, siltstone and conglomerate (deeply weathered in places); outcrop with shallow stony soils
Mount Isa	Rugged, hilly country with north-south ridges; mostly rock outcrops or skeletal soils; <i>Eucalyptus brevifolia</i> woodland.
GRANITE HILLS	Hills with plains on granite and gneiss with some schist; outcrop with shallow gritty or stony soils
Waverley	Undulating to low hilly granite country; mostly skeletal soils; <i>Eucalyptus brevifolia</i> woodland.



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Figure 2-4. Map of major landforms and land systems within the region of the Project footprint

2.4 VEGETATION COMMUNITIES

Vegetation within the Project footprint has been characterised through analysis of the Native Vegetation Information System (4.2) Major Vegetation Subgroups (MVS) (DoE 2016e). This is the most detailed (and standardised) vegetation dataset available for the study area. MVS groups are broadly described and mapped at a relatively large scale (for example, they do not detail dominant species); consequently, they have not been used as a primary data source for determining presence of threatened species habitat. Instead, they provide contextual purposes and locate general areas of potential threatened species habitat.

The Project footprint traverses 15 MVS – 7 in Northern Territory and 13 in Queensland (described in Table 2-3 and mapped in Figure 2-5 and Figure 2-6. The dominant vegetation groups within the Project footprint are 'Eucalyptus low open woodlands with hummock grass' (MVS 18), 'Mitchell Grass tussock grassland' (MVS 34), and 'Acacia (+/- low) open woodlands and sparse shrublands +/- tussock grass' (MVS 24). These three groups cumulatively cover 88% (2182.5 ha) of the Project footprint.

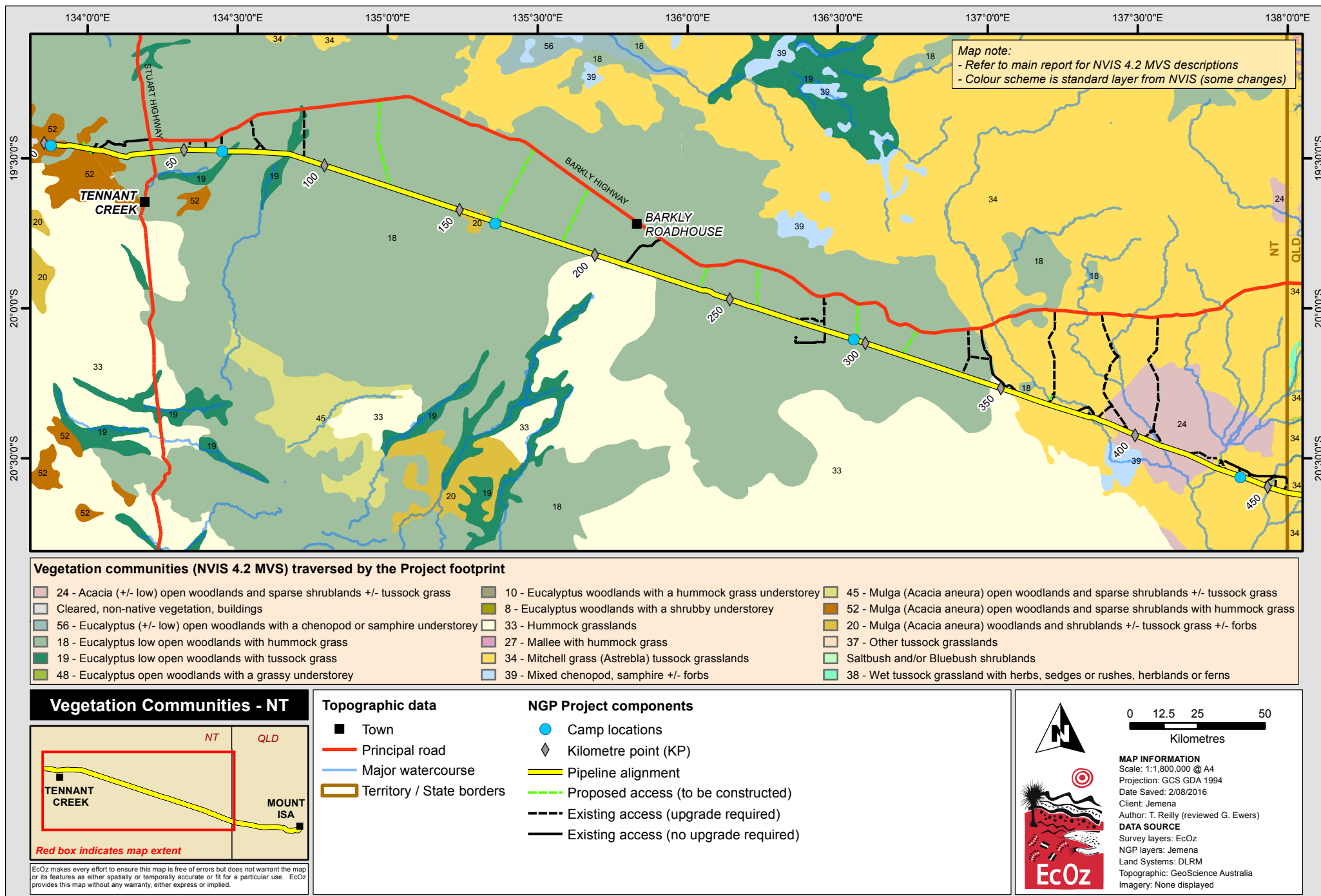
In the Northern Territory, DLRM have produced a Land Type dataset that incorporates a range of attributes at a scale of 1:250,000, which includes vegetation descriptions and dominant species. This information is discussed in Section 4 as part of the Project footprint habitat mapping survey.

In Queensland, Regional Ecosystem mapping is available at an approximate scale of 1:80,000. This dataset includes detailed vegetation descriptions and has been used in Section 4 as part of the Project footprint habitat mapping survey.

Table 2-3. MVS descriptions and area intersected by the Project footprint

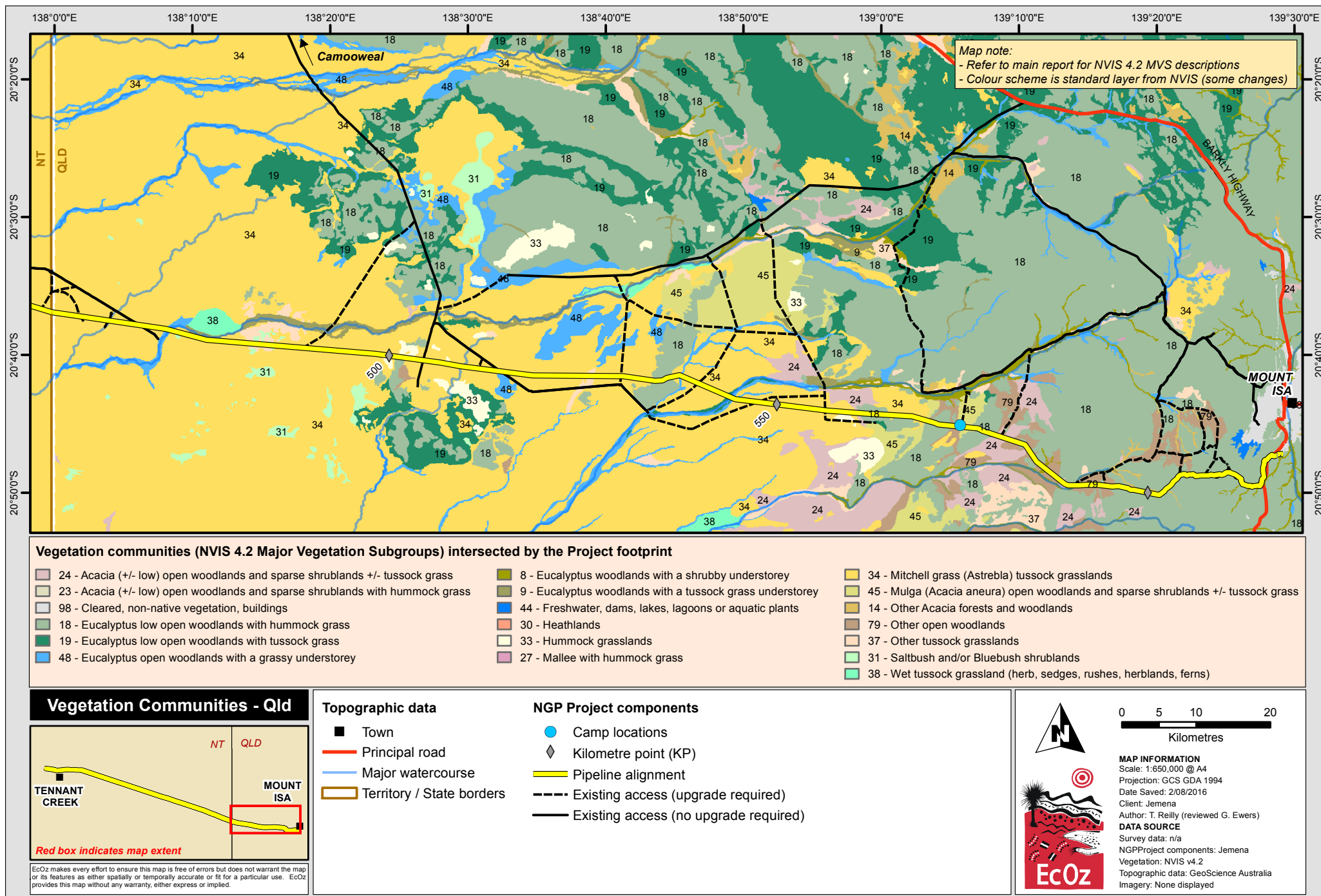
(listed in order of disturbance area within each community along the Project footprint)

MVS No.	Major Vegetation Subgroup (MVS) descriptions	Project footprint (ha)
Northern Territory		1753
18	<i>Eucalyptus</i> low open woodlands with hummock grass	1191.6
34	Mitchell grass (<i>Astrebla</i> sp.) tussock grassland	267.3
24	Acacia (+/- low) open woodlands and sparse shrublands +/- tussock grass	156.3
52	Mulga (<i>Acacia aneura</i>) open woodlands and sparse shrublands with hummock grass	67.5
20	Mulga (<i>Acacia aneura</i>) woodlands and shrublands +/- tussock grass +/- forbs	26.4
33	Hummock grasslands	25.0
19	<i>Eucalyptus</i> low open woodlands with tussock grass	17.5
Queensland		717
34	Mitchell grass (<i>Astrebla</i> sp.) tussock grassland	330.3
18	<i>Eucalyptus</i> low open woodlands with hummock grass	216.7
76	Regrowth or modified shrublands	50.5
24	Acacia (+/- low) open woodlands and sparse shrublands +/- tussock grass	20.3
37	Other tussock grasslands	12.1
33	Hummock grasslands	8.6
48	<i>Eucalyptus</i> open woodlands with a grassy understorey	14.5
19	<i>Eucalyptus</i> low open woodlands with tussock grass	15.5
8	<i>Eucalyptus</i> woodlands with a shrubby understorey	10.1
45	Mulga (<i>Acacia aneura</i>) open woodlands and sparse shrublands +/- tussock grass	28.3
31	Saltbush and/or Bluebush shrublands	2.7
9	<i>Eucalyptus</i> woodlands with a tussock grass understorey	4.6
14	Other <i>Acacia</i> forests / woodlands	1.7



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Figure 2-5. Map of vegetation communities proximate to the Propject footprint (Northern Territory)



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Figure 2-6. Map of vegetation communities proximate to the Project footprint (Queensland)

2.5 SENSITIVE VEGETATION TYPES

In the Northern Territory, sensitive vegetation types are those considered significant under the *Land Clearing Guidelines* (DNRETAS 2010). These vegetation types are either unique to the region and/or have inherently high biodiversity values. For this report, sensitive vegetation types have only been assessed for the Northern Territory (Queensland vegetation will be assessed separately).

The region of the Northern Territory in which the Project footprint occurs contains two sensitive vegetation types – riparian vegetation and wetlands.

2.5.1 Riparian vegetation

Riparian vegetation is ‘a distinct forest community occurring on the banks of rivers or streams that directly influences the adjacent water body’ (DLRM 2013). When in good condition, riparian vegetation is considered as a sensitive vegetation type as it supports a unique selection of habitat features that are relied upon by a range of flora and fauna species. Riparian vegetation provides refugia habitat, important habitat corridors, improve water quality by filtering terrestrial runoff, stabilise banks and reducing erosion, and support terrestrial and aquatic habitats by maintaining natural light, temperature and oxygen levels within waterways (DLRM 2013). The main threats to riparian vegetation are weed invasion, feral animals, fire, over-grazing, erosion, sedimentation and land clearing (DLRM 2013).

In the Northern Territory section of the Project footprint, riparian vegetation occurs along the larger creeks and rivers, of which all are located within the Mitchell Grass Downs bioregion (i.e. black soil plains). Surveys identified riparian vegetation at four intersection points (associated with the Ranken River, James River, Georgina River and Blue Bush Creek). This is mostly comprised of a few reeds on the bank, some with Coolabah (*Eucalyptus coolabah*) – see Figure 2-7. The riparian vegetation in the region is heavily impacted by cattle and weeds. There was no evidence of aquatic vegetation, such as Lilly pads (which were incidentally observed further north in more substantial and less impacted pools within the major river channels). Access tracks do not intersect any major river channels; however, twelve smaller tributaries that support Coolabah trees are intersected by proposed access tracks (and have been subsequently defined as ‘riparian’ vegetation) (noting that proposed access tracks are positioned on existing tracks that require 5 m widening).

Riparian vegetation communities (as well as floodouts, tributaries, drainages and depressions) in the black soil plains within the Northern Territory may provide habitat for the threatened flora species Tobermorey Melon (*Austrobryonia argillicola*). More detail on this species is provided in Section 5.5.

2.5.2 Wetlands

Wetlands are considered a sensitive vegetation type as they provide essential habitat for a diverse range of flora and fauna (including threatened and migratory species) and can be easily impacted upon by poor land management and planning (DNRETAS 2010).

Wetlands that occur in arid Northern Territory are defined as follows by Duguid et al. (2005):

“Wetlands are areas of permanent or temporary surface water or waterlogged soil. They may be dry for decades but inundation or waterlogging must be reoccurring and of sufficient duration to be used by macroscopic plants and animals that require such conditions during their lifecycles. They may be natural or artificial, with still or running water which can be fresh or saline. In the inland they may be of any depth or size.”

Wetlands includes waterholes, rivers, swamps, claypans, salt lakes, springs and artificial water sources (such as dams and sewage ponds). They can vary in size and are dry most of the time, but nevertheless, these areas may be important for species conservation. They may support important populations of endemic or threatened species, as well as isolated and relic populations of more widespread species (Duguid et al. 2005) that are important for local biodiversity reasons.

The Project footprint is dry for much of the year and largely includes sandplains with little relief and expansive black soil plains intersected by rivers and creeks. There are temporary swamps and flood-outs in the region of the Project footprint; however, none are directly intersected as it has been aligned to avoid all temporary swamps and subsequently does not pass through (or near to) any wetlands of significance. One swamp in the region (called Frewena Marsh, Figure 2-8) is considered to be of regional significance as it is known to support breeding colonies of water bird species (Fisher et al. 2002). An access track was initially positioned close to this marsh, but was removed from Project footprint plans due to potential ecological impacts that may have eventuated from construction activities. Wetlands were inspected during the reconnaissance survey discussed in Section 3 and threatened species surveys discussed in Section 5.

Wetlands in the region of KP 150 to KP 300 may provide habitat for the threatened flora species Latz's Grass (*Sporobolus latzii*), and wetlands within the region of KP 350 to KP 457 may provide habitat for the threatened flora species Tobermorey Melon (*Austrobryonia argillicola*). More detail on these species is provided in Section 5.4 and 5.5, respectively.



Ranken River, Northern Territory (May 2016)



Georgina River (near Austral Downs Homestead), Northern Territory (March 2016)

Figure 2-7. Photographs of riparian vegetation on Ranken and Georgina Rivers



March 2016



May 2016

Figure 2-8. Photographs of Frewena Marsh, wetland of regional significance near Project footprint

2.6 EXISTING THREATENING PROCESSES

2.6.1 Fire

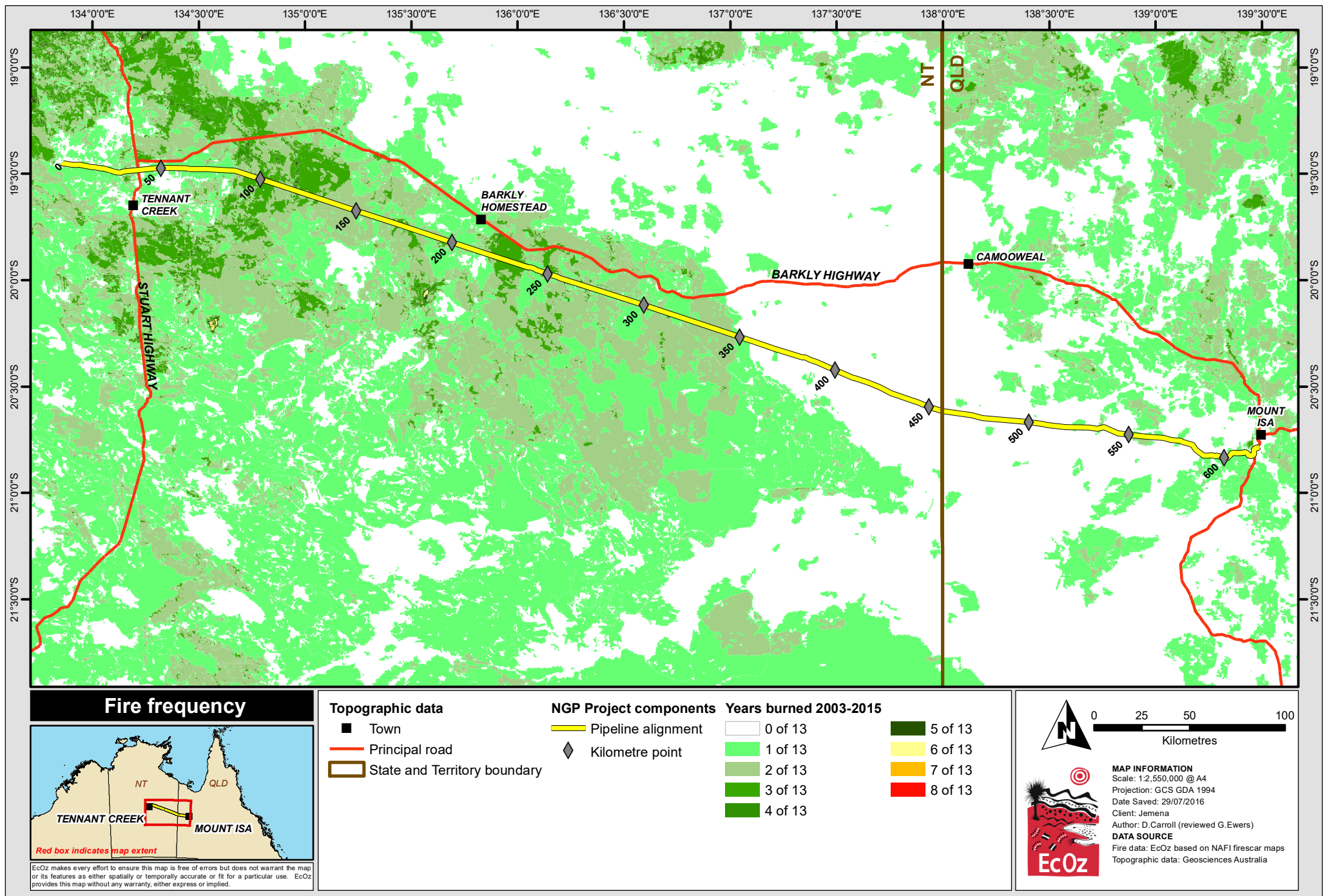
Fire is an essential part of ecosystems within arid and semi-arid Australia (Kershaw et al. 2002) and is caused by natural and anthropogenic sources. It is thought to be a major contributor towards landscape change (Latz 1995 & Latz 2007), particularly within the last 130 years where significant changes in land use have led to more frequent, larger scale fires (Edwards et al. 2008). Fire in the region of the Project area is strongly associated with presence and extent of spinifex-dominated landscapes (i.e. hummock grasslands). Spinifex (*Triodia* sp.) is a fire-tolerant species that creates high fuel-loads and re-establishes after fire (Latz 1995; Edwards et al. 2008). More frequent, large-scale fires often result in further expansion of spinifex grasslands, which can have negative impacts on many flora and fauna. Introduced grasses – such as Buffel Grass (*Cenchrus ciliaris*) – also play a major role in increasing fire frequency and intensities within central Australia.

Regional fire history and fire scar mapping was obtained through the Northern Australia Fire Information website (NAFI 2016). Fire mapping indicates that approximately half of the Project footprint has burnt 2 to 3 times between 2003 and 2015 – as shown in Figure 2-9 (noting that the resolution of this database does not include local, small-scale fires). In general, burnt areas are either located on Aboriginal Land or Vacant Crown Land. This is on the higher scale of burning frequency for central Australia. Spinifex grasslands that dominate the lower strata of vegetation communities in the region are able to re-establish enough fuel-load within a 5- to 7-year period to sustain repeat broad-scale fire events. Therefore, fire intervals within spinifex grasslands are usually between 7 years (high frequency) to > 20 years (low frequency), with fuel-load re-establishment being affected by rainfall and regional fire management (i.e. higher rainfall areas have more rapid re-establishment rates) (Edwards et al. 2008).

The most significant fire period for the Project region (in recent years) was in 2011, when the majority of the western half (KP 0 – KP 354) of the Project footprint was burnt. In that year, there were several large-scale, spinifex-fuelled fires that swept through the region. These fires burnt significant areas of both long unburnt (> 13 years) and previously burnt (with < 7 years) vegetation communities. Part of this area, between KP 150 – KP 354, falls within an area known as the Wakaya Desert, which Latz (2007) refers to as a 'fire-produced desert'. Gibson et al. (1994) and Latz (2007) present evidence that over the years spinifex-dominated grasslands have increased in extent which, through wildfire, has changed the landscape and reduced the diversity of vegetation communities (evidenced by Coolabah trees being reduced to mallee form, lack of tree hollows and fallen logs, presence of red soils on the surface of many clay 'relict' swamps, and only occasional small patches of fire-sensitive species). Consequently, long-term fire impacts are likely to have reduced the overall flora and fauna biodiversity of the region (Latz 2007).

The black soil plains between KP 353 and KP 561 generally experienced no fires between 2003 and 2015 – likely due to cattle grazing (fuel-load reduction) and perhaps the lack of spinifex-dominated grasslands (Figure 2-9). Land is predominantly cattle stations within the black soil country. Pastoral management (through active suppression, access tracks and firebreaks) usually aims to exclude fire from the clay-soil environment to maintain pasture throughout the dry season (DEWHA 2009b).

Low fire frequencies (i.e. between 0 and 1 burn in the last 13 years) are observed on cattle stations outside of the black soil country. Vegetation communities within these stations have a mix of tussock and spinifex hummock grasses (Figure 2-5); therefore a higher fuel-load is present (spinifex is generally not grazed upon by cattle). When conditions are suitable, pastoralists periodically burn hummock (spinifex) grasslands to promote green forage for cattle (as palatable tussock grasses, herbs and forbs often emerge after burns in hummock grasslands if weather conditions are suitable).



Path: Z:\01 EcOz Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-6. Map of fire frequency in the region of the Project footprint between 2006 and 2016.mxd

Figure 2-9. Map of fire frequency in the region of the Project footprint between 2006 and 2016

2.6.2 Weeds

In the Northern Territory, weed occurrence data is held by the Weeds Management Branch in the DLRM. Twenty-two weed species (declared under the Northern Territory *Weeds Management Act*) have been recorded within 20 km of the Project footprint.

In Queensland, weed occurrence data is held by Biosecurity Queensland in the Department of Agriculture and Fisheries. Twenty-eight weed species (as declared under the *Land Protection (Pest and Stock Route Management) Act 2002*) have been recorded within 20 km of the Project footprint.

Weed species in the region are expected to be mainly occur within watercourses, alluvial flats, disturbed areas (i.e. roadsides, fences and water-points), and on drainages or depressions within clay plains located within the Mitchell Grass Downs bioregion. Sandplains, rocky rises and clay plains (which represent the majority of the Project footprint) are not expected to support declared weed species. Table 2-4 presents a list of known declared weed species and preferred habitat type; Figure 2-10 shows known weed records in the region.

Although not a declared weed, Buffel Grass (*Cenchrus ciliaris*) is also considered a threat to biodiversity value in the region of the Project footprint. That species can out-compete native tussock and hummock grasses, which often results in more frequent and intense wildfire.

Incidental and opportunistic weed records made during fieldwork conducted in April and May 2016 noted that the following weeds were present within (or close to) the Project footprint.

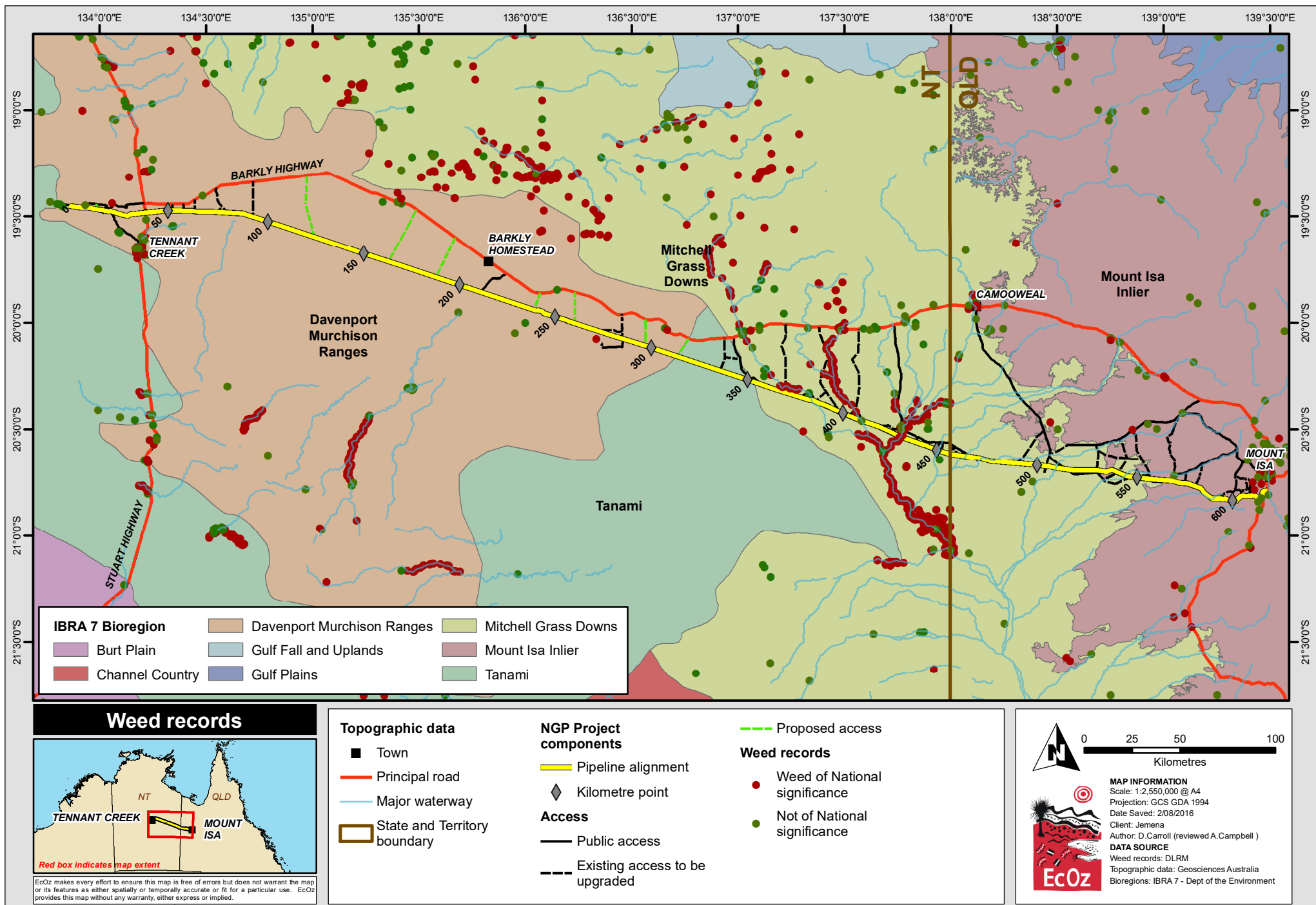
- Noogoora Burr (*Xanthium strumarium*) – dense (but small) infestations recorded on the banks of the Ranken River
- Buffel Grass (*Cenchrus ciliaris*) – recorded along watercourses near Mount Isa, Tennant Creek, and Barkly Homestead
- Kapok Bush (*Aerva javanica*) – recorded near Barkly Homestead
- Parkinsonia (*Parkinsonia aculeata*) – low density of saplings on floodouts of Georgina River
- Mesquite (*Prosopis pallida*) (identification to be confirmed during weed surveys) – located along some small drainages within the black soil plains
- Annual Mission Grass (*Pennisetum pedicellatum*)

A complete weed survey of the Project footprint will occur prior to commencement of works. Survey methods will be in accordance with Northern Territory and Queensland requirements. Details of the approach to field survey and subsequent refinement of weed management controls are provided in the Weed Management Plan (an appendix of the main EIS).

Table 2-4. Declared weed species recorded within bioregions intersecting the Project footprint

Habitat key: **W** – watercourses and drainages; **Dp** – drainages and depressions within Mitchell Grass Downs; **Dt** – disturbed areas; **V** – variable habitat; **Gr** – grasslands; **Pa** – pasture or agriculture.

Family	Common Name	Genus	NT	Qld	WoNS	Typical habitat
ACANTHACEAE	Thunbergia	<i>Thunbergia annua</i> , <i>T. fragrans</i> & <i>T. laurifolia</i>	-	1	No	W
	Thunbergia	<i>Thunbergia grandiflora</i>	-	2	No	W
ANACARDIACEAE	Broadleaved pepper tree	<i>Schinus terebinthifolius</i>	-	3	No	W
APOCYNACEAE	Rubber bush	<i>Calotropis procera</i>	B/C	-	No	W;Dt
	Rubber vine	<i>Cryptostegia grandiflora</i>	-	2	Yes	W
ASTERACEAE	Star burr	<i>Acanthospermum hispidum</i>	B/C	-	No	Dt
	Parthenium	<i>Parthenium hysterophorus</i>	A/C	2	Yes	W;Dp
	Fireweed	<i>Senecio madagascariensis</i>	-	2	No	Pa
	Noogoora burr	<i>Xanthium strumarium</i>	B/C	-	No	W;Dt
BIGNONIACEAE	Cat's claw creeper	<i>Macfadyena unguis-cati</i>	-	3	Yes	W;Dt
BORAGINACEAE	Patterson's curse	<i>Echium plantagineum</i>	A/C	-	No	Dt
CACTACEAE	Coral cactus	<i>Cylindropuntia fulgida</i> var. <i>mamillata</i>	-	2	Yes	V
	Harrisia cactus	<i>Harrisia</i> spp.	-	1	No	V
	Prickly pear	<i>Opuntia</i> spp. (not <i>O. stricta</i>)	-	1	No	V
	Prickly pear	<i>Opuntia stricta</i>	-	2	Yes	V
CRASSULACEAE	Mother of millions	<i>Bryophyllum</i> spp. and hybrids	-	2	No	Dt
EUPHORBIACEAE	Bellyache bush	<i>Jatropha gossypifolia</i>	A/C	2	Yes	W;Dt
	Castor oil plant	<i>Ricinus communis</i>	B/C	-	No	W;Dt
FABACEAE	Parkinsonia	<i>Parkinsonia aculeata</i>	B/C	2	Yes	W;Dp;Dt
	Mesquite	<i>Prosopis</i> spp.	A/C	2	Yes	W;Dp
	Coffee Senna	<i>Senna occidentalis</i>	B/C	-	No	W;Dt
	Sicklepod	<i>Senna obtusifolia</i>	B/C	-	No	Dt
	Prickly Acacia	<i>Vachellia nilotica</i>	A/C	-	Yes	W;Dp;Dt
LAMIACEAE	Hyptis	<i>Hyptis suaveolens</i>	B/C	-	No	W;Dt
MALVACEAE	Sida – Spiny head	<i>Sida acuta</i>	B/C	-	No	Dt
	Sida – Flannel weed	<i>Sida cordifolia</i>	B/C	-	No	Dt
	Sida – Paddy's Lucerne	<i>Sida rhombifolia</i>	B/C	-	No	Dt
PAPAVERACEAE	Mexican poppy	<i>Argemone ochroleuca</i>	B/C	-	No	W
POACEAE	Mossman river grass	<i>Cenchrus echinatus</i>	B/C	-	No	W;Dt
	Mission grass - perennial	<i>Cenchrus polystachios</i>	B/C	-	No	Dt
	Mexican feather grass	<i>Nassella tenuissima</i>	-	1	No	Gr
	Rats tail grass	<i>Sporobolus</i> spp.	-	2	No	Pa
RHAMNACEAE	Chinee apple	<i>Ziziphus mauritiana</i>	-	2	No	W
SALICACEAE	Pencil Willow	<i>Salix chilensis</i>	-	3	Yes	W
SALVINIACEAE	Salvinia	<i>Salvinia molesta</i>	-	2	Yes	W
SOLANACEAE	Thornapple - Longspine	<i>Datura ferox</i>	A/C	-	No	W
	African boxthorn	<i>Lycium ferocissimum</i>	-	2	Yes	W;Dt
TAMARICACEAE	Athel pine	<i>Tamarix aphylla</i>	A/C	3	Yes	W
VERBENACEAE	Lantana	<i>Lantana camara</i> , <i>L. montevidensis</i>	-	3	Yes	V
ZYGOPHYLLACEAE	Caltrop	<i>Tribulus terrestris</i>	B/C	-	No	Dt



Path: Z:\01 EcOz Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-7. Map of declared weed records in the region of the Project footprint.mxd

Figure 2-10. Map of declared weed records in the region of the construction footprint

2.6.3 Introduced fauna

The following introduced fauna species are expected to occur within the Project footprint:

- **Feral Cat (*Felis catus*)**

Feral Cats occur throughout the Australian mainland in a wide variety of different habitats – including deserts, forests and grasslands. The species is considered a ‘key threatening process’ under the *EPBC Act*. Feral Cats play a significant role in the decline of native fauna – an individual is estimated to kill 5 to 30 native species per day (AWC 2012) – and have been recognised as contributing to the decline of several ground-nesting birds and small to medium-sized mammals.

Previous studies (within the Northern Territory) have recorded Feral Cats in the region of the Project footprint (Gibson et al. 1994; Low Ecological Services 2009), and signs from the species were observed during the EIS field studies for the Greater Bilby (see Section 5.8). According to the Atlas of Living Australia (<http://bie.ala.org.au/species/Felis%20catus>), there are numerous records within the Northern Territory section of the Project footprint and no records within the Queensland section of the Project footprint.

It is likely that the Feral Cat is prevalent across the Project footprint.

- **Cane Toad (*Rhinella marina*)**

Cane Toads are widespread across tropical Queensland and the Northern Territory in a wide variety of habitats, moving westward at an estimated 40 to 60 km per year (DEWHA 2010a). They need constant access to moisture to survive (which can be water, dew or moist sand).

This species is listed as a ‘key threatening process’ under the *EPBC Act* because it is lethal to carnivorous native animals if consumed. Cane Toads are known to be a key factor in the decline of a number of native predatory fauna – including monitors and Northern Quoll – and are poisonous to a wide range of snakes (Phillips et al. 2003).

It is unclear to what extent Cane Toads occur within the Project footprint. The most recent distribution modelling of Cane Toads (see Figure 2-11) includes the channel country to the eastern terminus of the pipeline, with a prediction of an eventual distribution of the species westwards along the entire Project footprint. That region is considered marginal habitat for Cane Toads, with a maximum of 3 to 4 months suitable for breeding (see Figure 2-11). During field surveys for this EIS, ecologists noted the species along the roadside near Camooweal – approximately 80 km north of the construction ROW. Camooweal is higher in the catchment than the Project footprint and so it could be assumed that Cane Toads would be present downstream in that catchment. However, there have been no observations of Cane Toads at either Avon Downs or Austral Downs (advice from pastoral managers), which are both located in black soil country of that catchment (the latter only 4 km north of the construction ROW).

Two possible conclusions can be drawn from this:

- a) Cane Toads have reached the limits of southerly expansion (as dictated by water availability) in the region, and this expansion does not include the construction ROW (except, perhaps, at the Mount Isa end). This seems the likeliest conclusion given the species is present at Camooweal, but not downstream at Austral Downs.
- b) Cane Toads yet to spread as far south as the construction ROW (except, perhaps, at the Mount Isa end), but suitable (albeit sub-optimal) habitat occurs, and so expansion into that region is inevitable. This is possible if the species only recently expanded to Camooweal and has not yet had the opportunity to travel downstream.

Where Cane Toads do occur within the footprint, they are likely to be restricted in numbers due to limited water availability.

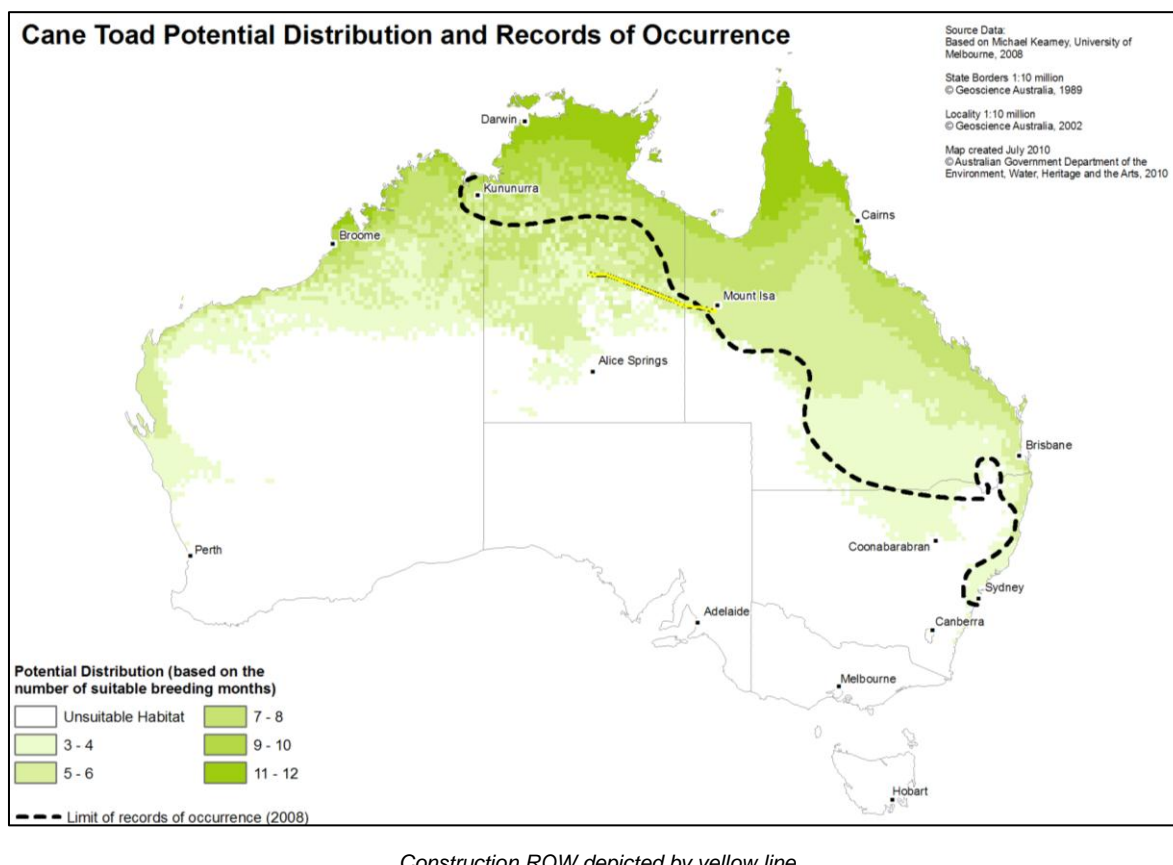


Figure 2-11. Map of known extent and potential distribution of Cane Toad

- **Domestic Cattle (*Bos taurus*)**

Cattle production is one of the primary economic drivers of the region and so cattle are common throughout pastoral properties intersected by the Project footprint. Domestic Cattle can cause land degradation through trampling, soil compaction, erosion, weed spread and decreases in water quality (DLRM 2016b). Addition information on pastoralism is provided in Section 2.6.4.

- **Feral Horse (*Equus caballus*)**

Feral Horses occur across the Australian mainland in a wide variety of different habitats. The species prefers grassland and shrubland with plentiful water and pasture (DSEWPac 2011a). The Feral Horse population is highest in the cattle-raising districts of Queensland and the Northern Territory (IACRC 2015). The species causes erosion of soil and watercourses, weed spread, trampling and consumption of native flora, and sedimentation and increased nutrient levels in watercourses (DSEWPac 2011a).

Feral Horse were not observed during EIS field studies.

Distribution mapping from 2000 indicates that Feral Horses are likely in the Queensland section of the Project footprint (DSEWPac 2011).

- **One-humped Camel (*Camelus dromedarius*)**

Feral Camels are distributed through much of the Australian rangelands, wandering widely according to conditions. The species utilises most habitats in the arid and semi-arid areas, depending on availability of food and summer shade (DEWHA 2010b). Feral Camels cause environmental damage through trampling and foraging behaviour, suppression of plant recruitment, damage to wetland and riparian areas, and competition with native animals for food

and shelter (NRMCC 2010). Feral Camels are expected to occur within the Project footprint – although camels are sparsely distributed through this area (0 – 0.25 per km²) (NRMCC 2010).

EIS field studies recorded One-humped Camel in the rocky country near Mount Isa (Queensland). Very low numbers of tracks and scats were observed within the desert sandplains in the Northern Territory

- **Feral Pig (*Sus scrofa*)**

Feral Pigs are a widely-distributed, environmental and agricultural pest. Up to 23.5 million Feral Pigs are spread across about half of the continent – from western Victoria, through New South Wales into Queensland, and across northern Australia (DSEWPac 2011b).

This species is listed as a 'key threatening process' under the *EPBC Act* because of native fauna predation, contribution to habitat loss and competition with native fauna. The threats associated with Feral Pig are largely confined to riparian and wetland habitats, where rooting, wallowing, tusking and rubbing impact upon flora and fauna, and water quality.

The distribution of Feral Pig includes most of the Project footprint when water is present – more commonly in the east, with only occasional low numbers and/or localised occurrences in the west (West 2008).

- **Red Fox (*Vulpes vulpes*)**

Red Foxes occur across a variety of habitats in most of Australia. The species is absent from north-western WA, northern Northern Territory (north of Tennant Creek), and northern and north-eastern Queensland. (West 2008).

This species is listed as a 'key threatening process' under the *EPBC Act* due to the species' predation of native fauna. The species is known to prey on ground-nesting birds and small to medium-sized mammals such as the Greater Bilby (DSEWPC 2011b).

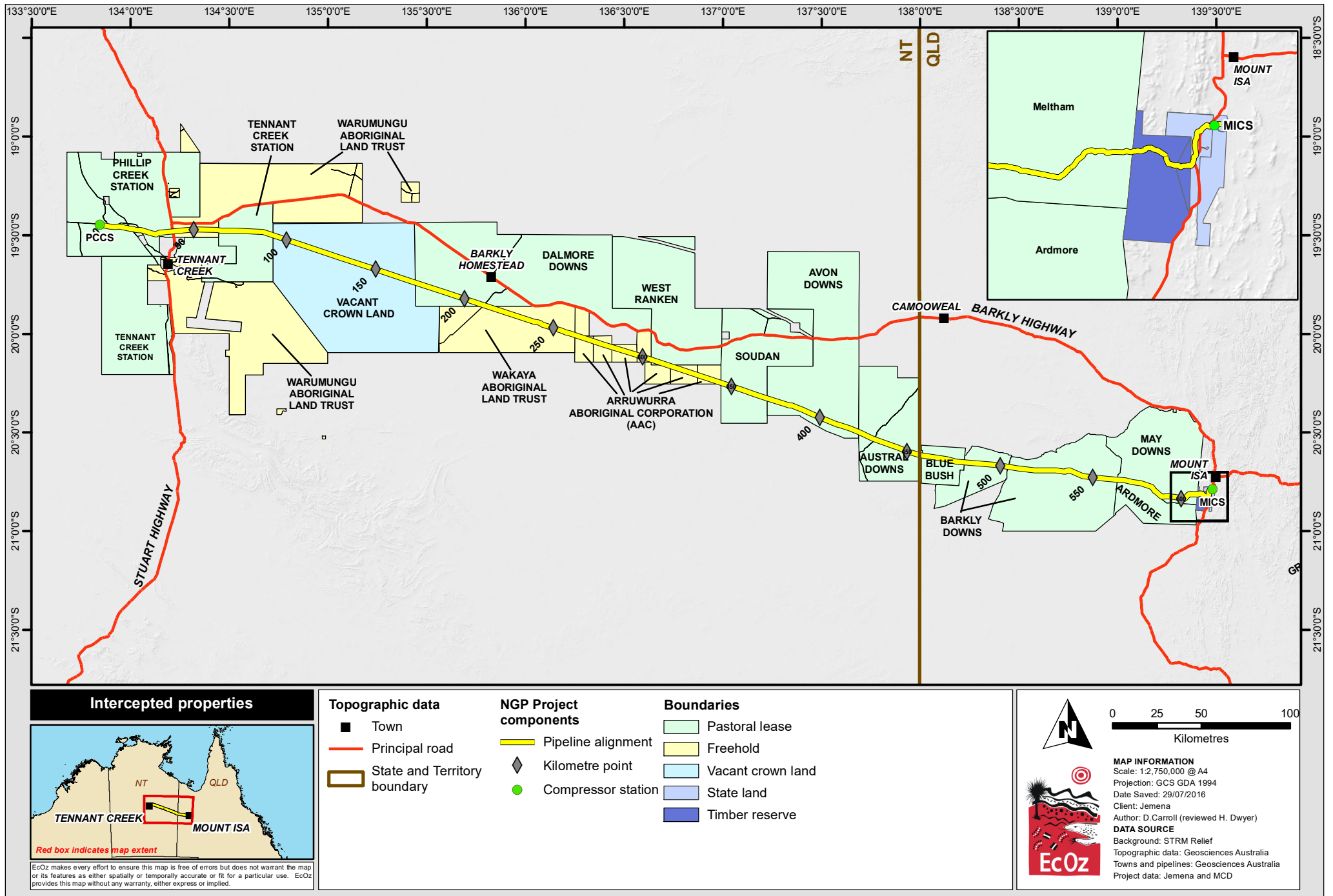
The Project footprint is at the northern edge of the species' distribution. One Fox track was recorded in desert sandplains within the Northern Territory during EIS studies. According to the Atlas of Living Australia (<http://bie.ala.org.au>), there are a few records in sandplains within the Northern Territory section of the Project footprint and no records within the black soil plains or Queensland section of the Project footprint.

It is likely that Red Fox occurs in low densities within the sandplains of the Northern Territory section of the Project footprint, and absent in black soil plains and Queensland.

2.6.4 Pastoralism

Pastoral stations cover much of the Project footprint (see Figure 2-12) – the ROW crosses pastoral leases for 99% of the Queensland length and 50% of the Northern Territory length. Consequently, environmental impacts typically associated with pastoralism are expected to occur within the Project footprint (i.e. increased weeds, erosion development, soil surface structure/infiltration, water source degradation and altered fire regimes) (DEWHA 2009b). Cumulatively, these impacts can have a negative influence on biodiversity. It is implicated that pastoral impacts have resulted in the decline of some vertebrate species and changes in plant species composition in the Australian rangelands (Fisher et al. 2002; DEWHA 2009). Pastoral impacts have particularly affected larger dasyurids and rodents, bandicoots and smaller macropods (Woinarski et al. 2001 – cited in DEWHA 2009b).

The level of impacts from pastoral activities on biodiversity values will be dependent on the management of station (i.e. stocking rates, provision of artificial water points and prescribed burns), and also the sensitivity of vegetation communities to grazing. Observations of pastoral impacts within the Project footprint were collected during field studies as part of determining the habitat suitability for targeted threatened species.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-9. Map of the extent of pastoralism within the Project footprint.mxd

Figure 2-12. Map of the pastoral properties and other tenures intersected by the Project footprint

3 RECONNAISSANCE SURVEY

On the 23 and 24 March 2016, the Project footprint was surveyed (via helicopter) to obtain a preliminary description of habitat types that occur in the general region of the Project footprint (general observations only as the footprint had not been finalised at the time of survey). High-resolution, geo-referenced footage of the construction ROW and a selection of proposed access tracks was also recorded (flight path is provided in Figure 3-3). Footage was recorded at an approximate height of 150 m at a speed of 90 knots.

The survey and footage allowed direct observation of habitat features which were difficult to confidently infer from available desktop resources. The survey and footage also allowed for the identification of sensitive vegetation types (riparian vegetation and wetlands) within the Project footprint. Information collected during the survey was used to inform threatened species surveys design and to conduct validation of draft 'land type' mapping (provided by DLRM) along the Project footprint.

The reconnaissance survey provided valuable preliminary information on the presence of potentially-suitable habitat for the following threatened species:

- Latz's Grass (*Sporobolus latzii*)
- Tobermorey Melon (*Austrobryonia argillicola*)
- Carpentarian Antechinus (*Pseudoantechinus mimulis*)
- Greater Bilby (*Macrotis lagotis*)
- Gouldian Finch (*Erythrura gouldiae*)
- Australian Painted Snipe (*Rostratula australis*).

Latz's Grass (*Sporobolus latzii*)

Two swamps (also referred to as 'playas') were identified in the region of the Project footprint. At the time, both contained water, and supported stunted Coolabah (*Eucalyptus coolabah*). This confirms that potentially suitable habitat for *S. latzii* occurs in the region of the Project footprint and will require targeted field assessments to confirm its presence.

The swamp where *S. latzii* has been previously recorded (~ 4 km to the south of KP 273) was visited (at >100 m above ground) to record video footage and observe habitat features associated with the swamp to familiarise surveyors with the species 'type locality' (see photos in Figure 3-2). The swamp was mostly dry at the time of survey. There was evidence of recent fire. Later inspection of fire scar mapping (using NAFl and LandSat imagery) indicated that the swamp has burnt in 2007 (broad-scale burn), 2011 (broad-scale burn), and 2014 (small-scale burn which included the swamp). The swamp was comparably large (171.2 ha) compared to swamps observed near the Project footprint. It contained a variety of habitat features, such as many small 'islands', low presence of spinifex hummocks, large single-trunked Coolabah trees, evidence of sedges within the swamps and a variety of tussock grass species on its edges.

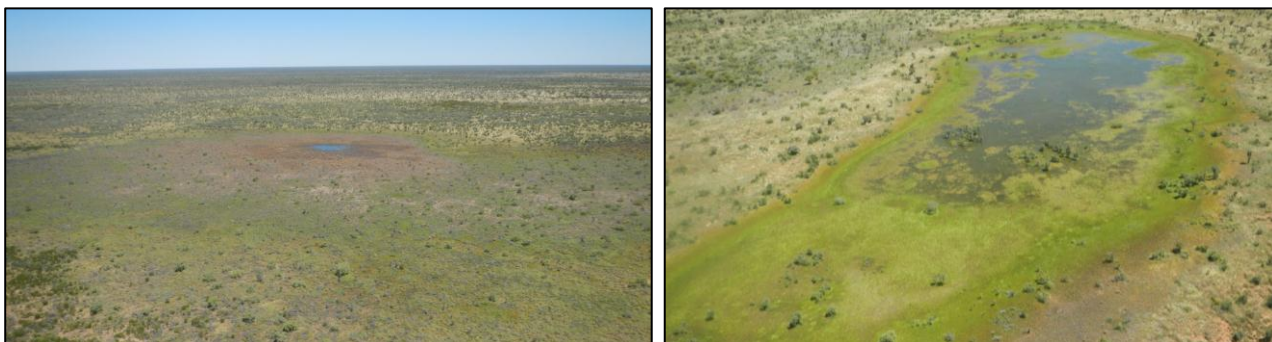


Figure 3-1. Photographs (aerial) of swamps within the region of the Project footprint



Figure 3-2. Photographs (aerial) of the 'type locality' for Latz's Grass (*S. latzii*), March 2016

Tobermorey Melon (*Austrobryonia argillicola*)

The Project footprint crosses numerous rivers, creek, drainages and depressions within the Mitchell Grass Downs bioregion (within the Northern Territory) that are likely to support Tobermorey Melon . These areas will be targeted during field surveys to confirm the presence of Tobermorey Melon within the Project footprint.

Carpentarian Antechinus (*Pseudantechinus mimulus*)

Rocky hills and ridges are present in the region of the Project footprint between KP 510 and KP 622. These areas may potentially support Carpentarian Antechinus and will require field surveys to confirm the presence of the species within the Project footprint. Rocky habitat observed was either metamorphic hills and low ridges, or granitic hills with varying levels of exposed outcrop. In most circumstances, the Project footprint avoided direct impact of these rocky areas. Suitable habitat was photographed and a waypoint recorded.

Greater Bilby (*Macrotis lagotis*)

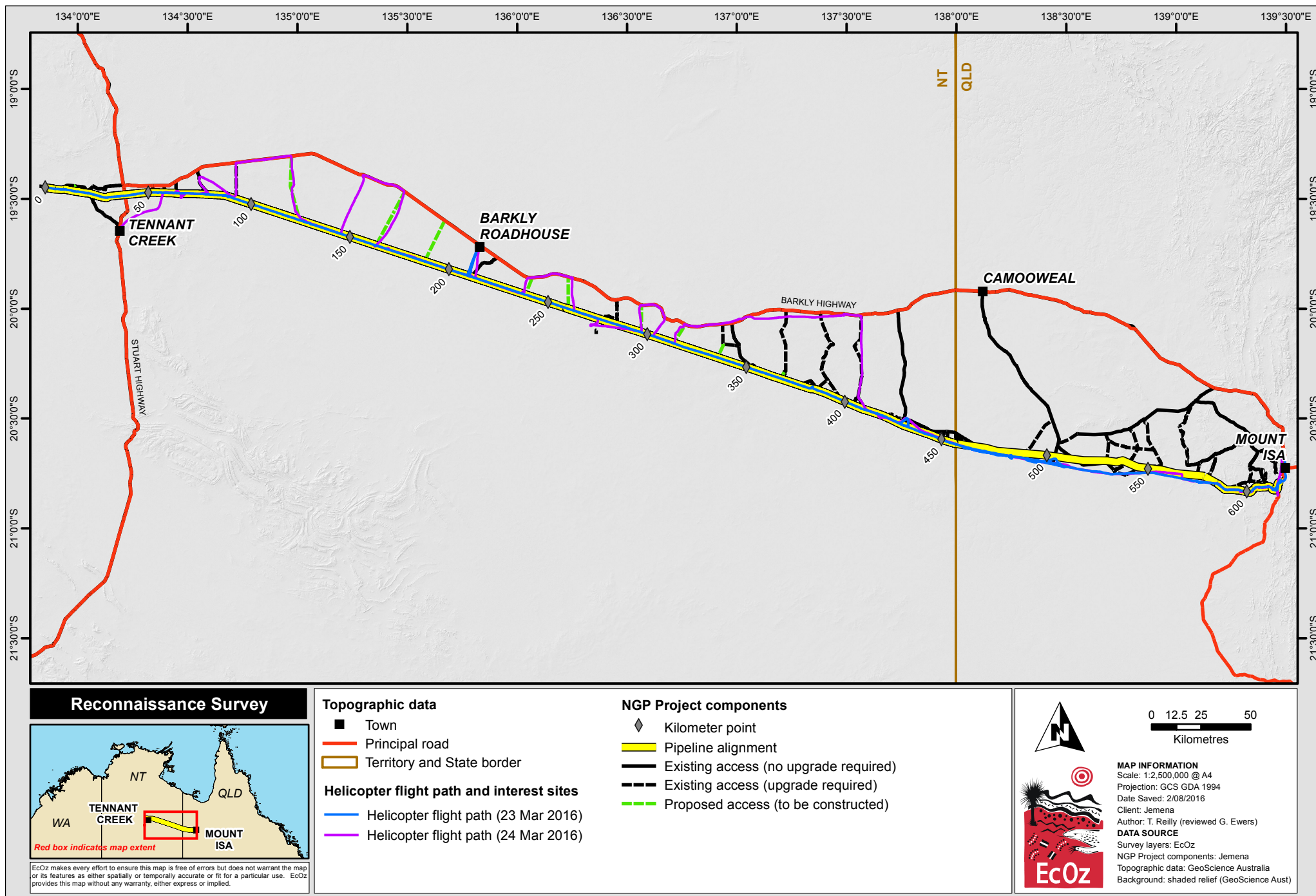
There are large expanses of potentially suitable habitat for Greater Bilby in the western portion of the Project footprint – between KP 0 and KP 355. This area is dominated by sand plains, with smaller areas of lateritic rises, seasonal swamps, and alluvial plains. No palaeodrainage channels were observed within the project footprint or surrounds; however, relic drainage features were observed between KP 200 and KP 355 in areas where laterite rises were more common. Large recent fire scars were observed within the region. Targeted field surveys will be required to determine the presence of Greater Bilby within the Project footprint. These surveys will target habitat types considered to have a high chance of occupancy of Greater Bilby – such as recently burnt sandplains, rocky rises, edges of seasonal swamps, and alluvial plains.

Gouldian Finch (*Erythrura gouldiae*)

Habitat occurs in the eastern part of the Project footprint that may support suitable nesting and feeding opportunities (variety of grasses) for Gouldian Finch. Nesting habitat was focused on identifying the presence of mature Snappy Gum (*Eucalyptus leucophloia*) trees, which were more often established on the slopes of rocky hills and ridges. It is these larger trees that are more likely to provide suitable nesting hollows for Gouldian Finch. Assessment of potential feeding habitat is only assumed, and would more likely occur in run-on areas such as depressions and small drainages. No permanent freshwater pools were observed within the Project footprint. Field surveys will be required to determine the suitability of these areas for Gouldian Finch.

Australian Painted Snipe (*Rostratula australis*)

Small swamps were observed within the region of the Project footprint that may provide stop over habitat for the Australian Painted Snipe; however, none were considered to be core-habitat or important wetlands in regards to population dispersion and species presence in the region. Additionally, all swamp areas will be avoided by the Project footprint, therefore impacts to this species habitat is considered negligible. The large more significant swamps in the region that are more likely to be periodically occupied by the species are distant from Project footprint disturbances. In conclusion, observations confirmed that targeted field surveys for Australian Painted Snipe are not necessary due to absence of preferred habitat within the Project footprint.



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Figure 3.3. Map of reconnaissance survey flight paths

4 HABITAT MAPPING

4.1 PURPOSE

Habitat mapping of the Project footprint was undertaken to spatially determine the area and location of habitat that may be (generally) suitable for threatened species. This information was essential for targeted threatened species survey design (i.e. site selection) and assists in measuring the potential impact to threatened species habitat (although a more detailed habitat analysis was undertaken specifically threatened species if they were found to potentially occupy an area of the Project footprint).

4.2 METHOD

Habitat mapping is predominantly based on delineating landforms along the Project footprint at an approximately scale of 1:10 000. Other key habitat features such as vegetation community and soil types are not specifically mapped; however, typical associations with each landform in the region were identified (and extrapolated further in specific threatened species studies where relevant).

Habitat mapping was produced in ArcGIS by creating polyline shapefiles along the Project footprint. This enabled a spatial representation of habitat types along the Project footprint at a scale fine enough to make accurate inferences on the location of potentially suitable threatened species habitat. Separate maps and descriptions were made for the Northern Territory and Queensland due to different attributes (and scales) within existing datasets.

4.2.1 Northern Territory

Land type mapping was available for the Northern Territory section of the Project footprint, which was advised by DLRM to be the most recent and accurate dataset for the region (pers. comm. Peter Brocklehurst 2016). Land type data files were provided by DLRM in March 2016 – *Land Types of the Barkly and Tennant Creek Regions* (Department code: STHNT_250). The dataset is produced at a scale of 1:250 000 and is based on land system 'Survey of the Barkly Region' (Christian et al. 1954). It has the following data attributes applied to each land type polygon – land type name, landscape class, landscape class description, landform unit, soil type, dominant vegetation group, NVIS vegetation structure, dominant flora species (three maximum), and land type region.

Landform units were the most useful component of the dataset in terms of determining the potential presence of threatened species habitat, therefore this survey aims to describe each landform unit traversed by the Project footprint. It was not possible to consistently field-check soil types, vegetation groups, and dominant flora species within each landform unit along the Project footprint; subsequently, habitat descriptions provided in this report included all possibilities as per Land Type mapping dataset.

Habitat mapping for the Northern Territory section of the Project footprint was produced by comparing DLRM land type mapping descriptions against satellite imagery (World Imagery available on ESRI Online) at an approximate scale of 1:10 000. Geo-referenced video footage recorded as part of the reconnaissance survey (see Section 3), as well as habitat descriptions undertaken as part of threatened species surveys (Section 5) was used as part of the landform validation process.

Habitat mapping attributes applied to each polyline segment are 'landscape class' and 'landform unit' (see Table 4-1 for categories applicable to the Project footprint), and also depicts the particular 'land type' region (i.e. Tennant Creek Sandplains or Barkly Clay Plains). Bioregions were also attributed to each polyline – it was assumed that Tennant Creek Sandplains incorporates 'Davenport / Murchison Ranges' and 'Tanami' bioregions, and the Barkly Clay Plains incorporates 'Mitchell Grass Downs' bioregion.

Table 4-1. Habitat mapping categories – Northern Territory



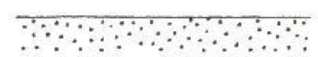




Landscape class	Landscape class description (general)	Landform units
<i>ALLUVIAL FLOODPLAINS</i>	Alluvial plains, swamps, drainage depressions and alluvial fans; sandy, silty and clay soils on Quaternary alluvium.	Alluvial plains Drainage systems Inland wetlands Swamps
<i>CLAY PLAINS</i>	Level to gently undulating clay plains (black soil plains); cracking clay soils.	Plains Downs plains Inland wetlands
<i>DESERT SANDPLAINS</i>	Level to undulating sandplains with red sands.	Plains Sand plains Playas
<i>LATERITIC PLAINS AND RISES</i>	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils.	Plains Low rises Rises Playas
<i>LIMESTONE PLAINS AND RISES</i>	Plains, rises and plateaux on dolomite, limestone, chalcedony, shale and sandstone; red clayey sands, calcareous earths and outcrop with shallow stony soils.	Plains Low rises Rises
<i>SANDSTONE PLAINS AND RISES</i>	Plains, rises and plateaux on mostly on sandstone, siltstone, claystone, shale and some limestone; commonly shallow soils with surface stone and rock outcrop.	Plains Rises Hills

4.2.2 Queensland

Regional ecosystem land zone mapping and descriptions were used for the habitat survey of the Project footprint within Queensland. Land zones are categories that describe major geology, associated landforms and geomorphic processes, and often support different ecosystem function and biodiversity assemblages (Wilson and Taylor 2012). Land zones within the Project footprint are currently available at a scale of 1:80 000. Table summarises land zones applicable to the Project footprint. Finer scale regional ecosystem mapping is also available which provides detailed vegetation data and describes landform units that are clumped together in the broader land zones. This finer scale habitat data is provided in specific threatened species surveys when appropriate (Section 5). For example, Land Zone 11 (hills and lowland on metamorphic rocks) contains three different sub-units – ranges, hills and lowlands – that are not delineated by habitat mapping presented in this section.

Habitat mapping for the Queensland section of the Project footprint was produced by comparing land zone mapping polygons and descriptions against satellite imagery (World Imagery available on ESRI Online) at an approximate scale of 1:10 000. Geo-referenced video footage recorded as part of the reconnaissance survey (see Section 3), as well as habitat descriptions undertaken as part of threatened species surveys (Section 5) was used as part of the landform validation process. Habitat mapping attributes applied to each polyline segment are 'land zone number', 'land zone description', and 'bioregion' (IBRA v7).

Table 4-2. Habitat mapping categories – Queensland

Land zone	General description	Cross-section sketch (source: Qld Government)
3	Alluvium (river and creek flats) (includes depressions, inland lakes, and palaeo-estuarine deposits)	
4	Clay plains (level to gently undulating plains not associated with current alluvium)	
5	Old loamy and sandy plains (level to gently undulating)	
7	Ironstone jump-ups (mesas and scarps, present as low rocky rises in Mitchell Grass Downs)	
9	Undulating country on fine grained sedimentary rock (usually with little or no deformation, outcrops)	
11	Hills and lowlands on metamorphic rocks (ranges, hills and lowlands that are usually deformed)	
12	Hills and lowlands on granite rock (ranges, hills and lowlands)	

4.3 RESULTS

4.3.1 Northern Territory habitat mapping

Five landscape classes are traversed by the Project footprint that incorporate 11 landform units (Table 4-3; Figure 4-1). Two land type regions are traversed – the Tennant Creek Sandplains (from KP 0 to KP 350) and Barkly Clay Plains (KP 350 to KP 457).

Lateritic rises and plains, desert sandplains, and clay plains are the dominant landscape classes traversed by the Project footprint (Table 4-3). These three landscape classes cumulatively covered 91% of the Project footprint. The majority of all proposed disturbance is temporary (estimated to be 97% or 1685.3 ha of all disturbance will be temporary; 3.8% or 67.7 ha will be permanent) (Table 4-4).

Detailed descriptions of each landform unit are provided in Appendix A (including representative photographs, landform, soils, drainage, related land systems, regional extent, area traversed by Project footprint and dominant vegetation associations).

Table 4-3. Habitat mapping summary of the Project footprint within the Northern Territory

Landscape Class		Disturbance Area (ha)			Grand Total
	Landform Unit				
	Bioregion	ROW	Access tracks	Other	
ALLUVIAL FLOODPLAINS		95.9	22.0	38.9	156.8
	Alluvial Plains	93.0	21.3	38.9	153.1
	Mitchell Grass Downs ¹	(61.6)	(12.8)	(28.6)	(103.0)
	Davenport / Tanami ²	(31.3)	(8.5)	(10.3)	(50.1)
	Drainage Systems (i.e. riparian area)	15.3	0.8	0.0	3.7
	Mitchell Grass Downs ¹	(2.9)	(0.8)	(0.0)	(3.7)
CLAY PLAINS		243.5	71.3	29.2	344.0
	Downs Plains	200.0	33.3	29.2	262.5
	Mitchell Grass Downs ¹	(200.0)	(33.3)	(29.2)	(262.5)
	Plains	35.9	37.4	0.0	73.2
	Mitchell Grass Downs ¹	(35.9)	(37.4)	(0.0)	(73.2)
	Inland Wetlands	7.7	0.6	0.0	8.3
	Mitchell Grass Downs ¹	(7.7)	(0.6)	(0.0)	(8.3)
	DESERT SANDPLAINS	459.8	40.1	41.6	541.5
	Plains	51.6	4.7	19.2	75.6
	Davenport / Tanami ²	(51.6)	(4.7)	(19.2)	(75.6)
	Sand plains	408.2	35.9	22.4	465.9
	Davenport / Tanami ²	(408.2)	(35.9)	(22.4)	(465.9)
LATERITIC PLAINS AND RISES		567.1	109.6	29.2	706.0
	Plains	451.5	88.0	20.1	559.6
	Mitchell Grass Downs ¹	(5.0)	(0.0)	(0.0)	(5.0)
	Davenport / Tanami ²	(446.5)	(88.0)	(20.1)	(554.6)
	Low Rises	115.0	21.0	9.2	145.1
	Mitchell Grass Downs ¹	(0.0)	(1.2)	(0.0)	(1.2)
	Davenport / Tanami ²	(115.0)	(19.7)	(9.2)	(143.9)
	Playas	0.6	0.7	0.0	1.3
	Davenport / Tanami ²	(0.6)	(0.7)	(0.0)	(1.3)
SANDSTONE PLAINS AND RISES		4.6	0.0	0.0	4.6
	Rises	4.6	0.0	0.0	4.6
	Davenport / Tanami ²	(4.6)	(0.0)	(0.0)	(4.6)
Grand Total		1371.0	243.0	139.0	1753.0

¹ Mitchell Grass Downs bioregion (IBRA v7) = Barkly Clay Plains (Land Type Region)

² Davenport / Murchison Ranges bioregion and Tanami bioregion (IBRA v7) = Tennant Creek Sandplains (Land Type Region)

Table 4-4. Habitat mapping Northern Territory – temporary and permanent disturbance area (ha)

Landscape Class		Disturbance Area (ha)		Grand Total
	Landform Class	Permanent	Temporary	
ALLUVIAL FLOODPLAINS		2.3	154.5	156.8
	<i>Alluvial Plains</i>	(2.3)	(106.3)	(108.5)
	<i>Drainage Systems</i>	(0.0)	(48.2)	(48.2)
CLAY PLAINS		7.4	336.6	344.0
	<i>Downs Plains</i>	(7.4)	(255.1)	(262.5)
	<i>Plains</i>	(0.0)	(73.2)	(73.2)
	<i>Inland Wetlands</i>	(0.0)	(8.3)	(8.3)
DESERT SANDPLAINS		30.1	511.5	541.6
	<i>Plains</i>	(20.4)	(55.2)	(75.6)
	<i>Sand plains</i>	(9.7)	(456.2)	(465.9)
LATERITIC PLAINS AND RISES		27.9	685.2	710.7
	<i>Plains</i>	(25.0)	(534.6)	(559.6)
	<i>Low Rises</i>	(3.0)	(142.1)	(145.1)
	<i>Playas</i>	(0.0)	(1.3)	(1.3)
SANDSTONE PLAINS AND RISES		0.0	4.6	4.6
	<i>Rises</i>	(0.0)	(4.6)	(4.6)
Grand Total		67.7	1685.3	1753.0

4.3.2 Queensland habitat mapping

Two bioregions are traversed by the Queensland section of the Project footprint (Figure 4-2) – Mount Isa Inlier (from KP 561 – KP 622) and Mitchell Grass Downs (from KP 353 – KP 561).

The Project footprint crosses six different land zone types (Table 4-5; Figure 4-2). Broadly, rocky areas and sandplains dominate the Mount Isa Inlier bioregion (Land Zones 4, 9, 11 and 12), with the exception of Land Zone 7 that occurs in higher proportions in the Mitchell Grass Downs bioregion (in the form of low rocky rises). Alluvial and clay plain habitats dominated the Mitchell Grass Downs bioregion (Land Zones 3 and 4).

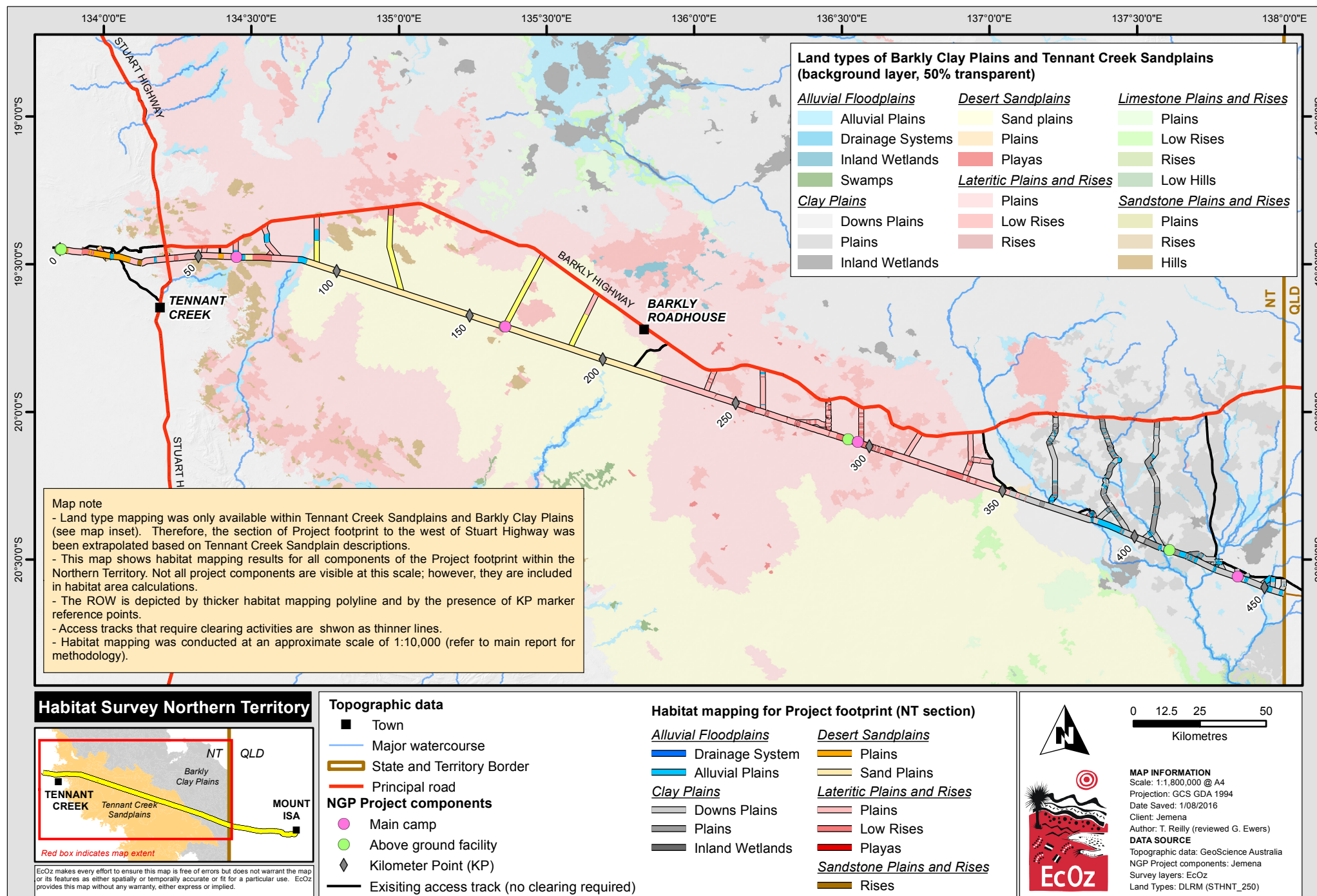
Detailed descriptions of each land zone are provided in Appendix B (including representative photographs, landform, soils, drainage, related land systems, regional extent, area traversed by Project footprint and dominant vegetation associations).

Table 4-5. Habitat mapping summary of the Project footprint within Queensland

Land Zone		Disturbance Area (ha)			Total (ha)
	Bioregion	ROW	Access	Other	
3	Alluvium (river and creek flats)	53.2	22.1	48.9	137.3
	<i>Mitchell Grass Downs</i>	34.4	11.4	23.2	69.1
	<i>Mount Isa Inlier</i>	18.8	10.7	25.7	55.2
4	Clay plains not associated with current alluvium	247.7	46.6	17.2	303.5
	<i>Mitchell Grass Downs</i>	246.5	44.6	9.2	300.4
	<i>Mount Isa Inlier</i>	1.1	2.0	0.0	3.1
5	Old loamy and sandy plains	88.2	45.3	20.2	153.7
	<i>Mitchell Grass Downs</i>	10.6	0.7	0.0	11.3
	<i>Mount Isa Inlier</i>	77.6	44.6	20.2	142.4
7	Ironstone jump-ups	26.7	1.1	0.0	27.9
	<i>Mitchell Grass Downs</i>	26.7	0.6	0.0	27.4
	<i>Mount Isa Inlier</i>	0.0	0.5	0.0	0.5
11	Hills and lowlands on metamorphic rocks	51.4	6.9	16.7	75.0
	<i>Mount Isa Inlier</i>	51.4	6.9	16.7	75.0
12	Hills and lowlands on granitic rock	27.8	4.9	0.0	32.7
	<i>Mount Isa Inlier</i>	27.8	4.9	0.0	32.7
Grand Total		495.0	127.0	95.0	717.0

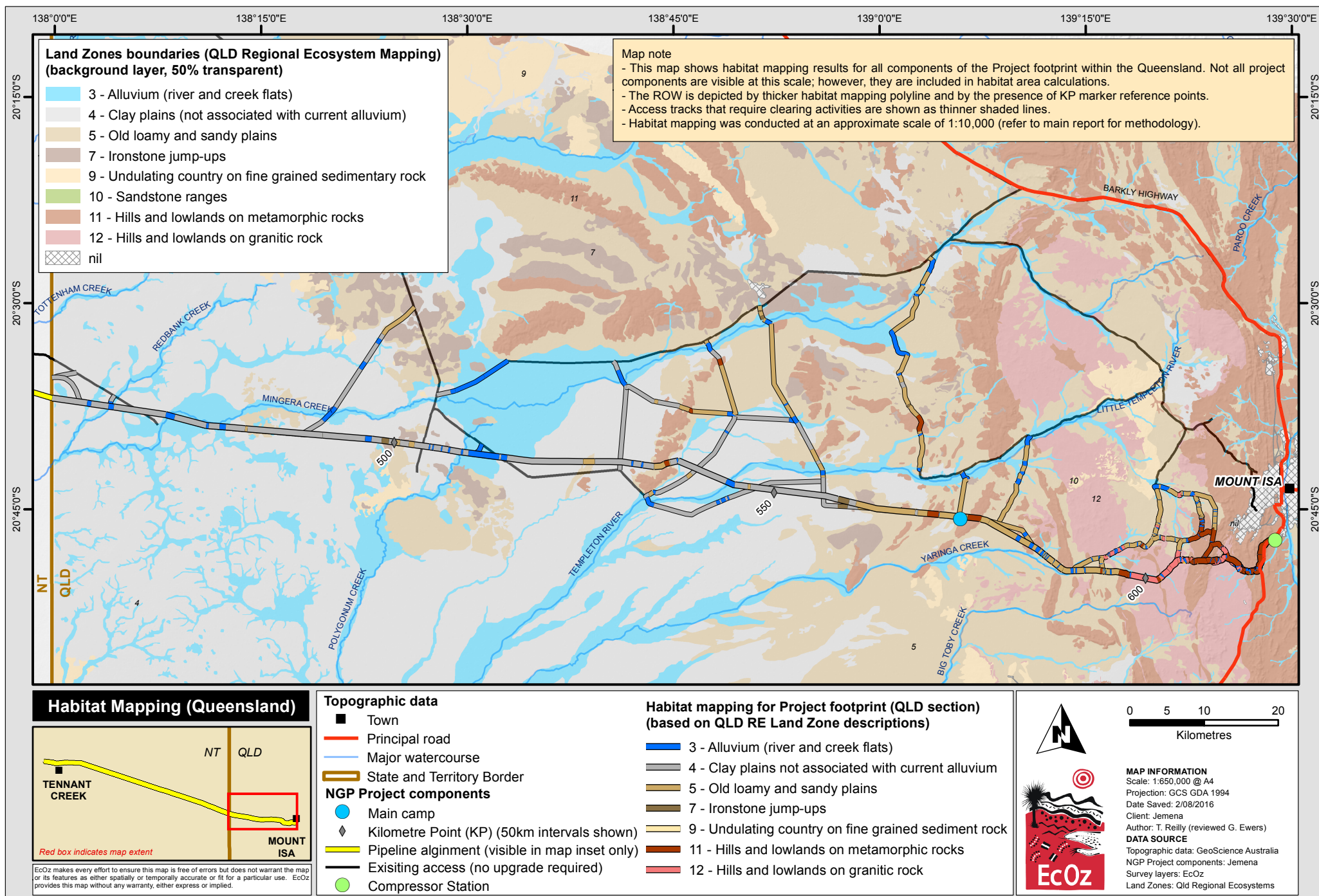
Table 4-6. Habitat mapping Queensland – temporary and permanent disturbance area (ha)

Land Zone		Disturbance Area (ha)		Grand Total
	Bioregion	Permanent	Temporary	
3	Alluvium (river and creek flats)	1.2	123.1	124.3
	<i>Mitchell Grass Downs</i>	1.2	67.9	74.0
	<i>Mount Isa Inlier</i>	0.0	55.2	63.3
4	Clay plains not associated with current alluvium	9.0	294.5	311.5
	<i>Mitchell Grass Downs</i>	9.0	291.4	300.4
	<i>Mount Isa Inlier</i>	0.0	3.1	3.1
5	Old loamy and sandy plains	13.2	140.5	153.7
	<i>Mitchell Grass Downs</i>	0.0	11.3	11.3
	<i>Mount Isa Inlier</i>	22.4	123.8	142.4
7	Ironstone jump-ups	0.0	27.9	27.9
	<i>Mitchell Grass Downs</i>	0.0	27.4	27.4
	<i>Mount Isa Inlier</i>	0.0	0.5	0.5
11	Hills and lowlands on metamorphic rocks	11.1	63.9	75.0
	<i>Mount Isa Inlier</i>	11.1	63.9	75.0
12	Hills and lowlands on granitic rock	0.0	32.7	32.7
	<i>Mount Isa Inlier</i>	0.0	32.7	32.7
Grand Total		34.5	682.7	717.1



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Figure 4-1. Map of habitat mapping survey of the Northern Territory section of the Project footprint



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Figure 4-2. Map of habitat mapping survey of the Queensland section of the Project footprint

5 THREATENED SPECIES SURVEYS

This chapter outlines the process to determine the likelihood of occurrence of Northern Territory and/or nationally listed threatened species occurring within the Project footprint. For each threatened species determined to have a High or Medium chance of occurrence, field surveys were undertaken. This chapter describes the methodologies to survey these species. Those methodologies are compared to existing survey guidelines and any divergences are justified. Survey results are then presented and discussed.

5.1 CONTEXT

The International Union for the Conservation of Nature nominates a set of criteria used to identify species at risk of extinction. These criteria are used to define categories of risk – see Figure 5-1 – which are used by the Northern Territory Government to determine which threatened species are listed under the *TPWC Act*, and by the Commonwealth Government to determine which threatened species are listed under the *EPBC Act*. This report focusses on species that are listed as Vulnerable, Endangered or Critically Endangered under the *TPWC Act*, the *EPBC Act*, or both.

Species that are only listed as threatened in Queensland are not discussed in this report, but will be addressed as part of the biodiversity assessments that will be undertaken later in 2016 as required under the pipeline Environmental Authority issued by the Queensland DEHP.

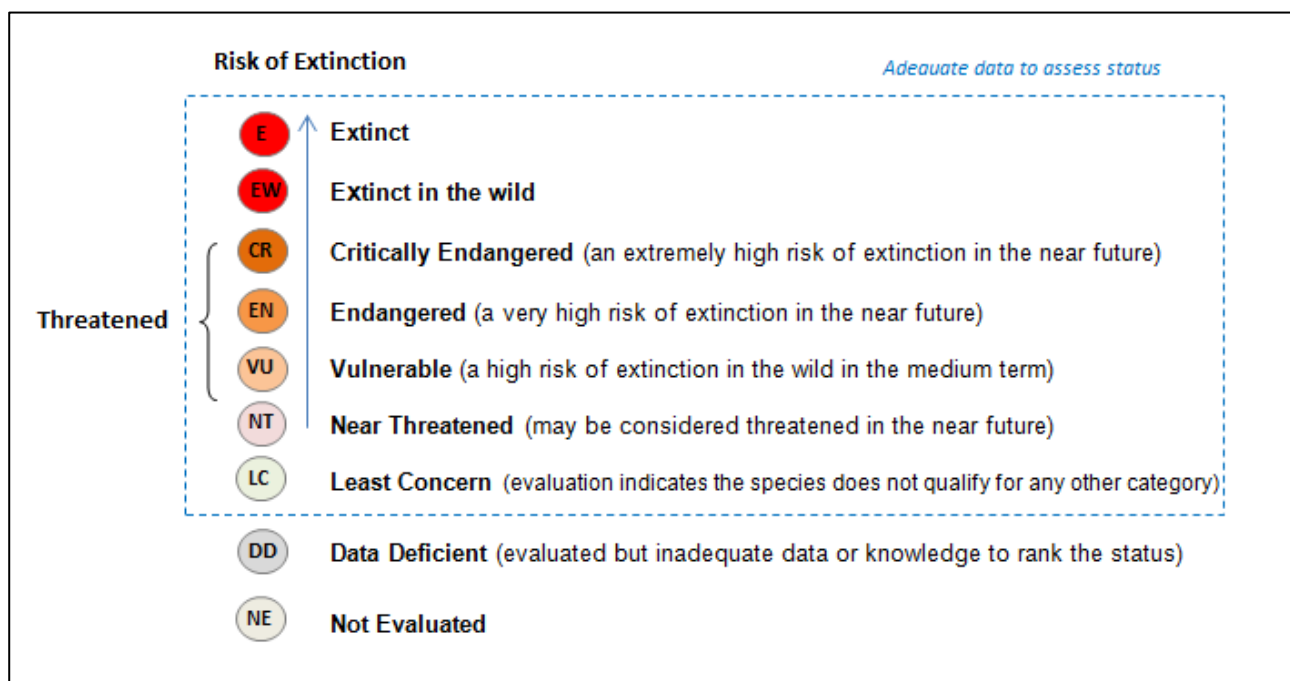


Figure 5-1. The IUCN red list categories of risk for threatened species

5.2 DESKTOP 'LIKELIHOOD OF OCCURRENCE' ASSESSMENT

5.2.1 Background

To determine which threatened species may occur within the Project footprint, a desktop analysis of threatened species databases was undertaken. This resulted in 22 threatened species (National and/or Northern Territory-listed) that have the potential to occur in the region of the Project footprint.

This section describes the process for determining which of these threatened species have a realistic chance of occurring within the Project footprint; these species were the focus of field studies (some targeted to detect presence/absence and some to quantify areas of suitable habitat within the Project footprint). The results of the field surveys are then used in Section 8.1 to determine which species are known to, or are likely to, occur within the Project footprint in an 'important population' (as defined in the *EPBC Significant Impact Guidelines 1.1* (DOE 2013)).

5.2.2 Procedure

Twenty-two threatened species (Commonwealth and/or Northern Territory-listed) that have the potential to occur in the region of the Project footprint. Records of these species within the region containing the Project footprint are depicted in Figure 5-2. For each of these, the likelihood that the species occurs within the Project footprint was assessed based on habitat requirements, distribution, and the number and dates of proximate records. The purpose of such an assessment was to identify those species that required further consideration, and those that can be reasonably excluded from further assessment because they are unlikely to occur within the Project footprint.

The following procedure was used to determine the occurrence likelihood of threatened species:

- 1) Identify potential habitat features within the Project footprint using available desktop information (i.e. land system mapping, existing vegetation mapping, aerial imagery, fire history etc.).
- 2) Search within a 50 km buffer of the pipeline alignment for
 - a. Matters of National Environmental Significance (MNES) using the Protected Matters Search Tool (most recently undertaken 9 May 2016) (Appendix C).
 - b. Northern Territory threatened species listed under the *Territory Parks and Wildlife Conservation Act* using the online tool *Northern Territory NRM Infonet* (Appendix D).
- 3) Collate the following details for each of those species – conservation status (Northern Territory and Commonwealth), habitat requirements, distribution and number of records within the search area.
- 4) Analyse the likelihood that each species will occur in the Project footprint by applying the following likelihood classifications:
 - a. HIGH – it is expected that this species will be within the Project footprint because of the presence of suitable habitat, and/or there are recent proximate records (i.e. post-2000).
 - b. MEDIUM – this species may occur within the Project footprint; however, there is evidence that lowers its likelihood of occurrence (i.e. lack of critical habitat, no recent records within the search area, habitat degradation etc.).
 - c. LOW – it is not expected that this species occurs within the Project footprint, as there is no suitable habitat for the species and/or current threats in the region are known to have significantly impacted the species.
 - d. NONE – there is strong evidence that this species will not occur within the Project footprint.

Note: For many threatened species, the Atlas of Living Australia provides 'likely' and 'possible' modelled expert distributions. These distributions are referred to throughout this document and mostly come from the Species of National Environmental Significance Database maintained by the Commonwealth Department of the Environment.

5.2.3 Assessment results

The results of the desktop 'likelihood of occurrence' assessment are presented in Table 5-1 and can be summarised as follows:

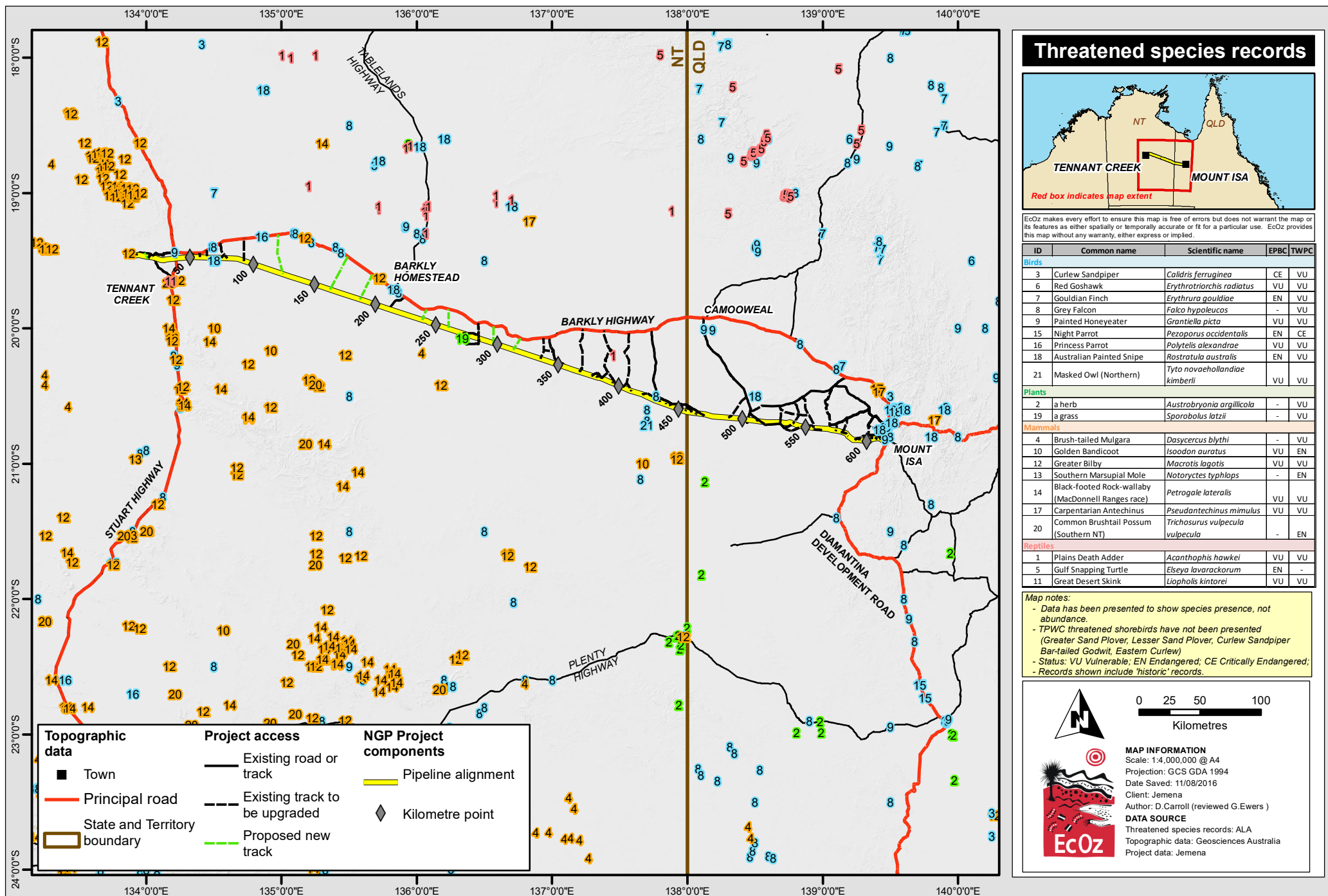
- Nine species were ranked as having a 'high' or 'medium' chance of occurring within the Project footprint. Therefore, these species were the focus of field studies (some targeted to detect presence/absence and some to quantify areas of suitable habitat within the Project footprint) and are discussed further in this report.
- Five species were ranked as having a 'low' chance of occurring within the Project footprint and so no specific surveys were carried out.
- Eight species were considered to not occur within the Project footprint as it does not support important habitat features for these species, or they are considered to be locally extirpated.

A meeting was held with the Flora and Fauna Division of the Department of Land Resource Management (DLRM) on the 8 March 2016 to ensure that these desktop results aligned with the concerns of the department.

Table 5-1. Desktop threatened species' likelihood of occurrence assessment

Likelihood	Common name	Scientific name	EPBC status	TPWC status
High	Carpentarian Antechinus*	<i>Pseudantechinus mimulus</i>	VU	VU
	Plains Death Adder	<i>Acanthophis hawkei</i>	VU	VU
	Tobermorey Melon #	<i>Austrobryonia argillicola</i>	-	VU
	Grey Falcon	<i>Falco hypoleucos</i>	-	VU
	Painted Honeyeater†	<i>Grantiella picta</i>	VU	VU
Medium	Gouldian Finch*	<i>Erythrura gouldiae</i>	EN	VU
	Latz's Grass #	<i>Sporobolus latzii</i>	-	VU
	Brush-tailed Mulgara	<i>Dasycercus blythi</i>	-	VU
	Greater Bilby**	<i>Macrotis lagotis</i>	VU	VU
Low	Red Goshawk	<i>Erythrotriorchis radiata</i>	VU	VU
	Australian Painted Snipe	<i>Rostratula australis</i>	EN	VU
	Curlew Sandpiper	<i>Calidris ferruginea</i>	CE	VU
	Black-footed Rock-wallaby (MacDonnell Ranges race)	<i>Petrogale lateralis</i>	VU	VU
	Night Parrot	<i>Pezoporus occidentalis</i>	EN	CE
	Princess Parrot	<i>Polytelis alexandrae</i>	VU	VU
None	Masked Owl (Northern)	<i>Tyto novaehollandiae kimberli</i>	VU	VU
	Southern Marsupial Mole	<i>Notoryctes typhlops</i>	-	EN
	Golden Bandicoot	<i>Isodon auratus</i>	VU	EN
	Common Brushtail Possum (Southern Northern Territory)	<i>Trichosurus vulpecula vulpecula</i>	-	EN
	Great Desert Skink	<i>Liopholis kintorei</i>	VU	VU
	Gulf Snapping Turtle	<i>Elseya lavarackorum</i>	EN	-
	Spencer's Land Snail	<i>Bothriembryon spenceri</i>	-	VU

† In Queensland only (likelihood is 'Low' in Northern Territory), * In Queensland only (likelihood is 'None' in Northern Territory), ** In Northern Territory only (likelihood is 'None' in Queensland); # not official common name for the species.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS\01 Project Files\Ch6\Figure 5-2. Map of threatened species records for the region surrounding Project footprint.mxd

Figure 5-2. Map of threatened species records for the region surrounding Project footprint

5.3 SPECIFICS

5.3.1 Personnel

The survey team consisted of experienced ecologists:

- **Tom Reilly** BSc – Natural Resource Management (Hons)

Tom led the Northern Territory survey which focussed on Greater Bilby, Brush-tailed Mulgara, *Sporobolus latzii* and *Austrobryonia argillicola*.

Tom has worked as an ecological consultant in Alice Springs and Darwin since 2002, leading numerous fauna surveys (general and targeting threatened species). In this time, he has gained survey expertise from the central deserts to the Top End. Tom has also undertaken a variety of targeted threatened flora surveys, general vegetation surveys and vegetation community mapping Projects (at a range of scales) throughout the Northern Territory, and is proficient at ArcGIS (ESRI).

Relevant to this Project, Tom has conducted targeted Greater Bilby and mulgara surveys within the Tanami Desert for Newmont Tanami Operations (Oberon), CLC/Newmont Regional Biodiversity Monitoring, ABM Resources (Old Pirate) and Ord River Resources (SuppleJack) – many of which were successful in identifying the presence of the species.

Tom is experienced in survey methodology design, and ensures that appropriate consultation with specialists within the government and private enterprises occurs for all Projects.

- **Mark Carter** Grad. Dip. Ecotourism & Wildlife Management; BSc / BE (Hons)

Mark accompanied Tom on the Northern Territory survey which focussed on Greater Bilby, Brush-tailed Mulgara, *Sporobolus latzii* and *Austrobryonia argillicola*.

Mark is a skilled arid zone fauna surveyor with widespread experience conducting targeted surveys for Greater Bilby. He has designed, led and authored reports on Greater Bilby surveys, including:

- Yulleroo Targeted Bilby Surveys 2012 and 2013 (for Buru Energy)
- McPhee Creek Targeted Bilby Survey 2013 (for Atlas Iron)
- Browns Range Targeted Bilby and Spectacled Hare-wallaby Tracking Survey 2013 (for Northern Minerals)

In addition to this direct field experience, Mark was employed as a zookeeper at the Alice Springs Desert Park between 2007 and 2011 where Greater Bilby was one of the key mammal species in his care. This gives Mark a strong understanding of the animal's anatomy, behaviour and biology, and extensive first-hand experience of the species field signs such as tracks and droppings.

- **Brett Taylor** BSc – Ecol. & Cons. Biol. (Hons)

Brett led the Queensland survey which focussed on Carpentarian Antechinus, Painted Honeyeater and Gouldian Finch.

Brett is a senior ecologist specialising with over nine years' field experience. He has carried out ecological surveys in a wide variety of habitats throughout Queensland. Brett was involved in the assessment of habitat and potential impacts on identified terrestrial ecological values associated with the proposed Copperstring powerline corridor Project (Townsville to Mount Isa) in northern Queensland. He carried out successful targeted surveys for conservation-significant species – including Carpentarian Antechinus – thereby expanding the known distribution for that species.

Advice on survey methodology was received from the following threatened species experts:

- **Associate Professor Sarah Legge**

Sarah was engaged to provide advice and comment on survey methodology and results for the Gouldian Finch survey program.

Sarah is a wildlife ecologist with over 20 years of research and conservation management experience. She is a Deputy Director of the Threatened Species Recovery Hub (part of the National Environmental Science Program), based out of the University of Queensland. She sits on a number of advisory groups, including the Commonwealth Government's Threatened Species Scientific Committee (since 2012), Birdlife Australia's Threatened Species Committee, and the National Feral Cat Taskforce. Previously, Sarah worked for the Australian Wildlife Conservancy, where she developed and led its Conservation and Science program for many years. One of the more substantial research Projects aimed to understand and adaptively manage key threats to seed-eating finch species of the northern savannahs, including the Gouldian Finch. The finch research (carried out in the Kimberley, Northern Territory and Queensland) led to several international publications and had profound implications for fire management regionally. Sarah has authored a book, over 90 peer-reviewed publications (in the fields of evolutionary ecology, wildlife ecology and threat management), and many dozens of technical reports and popular articles.

- **Dr Rick Southgate**

Richard was engaged to provide advice and comment on survey methodology and results for the Greater Bilby survey program.

Richard is a wildlife ecologist with over 30 years of research experience working with mammals in Australia's arid zone. Richard completed his doctorate investigating the suitability of habitat for the Greater Bilby in the Tanami region of central Australia. He has extensive experience developing and working with sign-based techniques to detect for and monitor wildlife, including Greater Bilby and Brush-tailed Mulgara. He has numerous publications detailing this work in peer reviewed scientific literature, technical reports and book chapters. Through his work, Richard has become the foremost expert in track-based monitoring of the Greater Bilby. Richard has held expert advisor roles for the Department of Environment regarding Greater Bilby habitat suitability and impact of clearance, and acted as expert advisor and peer reviewer to industry on Greater Bilby related projects.

Dr Catherine Nano (DLRM – Senior Scientist), Peter Jobson (Alice Springs Herbarium Curator), and Peter Latz (a freelance botany consultant who first identified *S. latzii*) for the two threatened plant species, and from Peter Macdonald (DLRM) for Greater Bilby.

5.3.2 Permits

All surveys were conducted under current Animal Ethics and Northern Territory Parks & Wildlife permits:

- Animal Ethics Project: A12005 '*Fauna Studies in the Northern Territory*'. Expires 17/02/2020.
- Animal Ethics Project: CA 2016/01/934. Expires 9/1/2019.
- Permit to Interfere with Protected Wildlife Northern Territory: 58158. Expires 1/4/2018.
- Scientific Purposes Permit (Queensland): WISP17062316. Expires 1/01/2020.

No permits are required for the flora surveys and vegetation mapping.

5.3.3 Nomenclature

Nomenclature and classification of flora species are taken from the *Checklist of Vascular Plants of the Northern Territory* (Short et al. 2011). Nomenclature and classification of fauna species use lists provided by the Northern Territory Government (<https://nt.gov.au/environment/animals/list-of-native-animals-in-nt>).

5.4 LATZ'S GRASS (*SPOROBOLUS LATZII*)

5.4.1 Conservation status

- Northern Territory: Vulnerable
- Queensland: Not Listed
- National: Not Listed

5.4.2 Background information

Description

Sporobolus latzii (referred to as Latz's Grass in this report) is a fairly robust, erect tufted perennial grass with flowering stems to almost 1 m high and leaves that are minutely roughened, flat and up to 16 cm long and 3.5 mm wide. Flowering has been observed in May.

Ecology

Latz's Grass is only known from one location, on clay soil at the edge of a seasonal swamp surrounded by Coolabah (*Eucalyptus coolabah*) (Albrecht et al. 2012). Associated flora species included *Cullen cinereum* and *Leptochloa fusca* (Albrecht et al. 2012). The seasonal swamp supported mature Coolabah (single trunks up to 7 m in height), which was a unique feature as many of the other swamps in the region had mallee-like (small multi-stemmed) Coolabah trees, indicating that wildfire is common throughout the region (Latz 2007). The swamp also had a higher diversity of flora species compared to other swamps in the region. Habitat observations of the swamp indicated that it has been subjected to a lower frequency of less intense fires, most probably due to the absence of dense hummock grasslands on its boundary. Instead, the swamp was bounded by low rocky (limestone) rises that were covered with small tussock grasses, which present a lower fuel-load than spinifex hummocks (Gibson et al. 1994; Latz 2007). Therefore, it is expected that Latz's Grass habitat requires a history of low level fire impact for the species to be present.

A description of the type locality is provided below (as per results listed for Site 27 in Gibson et al. 1994):

- **Landform** – claypan.
- **Description** – understorey of relatively dense *Enneapogon polyphyllus* (30%) and *Fimbristylis dichotoma* (25%) with a variety of perennial and annual grasses and herbs (10%). Upper storey primarily of low *Eucalyptus microtheca* (5%) with scattered *Eremophila latrobei* (1%).
- **Other flora species** (lower stratum only (<10% cover) as there were no other flora species recorded within the upper or mid strata).
 - Shrubs – *Sida platycalyx*, *Indigofera colutea*
 - Graminoids – *Aristida holathera*, *Aristida contorta*, *Aristida hygrometrica*, *Aristida inaequiglumis*, *Eragrostis eriopoda*, *Perotis rara*, *Dactyloctenium radulans*
 - Herbs – *Evolvulus alsinoides*, *Portulaca oleracea*, *Portulaca pilosa*, *Salsola kali*, *Ptilotus polystachyus*, *Cleome viscosa*, *Boerhavia coccinea*, *Boerhavia schomburgkiana*, *Heliotropium tenuifolium*, *Euphorbia drummondii*
 - Vine – *Bonamia media*

The type locality was also visited during aerial surveys undertaken during the reconnaissance survey in March 2016 (see Section 3 for an observation notes and representative photographs).

Distribution

Latz's Grass is endemic to the Northern Territory. It is only known from one site in the Wakaya Desert (Northern Territory) (recorded in 1993; Gibson et al. 1994), 4 km south of the construction ROW (near KP 273) – see Figure 5-5. Less than 200 individuals were found (Albrecht et al. 2012; pers. comm. P. Latz). Although Latz's Grass is considered to potentially occur in seasonal swamps throughout the Wakaya Desert (Albrecht et al. 2012), the 1993 survey included searches in approximately 40 swamps, none of which recorded other populations of the species (Albrecht et al. 2012). It is estimated that one-third to one-half of the potential swamps in the region were surveyed for the species during the 1993 surveys (pers. comm. P. Latz).

A return visit to the type locality in 2009 to target identification of the species (as part of the Wonarah Phosphate Project environmental approvals) did not record Latz's Grass as present (Low Ecological Services 2009), perhaps due to a broad-scale fire that occurred in 2007.

Threatening processes

According to Albrecht et al. (2012):

The Wakaya Desert experiences frequent, short-interval wildfire that may result in surface sand deposition into clay depressions, potentially making them unsuitable habitat for this species (see Latz 2007). In addition, competition from Buffel Grass (Cenchrus ciliaris) is a potential future threat as this species is becoming more common in Wakaya Desert just to the north of the Sporobolus latzii population (P. Latz pers. comm.).

5.4.3 Survey context

Purpose

If present within the Project footprint, Latz's Grass could be impacted by Project construction works – primarily by land clearing. The purpose of the survey was to identify whether this species occurs within 500 m of the Project footprint.

Overview

To achieve the abovementioned purpose, the survey was designed to:

- a) Identify locations containing potentially-suitable habitat using desktop mapping datasets.
- b) Visit those locations by helicopter to confirm whether they contain suitable habitat.
- c) If suitable habitat is present, undertake surveys for the species to determine presence/absence and extent.

5.4.4 Survey methodology

Existing survey guidelines

There are no species-specific guidelines for surveying Latz's Grass.

Survey design

Consultation with DLRM (Dr Catherine Nano – Senior Scientist), Alice Springs Herbarium (Peter Jobson – Alice Springs Herbarium Curator), and Peter Latz (botanist who first identified Latz's Grass) indicated that the survey methodology described below was sufficient in ensuring any previously undetected occurrences of Latz's Grass in proximity to the Project footprint would be identified.

Aerial footage of swamps within the region of the Project footprint was replayed to Peter Jobson and Peter Latz (footage recorded during the reconnaissance survey, described in Section 3). The footage included a

fly-over of the 'type locality' so surveyors could familiarise themselves with habitat features that occur at the only known location of Latz's Grass. Peter Jobson and Peter Latz advised particular areas where field surveys should be focused (i.e. on the swamp edges near unburnt Coolabah, 'likes' clay loam soils, typically not associated with sedges), and agreed that the small swamps within the Project footprint area were likely to only be marginally suitable for Latz's Grass. They advised that field surveys should prioritise swamps or depressions that support mature Coolabah trees.

Voucher specimens of Latz's Grass were photographed at the Alice Springs Herbarium (courtesy of Peter Jobson) to aid in field identification of the species.

Survey area and target habitat

Latz's Grass is only listed in the Northern Territory and its distribution is thought to be restricted to seasonal swamps in the Wakaya Desert. As there is no formal boundary of Wakaya Desert (Latz 2007; see approximate boundary in map inset of Figure 5-5), a conservative survey area has been applied for Latz's Grass to include any seasonal swamps encountered within 500 m of the following Project components (see Figure 5-5):

- Construction ROW between KP 200 to the edge of the Barkly Clay Plains (KP 350). This area was selected based on an initial review of aerial imagery which indicated that temporary swamps / playas are restricted to eastern area of Lateritic Plain and Rises.
- Proposed access roads within the region of KP 200 and KP 350.

Locations for Latz's Grass surveys sites were pre-selected prior to field surveys based on habitat advice from Peter Jobson and Peter Latz (see above), habitat mapping results of the Project footprint (see Section 4), review of aerial imagery (Google Earth Pro and ESRI Online Imagery) at a scale of 1:3,000, and observations made during the reconnaissance survey (see Section 3). This review resulted in the following:

- Habitat mapping in Section 4 identified that the Project footprint intersects one playa (i.e. seasonal claypan or swamp) at KP 242.
- No seasonal, Coolabah-fringed swamps of similar size to Latz's Grass type locality that are crossed, or are within 500 m, of the Project footprint (a description of the type locality is provided in Section 5.4.2 and photographs in Figure 3-2).
- Eight (potential) swamp / claypan are located within 500 m of the construction ROW.
- Numerous (potential) small depressions occur within 500 m of the construction ROW. These are considered to have low chance of habitat suitability and require field confirmation.
- Small depressions were not observed within 500 m of proposed access tracks.

Sites will be checked during field studies for either habitat suitability or presence of Latz's Grass (or both).

Habitat suitability assessment

The intent of habitat suitability surveys was to field-check pre-selected Latz's Grass sites (see above), and to search the Project footprint between KP 150 and KP 350 for any additional sites not detected during these activities.

Surveys for Latz's Grass were conducted on the 8 and 9 May 2016, and included aerial (helicopter) inspections of each site, and ground surveys of sites within 500 m of the Project footprint that were considered to be potentially-suitable for Latz's Grass. The following data attributes were collected:

- Photographs at high altitude (> 500 m) above ground)
- Photographs at low altitude to record habitat characteristics (15 m above ground)

- The edge of each swamp was flown at low altitude to inspect if it supported habitat features suitable for Latz's Grass, such as presence of mature Coolabah trees (or large trees in general) and evidence of low fire impact.
- General habitat description – landform, vegetation, dominant species. evidence of surface water
- Size of swamp (using GPS track log and aerial imagery)
- Surrounding landform and habitat type, particularly in relation to presence of spinifex-dominated hummock grasslands
- Evidence of cattle impact.

Targeted ground searches

Targeted ground searches for Latz's Grass were conducted on the 8 and 9 May 2016 at sites identified as potential habitat in the abovementioned habitat suitability assessment survey. Searches occurred at suitable swamps within 500 m of the Project footprint.

As per advice from Peter Jobson (Alice Springs Herbarium) and Peter Latz (consulting botanist), searches for Latz's Grass occurred along the clay-loam based soils that occur at the swamp edge. Survey effort was particularly focused where these soils were found at the base of (mature) Coolabah trees, or where many Coolabah were situated.

The following data were to be collected (at minimum) if a suspected identification of Latz's Grass occurred (which was not the case – see Section 5.4.5):

- Site geo-located
- Number of plants counted in the patch
- Size estimate of patch (walked with GPS with active track-log)
- Plant and micro-habitat photographed
- Vegetation description (detailed), particularly flora species in associated with *S. latzii*
- Assessment of fire history at the site
- Presence of weeds and native fire-promoting grasses
- Surface and sub-soil (to 250 mm) described and photographed
- Collection of a representative voucher specimen for verification by the Alice Springs Herbarium
- Description of surrounding habitat and fuel-load estimate (including photograph).

5.4.5 Results

Habitat suitability surveys

The Latz's Grass surveys field-checked eight (potential) seasonal swamps and inspected the numerous drainage depressions that were identified by desktop studies and/or the reconnaissance survey that may be suitable for Latz's Grass (Figure 5-5).

The findings are as follows:

- Aerial inspections of all pre-selected drainage depression sites concluded that these sites did not support habitat features typical of Latz's Grass, and that ground-searches for Latz's Grass was not required. These areas were small, indistinct, had no surface water evidence, and did not support Coolabah trees.

- Aerial inspections of the eight (potential) seasonal swamp sites identified the following:
 - Two of the nine (potential) seasonal swamps (sites SL2 and SL7) were re-defined as drainage depressions when observed during targeted aerial surveys (see Appendix F).
 - One of the nine (potential) seasonal swamps (SL6) was re-defined as a sinkhole when observed during targeted aerial surveys (see Appendix F).
 - Five of the nine (potential) seasonal swamps (SL3, SL4, SL5, SL8, and SL9) were identified as seasonal swamps / claypans. In all circumstances, Coolabah trees (*Eucalyptus microtheca* or *E. victrix*) were present, but often only in mallee-form (indicates history of high fire impacts). When larger trees were present (observed in low numbers at sites SL1, SL3, SL4, and SL9) they were often standing within the central parts of the swamp, therefore in a more fire-protected location.
- Habitat descriptions for the nine (potential) seasonal swamp sites are provided in Appendix F.
- Site SL5 was the only swamp within 500 m of the Project footprint that supported habitat features potentially-suitable for Latz's Grass (i.e. Coolabah trees were observed lining the swamp edge, although they were all reduced to mallee-form i.e. multi-stemmed shrubs – an indicator that they have experience repeated wildfire events over a long time-period) (see photographs in Figure 5-3 and Figure 5-4). Surface water was present within the central depression of the swamp, albeit a small pool with dimensions of ~ 5 x 5 m. A ground-based search for Latz's Grass was conducted at this site because of presence of habitat indicators and the potential risk of impact (if present) due to close proximity to construction ROW (described below).
- Most tussock grasses established along the edge of each swamp were flowering/seeding; grasses such as *Eulalia aurea*, *Aristida* sp., *Eragrostis* sp. were observed. No grasses with features similar to *Sporobolus* sp. were observed during these inspections (which was confirmed by several ground-based check-sites, described below).
- All swamps were surrounded by hummock grasslands with dense cover of Acacia shrubs and isolated trees (often *Corymbia opaca*).
- None of the swamps were surrounded by low rocky rise landform types, which is what occurs at the 'type locality' of Latz's Grass
- All swamps were small (ranging from 0.2 ha to 15.2 ha), and had a lower variety of micro-habitats compared to the 'type locality' (171.2 ha).
- No cattle impact was observed, which was expected as all swamps were within Aboriginal Land ('Wakaya Land Trust' and 'Arruwurra Aboriginal Corporation') (see Figure 2-12 for property boundaries).

On-ground searches

One swamp (SL5) required a ground-based targeted search for Latz's Grass. This was the only swamp that occurred within 500 m of the Project footprint that supported potentially-suitable habitat features (based on aerial assessment). Surveyors circumnavigated the edge of the swamp, and ran a search transect diagonally across the centre. The following lists the main findings from the survey:

- Latz's Grass was not observed.
- The clay loam swamp edge where 'mallee-like' Coolabah were established was overlain with approximately 100 mm of sandy red earth. Although the site has not burnt since 2011, these observations are typical of an area that has experienced a long history of fire impact, whereby fires open up the vegetation and winds transport, then deposit, sand (from the surrounding sand plain) into the claypan depressions.

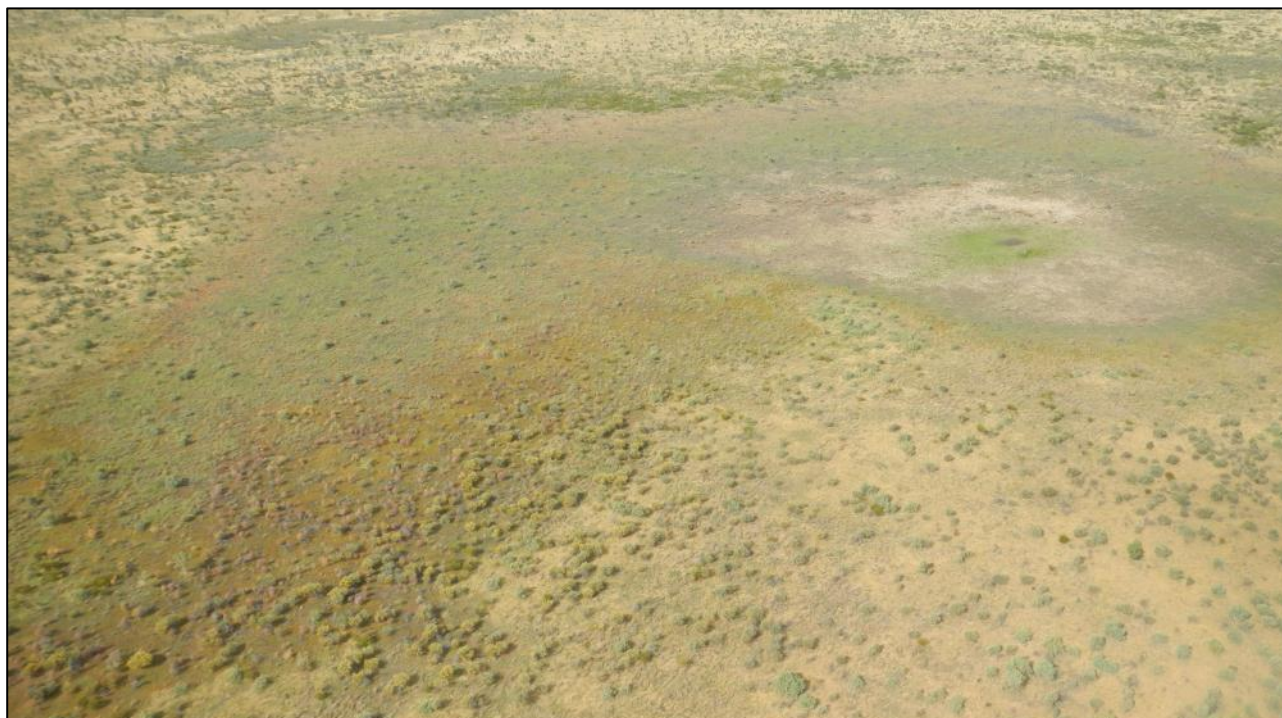
- The edge of the swamp was dominated by large tussocks of *Eulalia aurea*, which can cumulatively hold a high fuel-load when tussocks dry out and connect as a closed grassland.
- No Buffel Grass (*Cenchrus ciliaris*) was observed.
- The swamp was surrounded by desert sandplains that supported an Acacia shrubland with a spinifex-dominated grassland.
- The swamp is small compared with the type locality (15.2 ha compared to 171.2 ha), and does not present a similar variety of habitat features (see Section 3 for description and photographs of 'type locality').

5.4.6 Discussion

The survey did not identify Latz's Grass or suitable habitat within, or immediately surrounding, the Project footprint. Based on survey evidence, it is assumed that Latz's Grass is absent from the Project footprint.

Five swamps were found near the Project footprint. All were shallow and small (ranging from 0.2 ha to 15.2 ha), and considered to be in poor condition (in regards to Latz's Grass habitat requirements) when compared to the 'type locality'. None supported tall, single-stemmed, Coolabah trees. The Latz's Grass 'type locality' is comparably large (171.2 ha) and contains a complex surface hydrological pattern which likely provides fire-protection, additional to the surrounding low rocky rises that support a low fuel-load tussock grassland (Gibson et al. 1993; Latz 2007) (see Section 3 for description and photographs of 'type locality').

One swamp (SL5) was located within 500 m of the construction ROW (within the Latz's Grass survey area) (KP 273). However, on-ground searches for Latz's Grass at the site did not find the species. A habitat assessment indicated it is unlikely that Latz's Grass persists at the site due evidence of long-term fire impact (i.e. presence of red sandy loam over-topping clay soils, and mallee-like Coolabah). Repeated fire events are considered a major threat to the species (see threatening processes in Section 5.4.2). NAFI fire scar mapping indicates the swamp has burnt three times in the last 15 years (2011 most recent burn), which is a high fire frequency for the region.

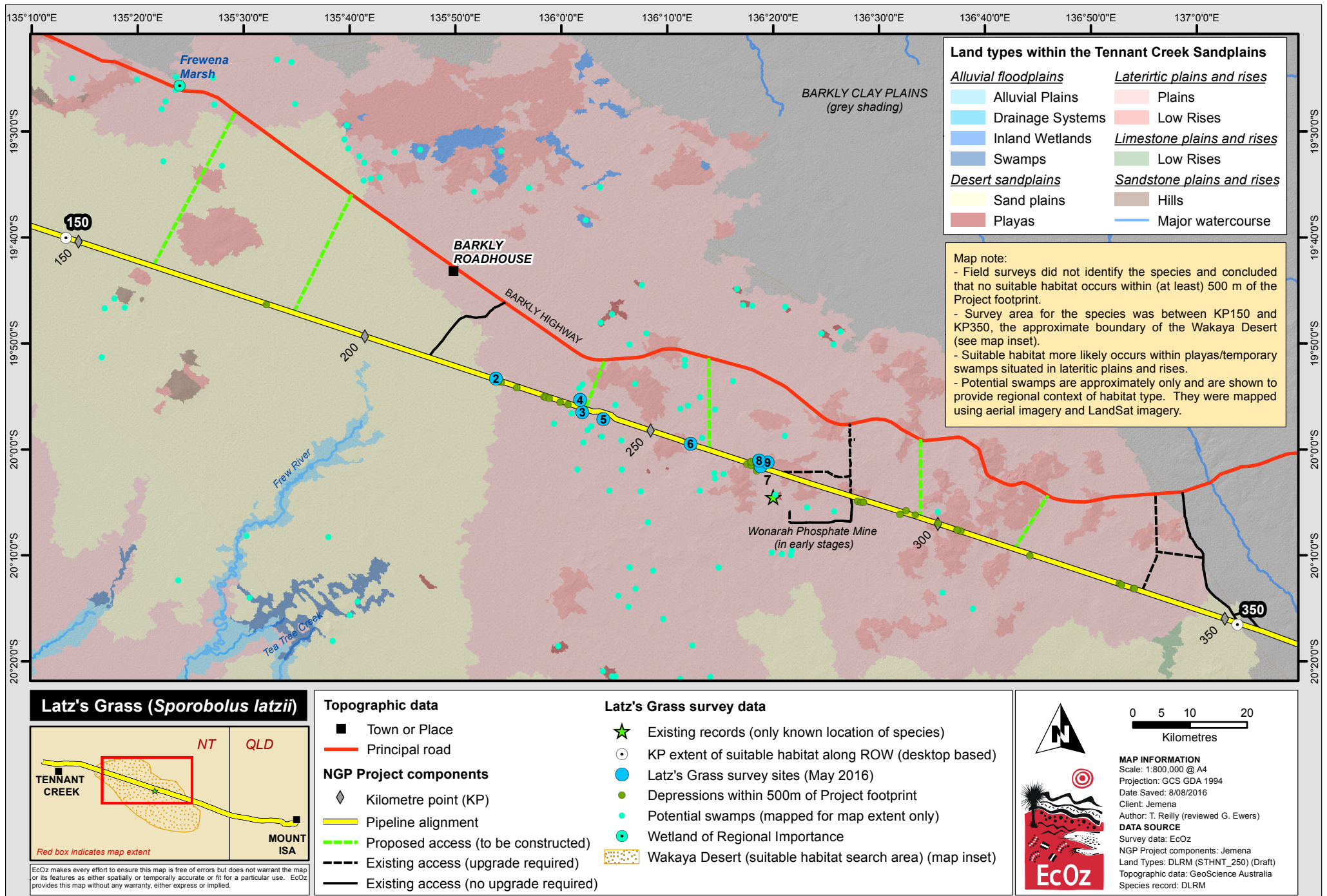


Site SL5: Easterly view. Construction ROW crosses within 500 m of the swamp edge (which is the left side of photograph, north side of temporary swamp). Note absence of large Coolabah trees.

Figure 5-3. Photograph (aerial) of the Latz's Grass site SL5



Figure 5-4. Photographs (on-ground) of the Latz's Grass site SL5



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Figure 5-5. Map of Latz's Grass survey results

5.5 TOBERMOREY MELON (*AUSTROBRYONIA ARGILLICOLA*)

5.5.1 Conservation status

- Northern Territory: Vulnerable
- Queensland: Least Concern
- National: Not Listed

Tobermorey Melon (*Austrobryonia argillicola*) was previously listed as Endangered under the *EPBC Act*. In 2010, the Commonwealth Threatened Species Scientific Committee determined that this species was eligible for delisting due to recent information that better defines its taxonomic status, and consequently establishes a much larger known range and number of populations. Furthermore, the TSSC stated that there are no listed threatening factors known to affect this species. Tobermorey Melon was subsequently de-listed as an *EPBC*-listed threatened species in December 2013.

5.5.2 Background information

Description

Tobermorey Melon is a prostrate herb with a thickened, perennial rootstock and annual stems to 1 m long (Nano et al. 2012). The leaves have a heart-shaped base and serrated edges. The pale yellow flowers (1.3 – 1.8 mm long) are often solitary. The fruits are 25 mm in diameter, and are smooth and pale yellow-green with darker stripes.

Ecology

Tobermorey Melon occurs along creeks and poorly-drained areas, mainly Mitchell Grass Downs on cracking clays (dominated by *Astrebla* spp.) (Schaefer et al. 2008). It is most abundant in seasonal swamps, clay pans and run-on areas. It has been recorded from Bluebush (*Maireana* spp.) swamps, Gidgee (*Acacia cambagei*) shrubland and riparian woodlands dominated by River Red Gum (*Eucalyptus camaldulensis*) (Nano et al. 2012).

This species exhibits natural fluctuations and more individuals are likely to be recorded following the wet season (Queensland Herbarium 2009) because the above-ground parts are seasonal or dependent on weather conditions (Schaefer et al. 2008). According to Nano et al. (2012), this species has been observed flowering in March, May, July and October. Schaefer et al. (2008) describe flowering and fruiting as occurring from February – July.

Distribution

Tobermorey Melon is endemic to central-western Queensland, extending to the adjoining Barkly Tableland in the Northern Territory (Schaefer et al. 2008). In Queensland, this species occurs in numerous locations south of the Project footprint (see map inset in Figure 5-8). In the Northern Territory, this species is currently known from six locations (according to records held within DLRM Fauna Atlas and Atlas of Living Australia) (see Figure 5-8 for the full extent of Tobermorey Melon records):

- Four located adjacent to the Northern Territory/Queensland border (near the Plenty Hwy ~200 km south of Project footprint).
- One located near Corella Lake (~200 km north of Project footprint).
- One located on a tributary of Ranken River approximately 15 km north of KP 356. This record is from 2001 and was at a location called Dingo Hole (see Figure 5-8).

The *Commonwealth Listing Advice on Austrobryonia argillicola* (TSSC 2013) states that this species has an extent of occurrence of 800 000 km² and an unknown area of occupancy. In 2006, Kerrigan and Albrecht estimated that, in the Northern Territory, Tobermorey Melon has an area of occupancy of 20 km²; however,

this was before additional records were found and also seems low because the then known population extent only just overlapped into the Northern Territory (see Figure 5-8).

TSSC (2013) asserts that although this species' known distribution is fragmented, this non-continuous distribution may be an artefact of limited collection effort (Kerrigan & Albrecht 2006). This has been re-affirmed during recent discussions with the Northern Territory Herbarium (Peter Jobson pers. comm. 2016). As such, Tobermorey Melon may be a candidate for de-listing as a threatened species in the Northern Territory to align with the current National listing.

Threatening processes

The preferred habitat of this species is favoured by livestock and feral animals. Pastoral and infrastructure (e.g. road and seismic lines) developments in Tobermorey Melon habitat could have a negative impact on this species (Nano et al. 2012); however, there is no supporting evidence of this to date.

5.5.3 Survey context

Purpose

If present, Tobermorey Melon could be impacted by Project construction works – primarily by land clearing within watercourse crossing in the Mitchell Grass Downs bioregion.

The purpose of the survey for Tobermorey Melon was to identify whether this species occurs within the Northern Territory section of the Project footprint.

Overview

To achieve the abovementioned purpose, the survey was designed to:

- a) Identify locations containing potentially-suitable habitat using desktop mapping datasets.
- b) Visit those locations by helicopter to confirm whether they contain suitable habitat.
- c) If suitable habitat is present, undertake surveys for the species to determine presence/absence and extent.

5.5.4 Survey methodology

Existing survey guidelines

There are no species-specific guidelines applicable to surveying Tobermorey Melon. This species exhibits natural fluctuations and more individuals are likely to be recorded following wet seasons (Queensland Herbarium 2009).

Survey design

Consultation with DLRM and Northern Territory Herbarium (Peter Jobson – Alice Springs Herbarium Curator) indicated that the survey methodology described below was sufficient in ensuring any previously undetected locations of Tobermorey Melon proximate to the Project footprint would be identified.

Voucher specimens of Tobermorey Melon (and *Cucumis maderaspatanus*, which is a species commonly confused with Tobermorey Melon) were photographed at the Alice Springs Herbarium (courtesy of Peter Jobson) to aid in field identification of the species.

Aerial footage recorded during the reconnaissance survey (described in Section 3) was shown to Peter Jobson, who noted there is a high chance that the species will be detected within river/creek banks, river/creek flood-outs, and minor drainage channels that are intersected by the Project footprint.

Survey area and target habitat

The survey area for Tobermorey Melon included the following components of the Project footprint (see Figure 5-8):

- Construction ROW between KP 355 (western edge of Mitchell Grass Downs bioregion) to KP 457 (Northern Territory / Queensland border).
- Three proposed access roads within the Mitchell Grass Downs bioregion (all following existing roads or fence lines, and therefore requiring widening and upgrade).

Target habitat types for Tobermorey Melon are drainages, creek and river banks, or run-on areas (such as depressions, swamps, or claypans). Preliminary analysis of potentially suitable habitat for Tobermorey Melon within the Project footprint was determined by referring to habitat mapping results (see Section 4), review of aerial imagery (Google Earth Pro and ESRI Online Imagery) at a scale of 1:3,000, and observations made during the reconnaissance survey (see Section 3). This review resulted in the following:

- Rivers and creeks. Tobermorey Melon may occur on the clay soils on bank crests and adjacent flood-out zones, but is not expected to occur within the riverbed or bank slopes. Preliminary review indicated the construction ROW intersects three rivers and one creek.
- Drainage lines. Tobermorey Melon may occur on the clay soils within or directly adjacent to the drainage. Preliminary review indicated the construction ROW intersects 11 drainage lines.
- Three access tracks (combined length of 108.6 km) intersect numerous creeks and drainages that may support suitable habitat for the species. Preliminary review indicated that access tracks intersect at least 49 watercourses (mostly small drainages).

The surrounding Mitchell Grass (*Astrebla* sp.) 'clay plains' may also support Tobermorey Melon; however, as this area is extensive across the Project footprint and the region, it is not a focus habitat of this survey. Drainage features are considered to be a better indicator of species presence within the Project footprint.

Construction ROW survey

A survey site was selected at each watercourse or drainage that was intersected by the construction ROW (15 sites were identified during preliminary review of habitat, see above, field assessment may record additional sites) (Figure 5-8). All sites were aerially surveyed for habitat suitability, and a ground survey was conducted at a selection of sites to provide a spatial representation across the survey area (noting that a ground inspection occurred at all rivers, creeks, and larger drainages).

Aerial surveys occurred at all sites and included the following data attributes:

- Representative aerial photograph(s)
- General habitat description – landform, vegetation type, dominant species and evidence of surface water
- Existing disturbances at site.

Tobermorey Melon ground-searches were undertaken by two surveyors over an approximate area of 2 ha for each site. Searches occurred up and down gradient of the watercourse / drainage. The following data was collected (at minimum) if a suspected identification of Tobermorey Melon occurred:

- Site geo-located
- Number of plants counted in the patch
- Estimate of patch size (walked with GPS with active track-log)
- Plant and micro-habitat photographed
- Vegetation description, particularly flora species in associated with Tobermorey Melon
- Cattle impact
- Collection of a representative voucher specimen for verification by the Alice Springs Herbarium.

Access track survey

Aerial-based habitat surveys were conducted along three proposed access tracks and targeted crossing points of rivers, creeks, drainages, and depressions (preliminary habitat assessment identified that access tracks intersect at least 49 sites that support suitable habitat for the species, see above). The survey included collection of representative habitat photograph(s), landform description, and assessment of general habitat suitability for Tobermorey Melon. No ground surveys were conducted due to all sites being located within current tracks or fence lines (therefore impact to the species was considered as low).

5.5.5 Results

Construction ROW surveys

Eighteen sites were surveyed along the construction ROW – 3 depressions, 8 drainages, 1 creek bank and 3 river bank (noting that all 15 desktop-selected sites were surveyed, plus three additional sites for which suitable habitat was noted once in the field). Site descriptions are provided in Appendix G and representative habitat photos are provided in Figure 5-7.

The main findings from the survey are:

- Tobermorey Melon was identified at seven sites along the construction ROW (sites AA2, 3, 8, 10, 13, 16 and 17) (see Figure 5-8). In all circumstances, Tobermorey Melon was present in low densities on clays soils (some cracking clay soils), and often foliage was senesced but large fruit was prominent and conspicuous. Voucher specimens were confirmed to be Tobermorey Melon by Peter Jobson at the Alice Springs Herbarium. Representative photographs are provided in Figure 5-6.
- Tobermorey Melon was also identified at Austral Downs airstrip (adjacent Georgina River).
- A moderate to high level of pastoral impact was observed at 17 of the 18 sites (i.e. grazing and trampling). One site (AA17) showed low grazing pressure from cattle.

Access track surveys

Forty-nine sites crossed by access tracks that could support potential habitat for Tobermorey Melon were surveyed. Site descriptions are provided in Appendix H.

The main findings from the survey are:

- Suitable habitat for Tobermorey Melon is common among the three proposed access tracks, with 28 drainages, 7 claypans, 6 creeks, and 8 depressions.
- No rivers were crossed by access tracks.
- All sites have been previously cleared for fence lines, firebreaks, or station access tracks.
- Evidence of cattle grazing and trampling was present at each site.

Table 5-2. Tobermorey Melon sites surveyed along the construction ROW

Sites	Easting	Northing	Survey type	Landform	Local catchment	Species present?
1	744536	7746241	Ground	Minor drainage	Ranken River	No
2	744697	7746414	Ground	River bank	Ranken River	Yes
3*	745240	7746342	Ground	Drainage	Ranken River	Yes
4	748073	7745292	Ground	Drainage	Ranken River	No
5	749580	7744679	Ground	Minor drainage	Ranken River	No
6	754865	7742228	Aerial	Drainage	Ranken River	No
7	756000	7741656	Aerial	Minor drainage	Ranken River	No
8*	762995	7738432	Ground	Depression	James River	Yes
9	769237	7735518	Ground	River bank	James River	No
10	770466	7735156	Ground	Drainage	James River	Yes
11	775894	7733150	Ground	Drainage	James River	No
12	776609	7732877	Aerial	Drainage	James River	No
13	781697	7730486	Ground	Drainage	Georgina River	Yes
14*	784345	7729073	Aerial	Depression	Georgina River	No
15	788224	7727075	Ground	River bank	Georgina River	No
16	799314	7722781	Ground	Drainage	Bluebush Creek	Yes
17	806661	7719502	Ground	Creek bank	Bluebush Creek	Yes
18	807792	7719105	Aerial	Depression	Bluebush Creek	No

* Site not identified by desktop studies or reconnaissance surveys, but instead detected during field surveys.



Figure 5-6. Photographs of Tobermorey Melon taken during field survey



Figure 5-7. Photographs of suitable habitat for Tobermorey Melon

5.5.6 Discussion

Tobermorey Melon as recorded at 58% of ground survey locations (7 of the 12 sites) along the construction ROW, and was incidentally recorded at the Austral Downs airstrip (during helicopter refueling). The species was observed within drainages, depressions and on the upper banks of creeks or rivers. In all circumstances, there was a low number of plants within the 2 ha search area, with 1 to 3 plants being observed at each site. Most plants had senesced foliage; however, the large round-to-oblong fruit was prominent and relatively conspicuous. Records from the survey were spread across four surface water sub-catchments of the Ranken River, James River, Georgina River, and Blue Bush Creek. This suggests that the species is likely to be widespread in drainage habitat within the region, but occurs in low densities at each location.

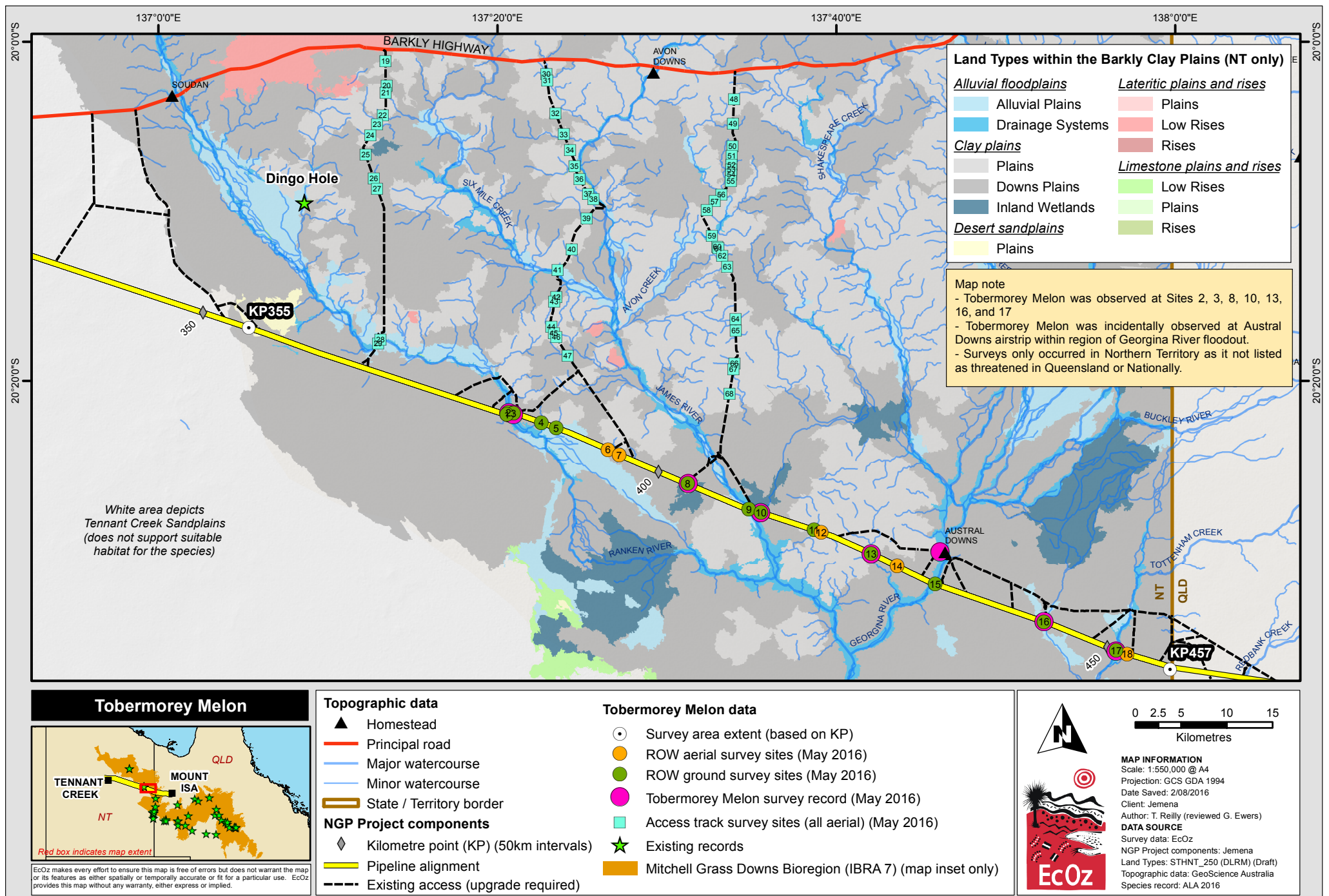
The survey indicated that suitable habitat for Tobermorey Melon is intersected by the construction ROW (at least 18 times) and three proposed access tracks (at least 49 times). Habitat types of particular importance to Tobermorey Melon are:

- a) The upper banks and floodouts of large rivers and creeks
- b) Small creeks and drainage
- c) Seasonally-inundated depressions.

It is also possible the species occurs in low numbers within the extensive clay plains which were not surveyed (pers. comm. Peter Jobson 2016).

As expected, high degrees of pastoral impacts occurred throughout the entire area defined as suitable habitat for Tobermorey Melon, with the exception of one site (AA18 – a creek) that showed low level pastoral impacts. The dominance of pastoralism may be a reason for the scarcity of Tobermorey Melon detected during the surveys; however, current publications only speculate pastoralism as a potential threatening process for the species.

Suitable habitat was common along the three proposed access tracks situated within the Tobermorey Melon survey extent (all 39 sites were considered to be suitable habitat). Ground-searches did not occur at these sites; consequently, the presence or absence of Tobermorey Melon along access tracks cannot be documented. Note that these access tracks occur all along existing linear disturbances, such as fence lines or station tracks, that will require a 5 m maximum widening. Therefore, survey priority was focused on the construction ROW as no existing linear disturbance exists.



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Figure 5-8. Map of Tobermorey Melon habitat assessment and field survey

5.6 PLAINS DEATH ADDER (*ACANTHOPHIS HAWKEI*)

5.6.1 Conservation status

- Northern Territory: Vulnerable
- Queensland: Not Listed
- National: Vulnerable

5.6.2 Background information

Description

The Plains Death Adder has a short, stout body, with a head that is triangular and distinct from the neck. The species' coloration varies but usually has wide, lighter bands across the body. The end of its tail tapers rapidly – becoming thin and worm-like – and is used to lure prey within striking distance (Hagman et al. 2008). Adults grow to a maximum length of approximately 1.2 m (Wells and Wellington 1985).

Ecology

This species occurs on floodplains and cracking soil plains (Webb et al. 2002).

According to Ward and Phillips (2012):

During the Wet season, individuals move every three to ten days, in apparently random directions, distances ranging from a few metres to a kilometre (Phillips and Webb, unpub. data). When it floods, they simply float in debris or rest on emergent vegetation. During the Dry season, movement is less frequent and they often retreat into deep soil cracks. Radio-tracking suggests that they are nomadic and do not have definable home ranges.

Plains Death Adder generally breeds from October to November, and produces live young from February to March (TSSC 2012).

Distribution

The exact distribution of Plains Death Adder is unclear. Based upon field experience and encounter rates across its range, the species can be locally common (in the absence of Cane Toads) on the highly productive floodplains of northern Australian rivers. On the Barkly Tableland and Mitchell Grass Downs (where the NGP Project is located), however, the species is less-commonly encountered and can probably be considered scarce in this habitat (TSSC 2012).

There is only one record (from 1978) south of the Barkly Highway (and approximately 22 km north of the construction ROW) in the Northern Territory (see Figure 5-11). There are, however, many records in similar habitat to the north of the Barkly Highway.

According to TSSC (2012), the Plains Death Adder extent of occurrence is estimated to be approximately 720,000 km² and its area of occupancy is estimated to be approximately 233,480 km².

Threatening processes

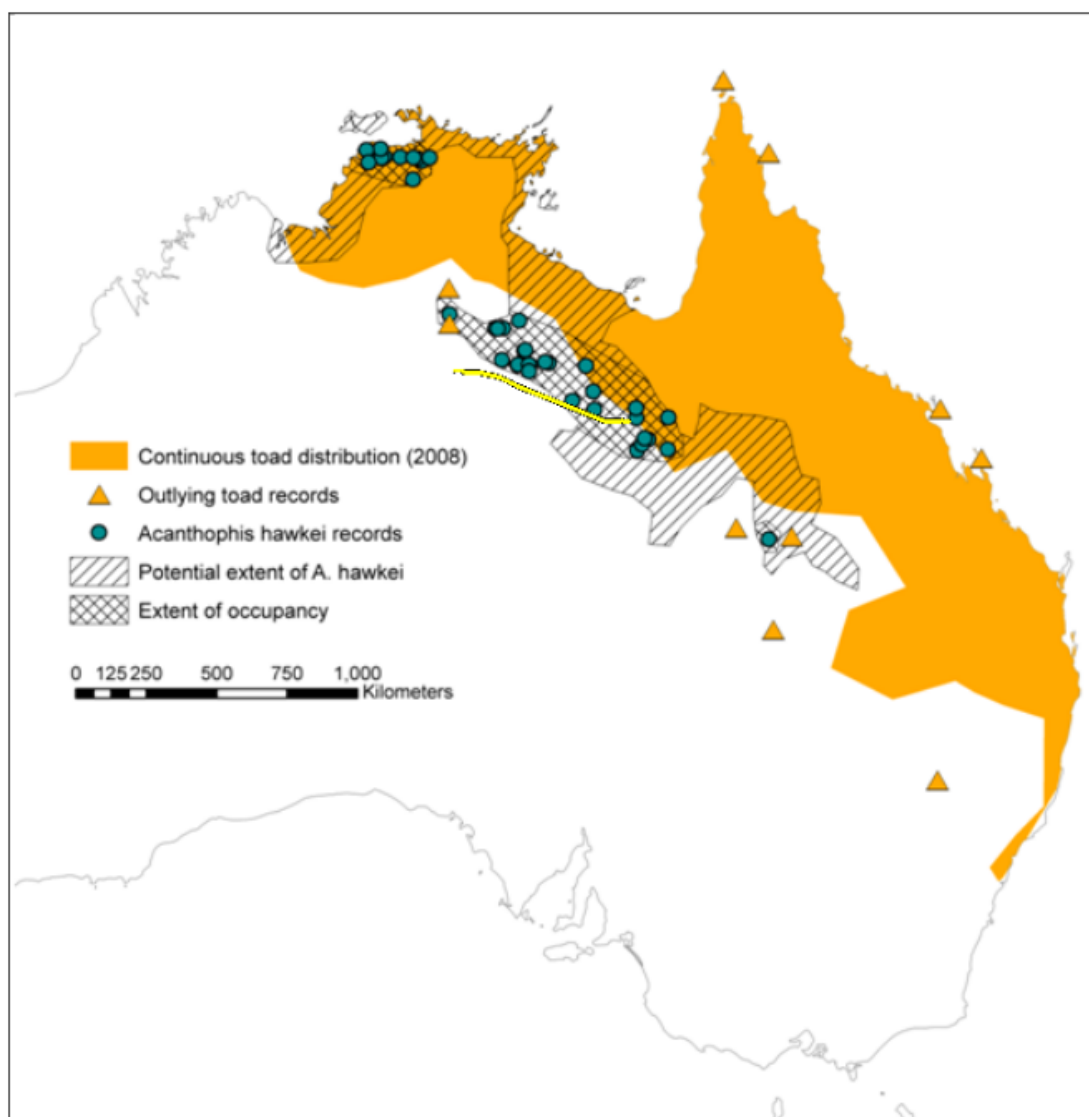
According to TSSC (2012):

The main identified threat to the Plains Death Adder is the introduced Cane Toad. The Plains Death Adder is an ambush forager and has a specialised foraging tactic of luring prey by waving the tip of its tail. Native frogs make up a large proportion of the species' diet (Webb et al. 2005). The Cane Toad responds more strongly to this lure than native prey species and Cane Toads are more likely to elicit luring from Plains Death Adders than native prey (Hagman et al. 2008). The species does not appear to have the ability to discriminate between Cane Toads and native frogs (Hagman et al. 2008, 2009). The toxins in Cane

Toads' skin typically cause death in the Plains Death Adder and individuals have been known to die in large numbers when Cane Toads arrive in an area (Hagman et al. 2008, 2009; Phillips et al. 2010).

Cane Toads are spreading across northern Australia at a rate of approximately 40 – 100 km per year (Phillips et al. 2007, Urban et al. 2008) and are slowly encompassing the geographic distribution of the Plains Death Adder. It has been predicted that by 2030 Cane Toads will have encompassed almost all of the species' range (Phillips et al. 2003) [see Figure 5-9]. It is possible that the range of the Cane Toad will not completely overlap that of the Plains Death Adder in the south, as the drier conditions would potentially restrict the Cane Toads' spread. However, outlying Cane Toad records suggest that these southern populations already experience Cane Toads, at least sporadically (Phillips et al. 2008).

Other potential threats to the Plains Death Adder identified by TSSC (2012) are habitat modification due to over-grazing by cattle and inappropriate fire regimes.



Construction ROW depicted by yellow line

Figure 5-9. Map of extent of occurrence and area of occupancy for Plains Death Adder, superimposed on 2008 distribution of Cane Toad (from TSSC 2012)

5.6.3 Survey context

The Project footprint intersects suitable habitat for the Plains Death Adder. If present, this species could be impacted by Project construction works – particularly land-clearing and trenching.

Consultation with DLRM indicated the likelihood of detecting the species during field surveys would be very low. Therefore, no targeted surveys for Plains Death Adder were undertaken. Instead, an identification of the extent of suitable habitat for this species within the Project footprint was determined using desktop mapping datasets.

5.6.4 Survey methodology

There are no species-specific guidelines applicable to surveying the Plains Death Adder. The Commonwealth *Threatened Reptiles Survey Guidelines* (DSEWPaC 2011d) do not refer to this species.

TSSC (2012) gives some advice on surveying for this species:

Within its habitat, this species is well camouflaged. It conceals itself in the substrate when in an ambush position and does not startle when approached. As such, the only reliable way of detecting individuals is to drive slowly on roads that cross or run close to suitable habitat for the species. Survey efforts need to be large, particularly in populations that have been invaded by cane toads, where detection rates can be as low as one individual per 30 – 60 hours of surveying.

Potential habitat for Plains Death Adder within the Project footprint is considered to be confined to the cracking clay soils within Mitchell Grass Downs bioregion. This habitat occurs in Northern Territory and Queensland and includes the following project components:

- Construction ROW between KP 355 and KP 561 (206 km),
- Three proposed access tracks (approximately 109 km) (all following existing roads or fence lines, and therefore requiring widening and upgrade). (Figure 5-9).

As mentioned in Section 5.6.3, consultation with DLRM indicated the likelihood of detecting the species during field surveys would be very low. As such, the recommended survey effort for determining presence/absence of Plains Death Adder within the Project footprint is not commensurate with the low risk that the Project activities will negatively impact upon this species. Therefore, surveying was limited to habitat mapping (at a scale of 1:10,000, see Section 4) to identify the location and extent of potentially-suitable habitat for Plains Death Adder within the Project footprint in both the Northern Territory and Queensland (because this species is listed under both Northern Territory and Commonwealth legislation).

5.6.5 Results and discussion

Whilst there are no existing records of Plains Death Adder within the Project footprint, there is a Northern Territory record (from 1978) from the area between the Barkly Highway and the construction ROW (Figure 5-11). There are also many other records north of the Barkly Highway that are situated in similar habitat to that which occurs within the Project footprint (Figure 5-11).

Land System mapping (scale of 1:250,000; Christian et al. 1954) was used to broadly assess the occurrence of Plains Death Adder in the region, as this dataset is standardised across Northern Territory and Queensland. The potential Plains Death Adder habitat within the Project footprint comprises five land systems (four of which are black soil clay plains), as shown in Figure 5-11. When the full extent of those land systems is examined, it can be seen that there are at 19 database records of Plains Death Adder – of which 16 are in the Barkly land system. That land system is intersected by the construction ROW between KP 354 and KP 385, between KP 485 and KP 499, and also 18 km of the access track that joins the construction ROW at KP 370. Whether or not the high proportion of records from the Barkly land system is because it constitutes preferred Plains Death Adder habitat is unknown. The nearest record to the

construction ROW is from the Wonardo land system, the only record from that land system, approximately 22 km north of the construction ROW.

Habitat mapping conducted at a scale of 1:10,000 (see Section 4) indicates that the Project footprint intersects approximately 820.1 ha of suitable habitat for Plains Death Adder (see Table 5-3 and Table 5-4 for breakdown of habitat types specific to Plains Death Adder in the Northern Territory and Queensland, respectively).

A selection of photographs that represent black soil plains (i.e. suitable habitat for Plains Death Adder) along the construction ROW are provided in Figure 5-10.

Regardless, the presence of suitable habitat contiguous with that known to support Plains Death Adder indicates a reasonable likelihood that the species occurs within the Project footprint. This would represent an extension of the known south-westerly range of this species.

Table 5-3. Potential habitat extent for Plains Death Adder within the Project footprint (NT)

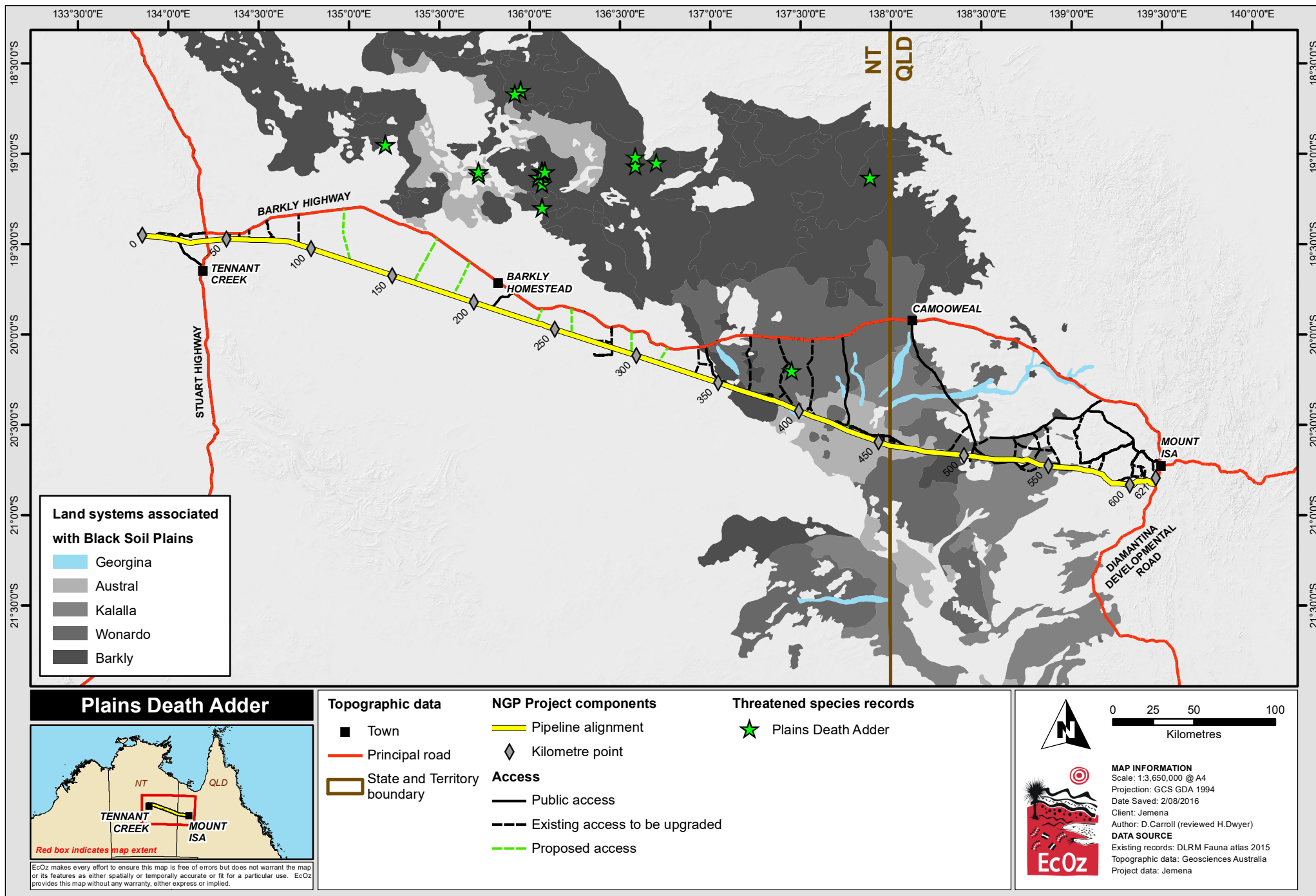
Landscape Class		Disturbance Area (ha)			Grand Total
	Landform Class	ROW	Access tracks	Other	
ALLUVIAL FLOODPLAINS		64.5	13.7	28.6	106.7
	<i>Alluvial Plains</i>	(61.6)	(12.8)	(28.6)	(103.0)
	<i>Drainage Systems</i>	(2.9)	(0.8)	(0.0)	(3.7)
CLAY PLAINS		243.5	71.3	29.2	344.0
	<i>Downs Plains</i>	(200.0)	(33.3)	(29.2)	(262.5)
	<i>Plains</i>	(35.9)	(37.4)	(0.0)	(73.3)
	<i>Inland Wetlands</i>	(7.7)	(0.6)	(0.0)	(8.3)
Grand Total		308.0	85.0	57.8	450.7

Table 5-4. Potential habitat extent for Plains Death Adder within the Project footprint (Qld)

Land Zone		Disturbance Area (ha)			Grand Total (ha)
	Description	ROW	Access tracks	Other	
3	<i>Alluvium (river and creek flats)</i>	34.4	11.4	23.2	69.0
4	<i>Clay plains not associated with current alluvium</i>	246.5	44.6	9.2	300.4
Grand Total		280.9	56	32.4	369.4



Figure 5-10. Photographs of potential habitat (clay plains) for Plains Death Adder



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-14. Map of Plains Death Adder habitat and records.mxd

Figure 5-11. Map of Plains Death Adder habitat and records

5.7 CARPENTARIAN ANTECHINUS (*PSEUDANTECHINUS MIMULUS*)

5.7.1 Conservation status

- Northern Territory: Vulnerable
- Queensland: Least Concern
- National: Vulnerable

5.7.2 Background information

Description

The Carpentarian Antechinus is a brown, mouse-sized, dasyurid marsupial with a white underside. It has large ears with reddish fur behind them. The species stores fat in its tail, and an individual in good condition has a tail that is swollen to carrot-shaped. Individuals have a head and body length of 63 – 91 mm and a tail length of 56 – 76 mm (Johnson et al. 2008). This species is closely related to, and superficially similar to, other *Pseudantechinus* that typically occupy rocky areas in northern and central Australia (Woinarski 2004).

Ecology

Carpentarian Antechinus occur in a range of vegetation types that are consistently associated with a high cover of rocks and boulders (Johnson et al. 2008; Perry et al. 2011). According to Woolley (2011), the species occurs in open woodland in rocky areas, particularly the side-slopes or bases of sandstone outcrops or hills, and featuring a scattered tree layer that typically includes *Eucalyptus* spp. and a ground layer dominated by spinifex (*Triodia* spp.) hummock grasses.

Lloyd et al. (2013) detail how all the Carpentarian Antechinus they trapped were on rocky ridges and hill-slopes of metamorphic or igneous rock, or weathered granite. The vegetation at these sites comprised a sparse tree layer dominated by *Eucalyptus leucophloia*, *E. leucophylla*, *Acacia shirleyi*, *Terminalia aridicola* and/or *Atalaya hemiglaucula*, a sparse shrub layer generally dominated by *Acacia chisholmii*, and a reasonably diverse native grass layer dominated by *Triodia* spp.

The breeding season is thought to be short, occurring sometime between August and October (Curtis et al. 2012). It is nocturnal, hides (roosts/dens) amongst rocks during the day, and does not appear to build a distinctive nest (Van Dyck and Strahan 2008). It feeds on insects and the tail can become fattened when food is in abundance (Van Dyck and Strahan 2008). Little else is known about the ecology of this species, although antechinus typically roost communally.

Distribution

The distribution of Carpentarian Antechinus is poorly understood. In the Northern Territory, this species is only known from Sir Edward Pellew group of islands (Kitchener 1991; Johnson & Kerle 1991; Taylor et al. 2004; Woinarski et al. 2011) and southern Arnhem Land near Borroloola. In Queensland, it was first reported in 1997 (Griffiths 1998), and there are currently only four known records of the species (according to Atlas of Living Australia, all in the Mount Isa Inlier bioregion. There are also some additional recent records of the species from recent surveys (in 2013) associated with the CopperString Project located 50 km east of the Project footprint.

The eastern end of the construction ROW (between KP 522 and KP 622) falls within the *expert distribution (likely)* of the species (Commonwealth of Australia 2016). There are records of Carpentarian Antechinus to the north and east of the Mount Isa end of the Project footprint, approximately 36 km and 40 km respectively (see Figure 5-2). This species is not expected to occur in the Northern Territory portion of the Project footprint as that area falls outside of the known Northern Territory distribution (the closest known occurrence of the species in the Northern Territory is approximately 420 km to the north), and no suitable habitat is intersected.

The extent of occurrence of the Carpentarian Antechinus is 16 000 km² (Curtis et al. 2012). Woinarski et al., 2014 suggest that the mainland area of occupancy is probably >2000 km²; however, this estimate is of low reliability.

Threatening processes

According to TSSC (2015):

Given the lack of specific information [of threatening processes to Carpentarian Antechinus], some assessment of threats likely to be affecting this species may be inferred from evidence of a more general decline in native mammal assemblages across much of northern Australia (Woinarski et al. 2001; Watson & Woinarski 2003; Pardon et al. 2003; McKenzie & Burbidge 2002).

The Feral Cat (Felis catus) probably predated the species, but its rocky habitat probably provides some protection (Curtis et al. 2012). Fire regimes in northern Australia have shifted to hot, extensive late dry season fires, and, although it is unlikely that these cause direct mortality to the Carpentarian Antechinus, they may impact on the abundance and availability of their prey (Curtis et al. 2012). Buffel grass invasion could significantly change the ecology of the central Queensland ridges where the species occurs (Lloyd et al. 2013).

5.7.3 Survey context

Purpose

If present within the Project footprint, Carpentarian Antechinus could be impacted by Project construction works – particularly by land clearing and trenching. The purpose of the survey was to identify whether species occur within the Project footprint.

Overview

To achieve the abovementioned purpose, the survey was designed to:

- a) Identify locations containing potentially-suitable habitat using desktop mapping datasets.
- b) Visit those locations by helicopter to confirm whether they contain suitable habitat.
- c) If suitable habitat is present, undertake surveys for the species to determine both presence/absence and extent.

5.7.4 Survey methodology

Existing survey guidelines

Survey guidelines for the Carpentarian Antechinus are provided in the following reference:

- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2011d, *Survey guidelines for Australia's threatened mammals – Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia, 2011.

The guidelines recommend the following survey techniques to detect the presence of the Carpentarian Antechinus in areas up to 5 hectares in size (DSEWPaC 2011d):

- Daytime searches for potentially-suitable habitat resources
- Daytime searches for signs of activity, such as tracks or scats among rocks and rock ledges
- Collection of predator scats, owl casts or remains in predatory bird/mammal nests/dens
- Pitfall trapping surveys

- Elliott A/E trapping survey (as per Gilfillan 2001; Sanders & Slater 2004) (increase Elliott trapping survey effort if pitfall traps are not used in methodology).
- Placement of camera traps in suitable habitat (method and survey effort are not defined).

There is no published information on the best time of year to conduct surveys for the Carpentarian Antechinus. General vertebrate fauna survey guidelines for the bioregions traversed by the Project footprint suggest that survey timing should be following rainfall (late Feb to May).

Survey design

Survey methodology adopted for this species aligns with Commonwealth guidelines for recommended for surveying Carpentarian Antechinus (DSEWPaC 2011d). Aerial footage from the reconnaissance survey (see Section 3) and observation notes on habitat suitability for Carpentarian Antechinus was provided to field ecologist Brett Taylor for his review as he has recently detected this species in the Mount Isa region. Brett validated that there is suitable habitat in the area and provided advice on where survey effort should be focused to determine if species is present.

Survey area and target habitat

Surveys for Carpentarian Antechinus were undertaken within the Queensland section of the Project footprint, and were not required in the Northern Territory for reasons stated above. The survey area within the Project footprint was focused the construction ROW, as other project components will not impact the species due to adequate avoidance of suitable habitat (i.e. rocky hills and outcrops).

The survey area along the Project footprint was between KP 534 and KP 622. This was depicted by reviewing the extent of regional ecosystem land zones within the Project footprint that support rocky habitat features (listed below) and also fits with distribution estimates as referenced on the SPRAT database (see Figure 5-17):

- Land Zone 7: Ironstone Jump-ups
- Land Zone 11: Hills and lowlands (Metamorphic)
- Land Zone 12: Hills and lowlands (Granitic)

Target habitat for the Carpentarian Antechinus survey was rocky hills or outcrops (granitic, metamorphic, or other rock type) intersected by the construction ROW, as surveying these habitat types were considered to provide the highest chance of detecting species presence. The survey area was examined by referring to observations made during the reconnaissance survey (see Section 3), cross-checking habitat mapping results (see Section 4), review of aerial imagery (Google Earth Pro and ESRI Online Imagery) at a scale of 1:3,000, and review of contours (10 m intervals). This identified twelve locations either intersected by, or are near to, the construction ROW that will require field assessment (refer to Figure 5-17).

On-ground habitat suitability assessment

On-ground habitat assessments were conducted on the 11 and 12 May 2016 at eight sites (identified above) to confirm if suitable habitat features were present. The following parameters were collected at each site:

- Photographs and geo-location
- Vegetation community
- Landform
- Presence of potential roost sites (i.e. rock crevices, caves, boulder piles etc.)
- Opportunistic sampling of scats and other potential signs of the species.

Habitat assessments also included daytime searches for signs of Carpentarian Antechinus activity, such as tracks or scats among rocks and rock ledges – and evidence in predator scats (i.e. owl casts or remains in predatory bird/mammal nests/dens).

Detailed rocky habitat mapping

Rocky habitat was mapped within the region of the Project footprint to show the level of connectivity with surrounding rocky ranges and hills where Carpentarian Antechinus has been previously records. This was produced in ArcGIS at a scale of 1:2,000 using ESRI online world imagery and 10m contours to identify ridge lines, rocky hills, and boulder piles – as these areas are considered to be critical habitat for the species.

Elliott trapping

Elliott trapping occurred between 12 and 17 May 2016, during which time there were mild temperatures, calm winds and no rainfall. Elliott trapping occurred at sites that were deemed to potentially support Carpentarian Antechinus (which occurred as part of the abovementioned on-ground habitat suitability assessment) (see Table 5-5 and Figure 5-18 for site names and locations).

The EPBC survey guidelines (Commonwealth of Australia 2011) recommend a minimum of two sample sites per 5 ha of suitable habitat within a project area. Therefore, sites that included suitable habitat areas of less than 3 ha were sampled using one trap site, and sites with greater than 3 ha of habitat area were sampled by two traps sites.

Elliott trapping was conducted as per Gilfillan (2001) and Sanders & Slater (2004) as recommended in the EPBC survey guidelines:

- Place 20 Elliott A or E traps at each survey site.
- Place traps 10 m apart in two parallel straight lines (transects) separated by 25 m
- Set traps for four consecutive nights
- Check traps early in the morning and close during the day
- Bait traps with a medium-sized ball of peanut butter, rolled oats, honey and raisins.
- Rebait and open traps in the late afternoon
- Provide within each trap a small amount of nesting material for shade and warmth.

Camera surveillance

Camera surveillance is recommended in the EPBC survey guidelines (Commonwealth of Australia 2011); however, method and survey effort are not discussed. Therefore, camera surveillance methods used by the Northern Territory Government for small mammals were adopted for this survey (Gillespie et al. 2015).

Camera surveillance was undertaken between 12 May and 22 June 2016. Surveillance was undertaken at six sites (see Table 5-5 and Figure 5-18). Five of these sites were also surveyed using Elliott traps (described above). CA6 was difficult to access which prevented the use of Elliott traps, therefore camera surveillance (coupled with active search techniques for fauna sign) was used to determine species presence.

Cameras used in this survey were KeepGuard KG690 digital cameras equipped with motion detection and infra-red flash (for dark environments and night). Sites were established based on the following criteria:

- Five cameras per site (referred to as a 'full spectrum' in Gillespie et al. 2015)
- Cameras set to operate continually (day and night) for at least 20 days (recommended by Gillespie et al. 2015). Cameras were set for 42 nights per camera (12 May & 22 June 2016).
- Cameras set to high sensitivity and to take three photographs per trigger, with a 10-second interval between triggers.
- Cameras attached to a picket and directed at a habitat feature of interest at a distance of 2 – 4 m. Night image capture was checked to ensure that infra-red reflectance was not an issue.
- A bait canister (filled with peanut butter, rolled oats, honey and raisins) placed within the field of view to attract fauna. The canister is constructed to reduce the chance of fauna and ants eating the bait, allowing it to remain an attractant for several weeks.
- The field of view was cleared of small plants and debris that may result in 'false triggers'.

Species detected in camera surveillance photos were identified by ecologists. Where required, species' morphometrics were used to identify animals – especially for images with dasyurids and rodents. Analysis of morphometrics was completed using the ImageJ program (Oracle 2011).

Table 5-5. Carpentarian Antechinus survey sites

Site	Coordinates		Elliott site	Camera site	Land zone	Description
CA1	-20.825054	139.456914	Yes	Yes	11 – metamorphic hills	Rocky ridge line
CA2	-20.818794	139.457117	Yes	Yes	11 – metamorphic hills	Rocky gully
CA3	-20.808777	139.416507	Yes	Yes	12 – granite hills	Boulder pile / low ridge
CA4	-20.811935	139.406079	Yes	Yes	12 – granite hills	Boulder pile / low ridge
CA5	-20.800284	139.464886	Yes	Yes	11 – metamorphic hills	Rocky ridge line
CA6	-20.829887	139.296153	No	Yes	11 – metamorphic hills	Rocky ridge line

5.7.5 Results

Habitat suitability assessment

- Of the 12 sites selected as target areas during the preliminary habitat assessment, six were selected as survey sites as they supported habitat features better suited for Carpentarian Antechinus.
- Habitat descriptions of the six survey sites are provided in Appendix I.
- Two main types of rocky hill habitat were recorded:
 - Granitic hills and low ridges with boulder piles that supported a low open woodland of *Eucalyptus leucophylla* and *Corymbia terminalis* or *Eucalyptus leucophloia* in the upper storey over Spinifex (*Triodia* sp.) grassland.
 - Metamorphic hills and ridges with a mixture of scree and outcrop that supported low open woodland *Eucalyptus leucophloia* +/- *Corymbia terminalis* over Spinifex (*Triodia* sp.) grassland.
- All sites supported crevices, caves, cracks etc. that would be suitable for daytime roost opportunities for Carpentarian Antechinus.
- All sites were recent burnt and there is evidence that the site experience high frequency of fire due to presence of mallee-form *Eucalyptus leucophloia* (confirmed by NAFI fire scar mapping).
- Annual Mission Grass (*Pennisetum pedicellatum*) (declared weed known to increase fire frequency and intensity) was observed in granitic low ridge and boulder pile at site CA4.
- Buffel Grass (*Cenchrus ciliaris*) was not evident in any of the rocky hill habitat sites.
- Food availability (insects) was observed in reasonable quantities at each site, it is not expected that food is a limiting factor in terms of habitat suitability.

Rocky habitat mapping

- Rocky hills and boulder outcrops regularly occur between KP 606 and KP 620 (Figure 5-18). Rocky refuge has been mapped as one habitat type rather than separating whether the rocky feature is ridge line, boulder pile or scree, because at this stage – all these rock types are considered to be equally suitable for Carpentarian Antechinus. The rocky habitat shown is indicative only and has not been ground-truthed for the area surrounding the Project footprint.
- The construction ROW intersects rocky habitat on three occasions (see Table 5-6).
- The ROW mostly avoids rocky habitat in the vicinity but intersects a comparably large section at KP 617 (as the alignment travels over a saddle within the ridgeline).
- There are numerous granite boulder piles located between KP 606 and KP 615, of which none are directly intersected by the construction ROW.

Table 5-6. Rocky refugia habitat intersected by the construction ROW – Carpentarian Antechinus

KP	Area (ha)
610.2	0.01
610.6	0.02
617	1.01
Total	1.04

Elliott trapping

- Five Elliott trap sites were established as part of the Carpentarian Antechinus surveys (CA1, CA2, CA3, CA4 and CA5) (Figure 5-18).
- Individual Carpentarian Antechinus were trapped at two of the five sites (CA1 and CA2) (see Figure 5-12). These sites are located in the highest rocky hills intersected by the construction ROW and contain cobble-sized, loose scree (metamorphic), with some outcropping. The sites fall within the same ridge; however they are separated by a gap in the ridge due to the flow path of Mica Creek. Both sites were covered with small hummocks of recently-burned spinifex in open formations with an open canopy of Snappy Gum (*Eucalyptus leucophloia*).
- Additionally, Elliott trapping detected the following species:
 - Common Rock Rat (*Zyomys argurus*) (at CA1 and CA4)
 - Desert Mouse (*Pseudomys desertor*) (at CA2)
 - Sandy Inland Mouse (*Pseudomys hermannsburgensis*) (at CA4)
- No fauna were trapped at two of the five sites (CA3 and CA5).

Camera surveillance

- Six camera surveillance sites were established as part of the Carpentarian Antechinus surveys (CA1, CA2, CA3, CA4, CA5 and CA6) (Figure 5-18).
- Camera traps detected Carpentarian Antechinus at one of the six sites (CA4) – a site where the species was not captured in Elliott traps. This site is comprised of piles of large boulders on low rocky country, with shallow sandy soil and an adjacent drainage line. Boulders (igneous) form many crevices through gaps in stacking (rather than cracking) and there are a number of small caves present. Surrounding vegetation consisted of spinifex (*Triodia* spp.) interspersed with both native and exotic annual tussock grasses.

- Additionally, camera surveillance detected the following species:
 - Common Rock Rat (*Zygomys argurus*) (at sites CA2 and CA4)
 - Desert Mouse (*Pseudomys desertor*) (at site CA1)
 - Euro (*Macropus robustus*) (at sites CA1, CA2, CA4 and CA5)
 - Red Kangaroo (*macropus rufus*) (at sites CA5 and CA6)
 - Purple-necked Rock Wallaby (*Petrogale purpureicollis*) (at sites CA1, CA2, CA4 and CA5)
 - Short-beaked Echidna (*Tachyglossus aculeatus*) (at sites CA1, CA2, CA3 and CA5)

5.7.6 Discussion

Field surveys identified Carpentarian Antechinus in rocky ridges north and south of Mica Creek (KP 617), and in a granite boulder outcrop to the west of those ridges (KP 610) (see Figure 5-18). Based on this evidence – and the ecology of the species – it is likely that Carpentarian Antechinus occupy any suitable rocky outcrops, boulder piles and rocky ridges/hills between KP 606 to KP 620 of the construction ROW. It is expected that rocky habitat provides daytime refuge as well as night-time foraging habitat – termed ‘rocky refugia habitat’ – which is considered to be critical habitat for the species.

To maintain gene flow between rocky refugia habitat, it is likely that the species uses the flatter areas surrounding them as dispersion habitat during the breeding season. This is inferred from the observation of the species on an isolated granite boulder pile at CA4 that is likely too small to support a population without any periodic new recruitment. These flatter areas have been termed ‘dispersive habitat’, and are more likely to be used during the breeding season (which is thought to occur between August and October, Curtis et al. 2012). Such movement would occur at night; however, there is no information regarding the distance to which the species can travel during dispersal periods.

There is a reasonable amount of rocky refugia habitat proximate to the construction ROW, occurring with some regularity between KP 606 and KP 620 (see Figure 5-18). Within this stretch, there are scattered granitic boulder piles and linear metamorphic ridges with varying levels of outcropping, situated among a larger area of flatter lowlands (sandy loams) that may be used as dispersive habitat for Carpentarian Antechinus between rocky refugia.

The construction ROW intersects rocky refugia habitat on three occasions (see Table 5-6). The largest (and most significant) intersection occurs on a metamorphic ridgeline between KP 616 and KP 616.3 (1.01 ha) (see Figure 5-13 and Figure 5-14), of which Carpentarian Antechinus was identified during field surveys. This ridgeline is part of a large contiguous area of rocky habitat connected to areas where the species has been identified in previous studies in the region. As such, it seems reasonable to assume that Carpentarian Antechinus occur throughout the rocky hills and ridges to the north and south of Mica Creek. The remaining two intersections of rocky refugia habitat are small and the construction ROW only traverses the edge of these areas (cumulative total area of 0.03 ha). Therefore, although Carpentarian Antechinus may occupy these areas, direct impact at these locations is possible, but considered as low risk.

The rocky ridge to the south of KP 567 was initially classified as potential habitat; however, due to its significant isolation from other rocky areas and the lack of evidence of Carpentarian Antechinus during field studies (trap site CA6), this location is now considered unlikely to support the species.



Figure 5-12. Photographs of Carpentarian Antechinus trapped at site CA1



Rocky scree slope at site CA1



Rocky outcrop at site CA2

Figure 5-13. Photographs of Carpentarian Antechinus Elliott capture sites



Figure 5-14. Photographs of habitat at KP 617 that is likely occupied by Carpentarian Antechinus



Figure 5-15. Photograph of camera-detected Carpentarian Antechinus at site CA4



Figure 5-16. Photograph of boulder pile where Carpentarian Antechinus was detected at site CA4

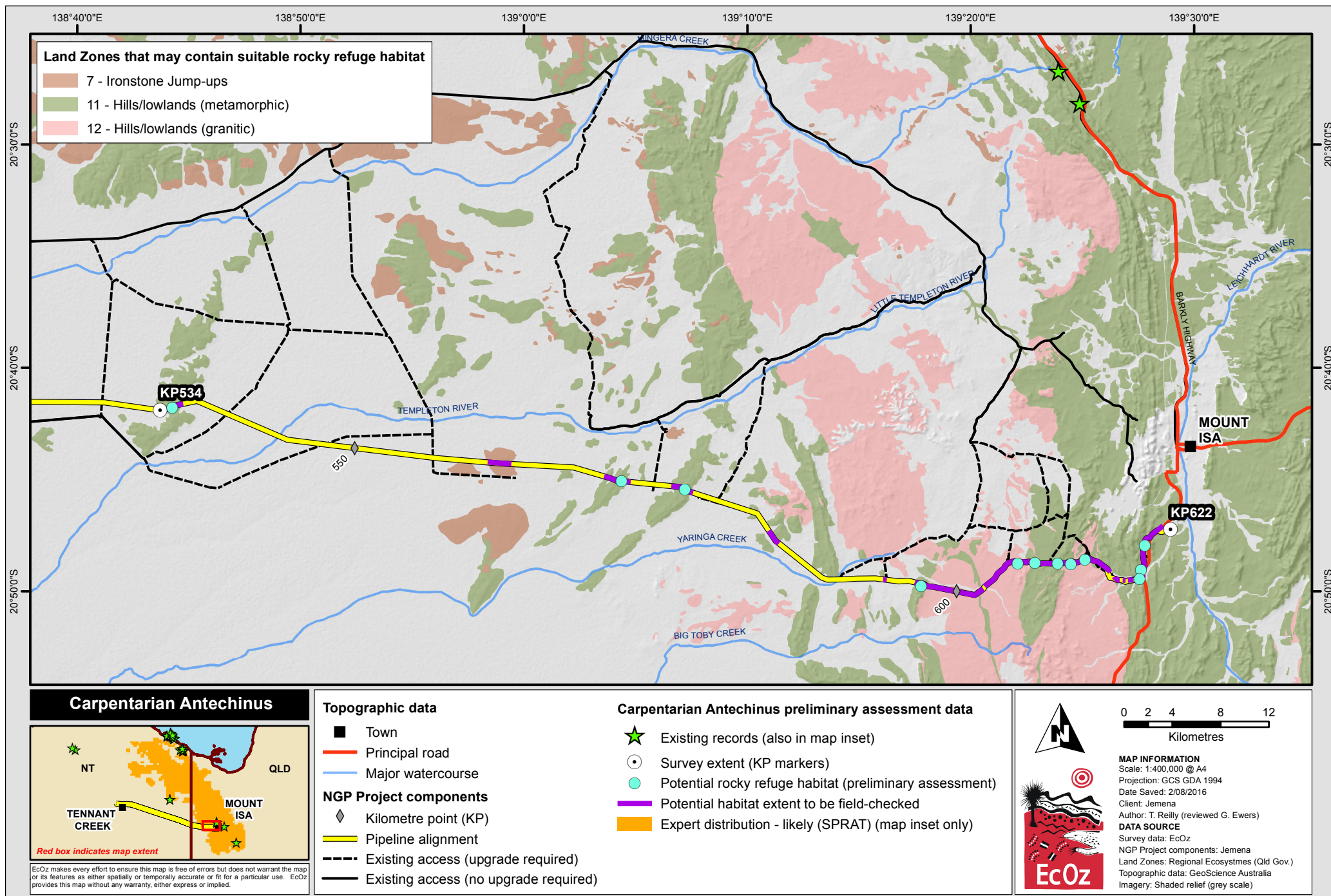
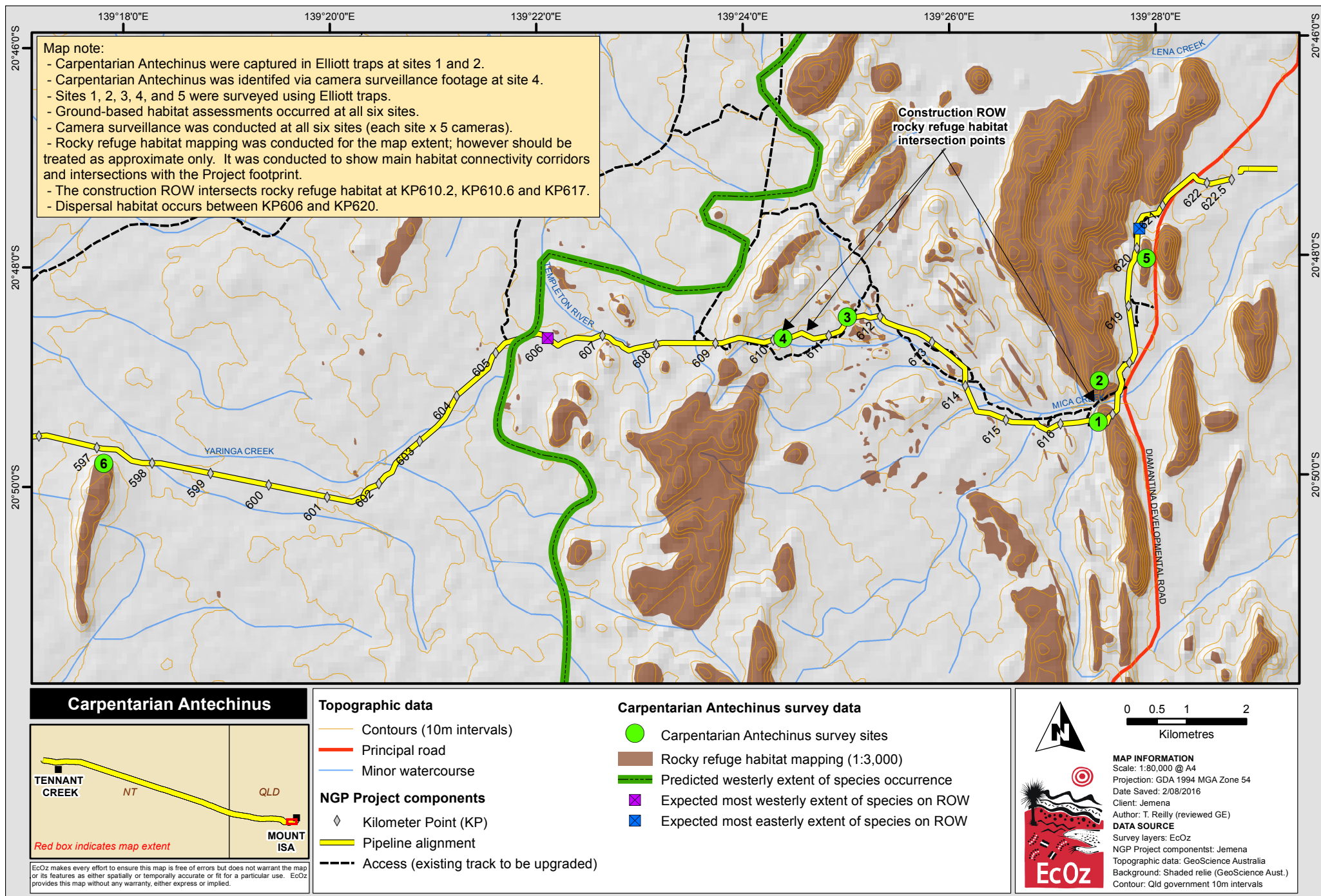


Figure 5-17. Map of Carpentarian Antechinus preliminary assessment information



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Figure 5-18. Map of Carpentarian Antechinus field survey and rocky refuge habitat in local area

5.8 GREATER BILBY (*MACROTIS LAGOTIS*)

5.8.1 Conservation status

- Northern Territory: Vulnerable
- Queensland: Endangered
- National: Vulnerable

5.8.2 Background information

Description

The Greater Bilby is a rabbit-sized (up to 55 cm body length; tail up to 29 cm), omnivorous, burrowing marsupial (Pavey 2006a). It has grey-blue fur, large ears, a long pointed snout and a black tail with a white fluffy tip (Van Dyck & Strahan 2008). The forelimbs are relatively strong and have a robust set of claws for burrowing and foraging (Van Dyck & Strahan 2008).

Ecology

In the Northern Territory, Greater Bilby are found in a wide range of habitats including stony uplands, lateritic areas, hummock grassland sand plains, mulga scrub and woodlands, drainage depressions and palaeodrainage systems (Southgate 1987; Southgate 1990). Typical habitat for the species in the Northern Territory consists of sandy soils dominated by hummock grasslands covered predominantly by three species of spinifex – *Triodia basedowii*, *T. pungens* and *T. schinzii* (Pavey 2006b). Surveys in the Tanami Desert (Northern Territory) indicate that laterite and drainage lines were occupied more frequently than sandplains and dune systems (Southgate et al. 2005). However, when resources are plentiful the species will forage in a variety of habitat types (Southgate et al. 2005). When Greater Bilby occur on sand plain they more frequently occur on recently burnt areas compared to longer unburnt areas (Southgate et al. 2005; Southgate & Carthew 2006).

The Greater Bilby tends to avoid densely-vegetated areas. A patchwork of different post-fire ages of vegetation is preferred (Southgate & Carthew 2007). Fire seems to maintain the sparse vegetation they prefer, and promotes the ephemeral plants used as primary and secondary food sources, such as *Yakirra australiense* (Southgate & Carthew 2006; Southgate & Carthew 2007; Johnson 1989).

The Greater Bilby is nocturnal and generally solitary or in pairs (Van Dyck & Strahan 2008). However, they can aggregate in relatively high densities in areas where favoured food plants become abundant and easy to obtain, and can reach a density of 12 to 16 individuals per km² in optimal habitat (Pavey 2006b). A density of 1 to 2 individuals per km² is considered more typical (Pavey 2006b).

Greater Bilby move over a wide area according to available food and vegetation cover conditions (associated with seasons and fires) (Southgate & Carthew 2006; Southgate & Carthew 2007; Southgate 1987; Johnson 1989), and the long-term seasonal home range of a group of Greater Bilby may be large (up to hundreds of square kilometres) (Southgate 1987). Estimates of short-term, home range sizes are up to 3 km² (Southgate & Paltridge 1998). Depleted food resources are the probable stimulus that results in vacating an area (Southgate 1987). This itinerant nature enables the Greater Bilby to respond to patchy and uneven food availability within the arid zone habitats (Southgate 1987).

The Greater Bilby has an opportunistic foraging strategy and feeds on a wide range of plant and animal taxa with major dietary components varying across seasons and geographic range (Pavey 2006b). Food is either excavated from the soil (holes can be 250 mm in depth; often referred to as diggings or scratchings), live captured on the surface, or seeds 'licked' from the soil surface. In the Tanami Desert, seed and bulb plant foods are a major dietary component of the Greater Bilby, in particular the seed of *Yakirra australiense*, and the bulb of *Cyperus bulbosus* (Southgate & Carthew 2006). Invertebrates (such as grubs and termites) are relied upon when food plants are scarce (Southgate & Carthew 2006).

They live in deep burrows excavated in sand that are 2 to 3 metres long, and 100 to 150 mm in diameter and the entrance is circular. The entrance is usually against a bush or surface irregularity, but may also occur in flat, featureless locations (Johnson 1989). The species appear to vacate burrows and reuse old burrows over time (Johnson 1989). An individual may have over a dozen regularly-used burrows within its home range, and several different burrows may be visited in a single night (SKM 2012; Pavey 2006b). Foraging distance from a burrow ranges from 200 to 600 m (Johnson 1989).

Greater Bilby can breed throughout the year (Pavey 2006b), with litter sizes typically two young and occasionally one or three (Southgate 1987). In good conditions, there is potential for four litters to be produced within a year (Southgate 1987).

Distribution

In the Northern Territory, recent records of the Greater Bilby occur within the Tanami bioregion, southern Sturt Plateau bioregion and the northern Great Sandy Desert bioregion (Pavey 2006a; Van Dyck et al. 2013), all located to the west of the Project footprint (point data presented within map inset in Figure 5-22). In Queensland, Greater Bilby has retracted to the south-west, which is 350 km from the Project footprint. Historically, the Greater Bilby occupied a substantial area of arid and semi-arid Australia. Its range and population declined dramatically following European settlement and it currently occurs across about 20% of its former range (Southgate 1990).

The Project footprint falls entirely within an area mapped by DoE (2016b) as 'species or species habitat likely to occur' (see map inset in Figure 5-22) (noting that the DoE 2016b dataset is not a population distribution map, but indicates the potential areas where Greater Bilby could persist).

Existing records and previous surveys

In the Northern Territory, the DLRM Fauna Atlas (2015 dataset) indicates there are 25 records of Greater Bilby within 50 km of the construction ROW (see Figure 5-22), of which 12 records have occurred between 1990 and 2004 (the remaining records being pre-1990). One of these records (from 1990) is located close to KP 3 on the western end of the construction ROW at 'White Devil Mine' (now decommissioned). The two 2004 records were adjacent to the Stuart Highway approximately 20 km south of Tennant Creek. All recent records of the species are located west of the Stuart Highway.

In the Northern Territory, there have been two relatively recent surveys for Greater Bilby in the region of the Project footprint:

- Gibson et al. (1994) conducted a regional flora and fauna survey of the Wakaya Desert, which included establishment of 28 sites and extensive opportunistic observations – to cover the 'desert sandplains' and eastern area of 'lateritic sand plains and rises' depicted in Figure 5-22. Although none of the sites recorded evidence of Greater Bilby, unequivocal signs of the species was observed at two locations – diggings at the base of Turpentine (*Acacia lysiphloia*) and an un-used burrow adjacent to a low, gravelly rise (Gibson et al. 1994) (both approximately 60 km south of KP 250 – Figure 5-22). The report considered it surprising that no other evidence of Greater Bilby was found despite the prevalence of suitable habitat.
- Low Ecological Services (2009) conducted a flora and fauna survey for the Wonarah Phosphate Project (operated by Minemakers Limited) in the approximate location of KP 270 to KP 285. They targeted Greater Bilby as part of their survey methodology and did not find evidence of the species, but concluded that suitable habitat and food resources are present in the area. The survey report noted that Traditional Owners within the Arruwurra Land Corporation have not observed Greater Bilby on their land.

There are no recent records within the vicinity of the Queensland section of the Project footprint, as the species has retracted to the south-west of Queensland (approximately 350 km from the Project footprint) and so is considered locally-extinct within the Queensland part of the Project footprint.

Threatening processes

Predation is a major threatening process to the Greater Bilby (Abbott 2001; Pavey 2006a; Pavey 2006b; Southgate et al. 2007). Predation by Red Fox (*Vulpes vulpes*) is a major threat to the Greater Bilby, while Feral Cat (*Felis catus*) and Dingo (*Canis lupus dingo*) also predate on the species. There is considerable interaction between these species, as Dingoes may (indirectly) protect the Greater Bilby by restricting Fox and Cat populations in certain areas (Pavey 2006b). It is known that predators persist in the region of the Project footprint – with recent records of Red Fox, Feral Cat, and Dingo (Gibson et al. 1994; Low Ecological Services 2009) (see Figure 5-22).

Competition with Feral Rabbits (*Oryctolagus cuniculus*) is an additional threatening process faced by the Greater Bilby, though the Project footprint falls outside of the known distribution of rabbits. The increase in One-humped Camel (*Camelus dromedarius*) numbers in western Northern Territory is also a potential threat to populations of the Greater Bilby. The large size of camels (up to 1000 kg) combined with their preference for dune systems can cause the destruction of burrows. That species tendency to consume a large portion of available plant species also poses a significant threat to Greater Bilby habitat (Pavey 2006b). It is possible that pastoralism will also have a similar impact.

5.8.3 Survey context

Purpose

If present within the Project footprint, Greater Bilby could be impacted by construction works – particularly by land clearing and facilitation of additional predator access to the region. The purpose of the survey was to identify whether any populations of this species occur within the Project footprint.

Overview

To achieve the abovementioned purpose, the survey was designed to:

- a) Identify potentially-suitable habitat using desktop mapping datasets and advice from experts.
- b) Conduct an aerial survey to identify signs of Greater Bilby and areas of high value habitat.
- c) Conduct a ground-survey at representative sample sites for signs of Greater Bilby and assess habitat quality (specifically impact by cattle and presence of predator species).

5.8.4 Survey methodology

Existing survey guidelines

Commonwealth survey guidelines for the Greater Bilby are provided in the following reference:

- Department of Sustainability, Environment, Water, Population and Communities (DSEWPac) 2011d, *Survey guidelines for Australia's threatened mammals – Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia, 2011.

These guidelines are summarised below (noting that these techniques are designed for survey areas up to 5 ha in size; and the Project footprint greatly exceeds this survey area):

- Tracking surveys (1 ha sites with 2 hr survey effort) that involve:
 - Daytime searches for suitable habitat resources, such as hummock grassland in arid regions.
 - Daytime searches for signs of activity, including burrows, tracks, scats and diggings.
 - Collection of predator scats, owl casts or remains, targeting predatory bird/mammal nests/dens.

- Soil plot surveys (1 m² sand plots that are raked and checked for 3 consecutive nights).
- If confirmation of the species' presence is required after detection of signs, then spotlight surveys conducted at the entrances of burrows after dusk are a more time- and cost-efficient manner to directly observe the species than conducting a trapping survey.

Guidelines do not recommend a preferred time of year for surveying Greater Bilby

Survey design

Given the linear nature of the Project footprint, coupled with an extensive survey area (> 400 km of construction ROW and access track), survey methodology was designed based on the following information sources:

- Previous landscape-scale surveys within the Northern Territory arid zone (Southgate et al. 2005; Southgate & Carthew 2006; Southgate & Carthew 2007; Southgate et al. 2007)
- DoE guidelines for Greater Bilby (SEWPaC 2011d) (described above)
- Advice from Dr Richard Southgate (private consultant, Greater Bilby specialist), and Peter MacDonald (Fauna Ecologist, Northern Territory Department of Land Resource Management).

The survey methodology adopted for the Project footprint used a combination of aerial-based (helicopter) and on-ground survey methodologies as was advocated by Southgate et al. (2005). Greater Bilby diggings (and occasionally burrows) were able to be seen from the air and larger distances with a wider 'field of view' could be observed compared to ground transects. The on-ground plots were used to ground-truth observations seen from the air and collect additional species occurrence and habitat information.

The following methodology was developed in consultation with, and endorsed by, Dr Southgate.

Survey area and target habitat

It is assumed that Greater Bilby (if still extant in the region) will be restricted to the Tennant Creek Sandplains within the Northern Territory, which encompasses the following components of the Project footprint (see Figure 5-22):

- Construction ROW – KP 0 to 350 (i.e. 350 km)
- Access tracks (existing, requires widening) x 8 – total length of 102 km
- Access tracks (to be constructed) x 8 – total length of 145 km
- Camp locations x 3 – 12 ha each

It is considered more likely that Greater Bilby will occur in the first 150 km of the Project footprint (western end of the ROW) due to the closer proximity to known populations in the Tanami Desert.

Greater Bilby are not expected to occur in the Barkly Clay Plains (of the Northern Territory) nor in Queensland parts of the Project footprint. This was supported by DLRM and Dr Richard Southgate (private consultant, Greater Bilby specialist).

Project footprint habitat mapping (see Section 4), reconnaissance survey aerial footage (see Section 3), and numerous publications on Greater Bilby habitat and diet in the Tanami Desert (Pavey 2006a; Pavey 2006b; Southgate 1990; Southgate et al. 2005; Southgate & Carthew 2006; Southgate & Carthew 2007; Southgate et al. 2007) were reviewed to identify high value habitat types within the survey area. These areas are considered to have a higher chance of Greater Bilby occupancy:

- Alluvial floodplains and playas. Particularly locations that support large termite mounds from the species *Nasutitermes triodiae*, as these are indicative of underlying palaeodrainage channels. Existing land resource mapping indicates that no palaeodrainage channels occur in the vicinity of the Project footprint; however, habitat mapping presented in Section 4 indicates that alluvial plains and playas are present in low densities.

- **Rocky rises** (particularly lateritic based rises). Habitat mapping (see Section 4) indicates that low rocky rises are crossed by the Project footprint in the western and eastern part of the Greater Bilby survey area (the central part of the survey primarily sand plain with little habitat variation).
- **Recently burnt areas** (< 1 year) within drainages, sandplains or rocky rises. These areas are known to support post-fire grasses that are foraged by Greater Bilby for seed. The main target post-fire grass species for this survey is Desert Flinders Grass (*Yakirra australiensis*). Land Sat imagery from February 2016 (30 m resolution) and NAFI fire scar mapping from 2015 / 2016 (250 m resolution) were used to help locate recent fire scars prior to conducting field work.
- **Shrub lands food plants**. Shrublands that contain flora species that are known to support root-eating grubs (target food source for Greater Bilby). Target flora species relevant to the survey area are Turpentine (*Acacia lysiphloia*), Flying-saucer Bush (*Acacia hilliana*) and Cockroach Bush (*Senna notabilis*).

Aerial transects

Aerial transects were conducted to identify Greater Bilby signs and select sites for targeted on-ground searches (on-ground search methodology is described in section below).

A continuous aerial transect was conducted between KP 0 and KP 350, and separate transects were conducted along seven proposed access tracks within the Greater Bilby survey area (see Figure 5-22) covering a distance of approximately 490 km. Fieldwork occurred between the 2 and 7 May 2016 (in conjunction with on-ground surveys, described below).

The helicopter was flown at a speed of 18 – 30 knots (33 to 55 km/hr) and at a height of 15 to 20 m above ground level (photographs in Figure 5-19 and Figure 5-20 provide an example of surveyor observation aspect from the helicopter). Two surveyors (Tom Reilly and Mark Carter, refer to Section 5.3.1 for experience) were seated on either side of the helicopter, each observing a search strip approximately 30 m wide (to make a total search strip of 60 m). The aerial survey recorded the following data:

- **Putative Greater Bilby sign** was identified based on the characteristics:
 - Large burrow that had a round appearance
 - Large spoil heap adjacent to a shrub that obstructed view of burrow or digging
 - Large hole or trench
 - Diggings under Turpentine (*Acacia lysiphloia*) or other shrubs that support root-dwelling larvae
 - Diggings with spoil evenly distributed around the dig

(see Figure 5-20 for an example of a putative Greater Bilby sign from the survey).

- **Putative goanna sign** was identified based on the characteristics
 - Burrow with crescent / kidney shape
 - Burrows that are wider than they are high
 - Digging with distinct triangular shape
 - Digging with spoil distributed on one side

(see Figure 5-19 for an example of a putative goanna sign from the survey).

Fresh burrows, diggings and scratching's were relatively easy to see from the air because excavated soil had a richer (red) colour in contrast to the sun-bleached surface soils.

Predator signs (Red Fox, Feral Cat and Dingo) that could be identified from the air were also recorded.

Some fauna observations and signs were able to be validated from the air while hovering. All putative Greater Bilby records and a sample of putative goanna sign was examined using on-ground survey methods (described below).

On-ground survey (i.e. track-plots)

On-ground surveys occurred in conjunction with aerial transects. The survey was primarily designed to determine whether Greater Bilby were present on the proposed Project footprint. While aerial survey can provide a rapid continuous assessment of the area, there are risks that both imperfect detection (false absence) and misclassification (false presence) of Greater Bilby sign. Ground truthing of putative signs and careful examination of habitat considered of high value provides an important step to correctly assess occupancy. The aim of survey results is to produce high true positives and negatives (as this measures data sensitivity and specificity, respectively)

On-ground surveys used track-plot methodology described in Moseby et al. (2012), which is a standardised technique designed to assist in recording information on a range of fauna species in arid and semi-arid habitat types. This method is commonly used in central Australia (pers. comm. Richard Southgate 2016) and information can be readily added to the national database on arid zone fauna (Moseby et al. 2012).

Track-based surveys incorporates the key components of survey guidelines for Greater Bilby advocated by the Commonwealth Government (SEWPAC 2011).

Plots dimensions were ~100 x 200 m (i.e. 2 ha), and avoided existing roads and cleared areas. Each plot was surveyed for a 30-minute period zig-zagging up one side and back down the other. Signs of Greater Bilby, goanna, Echidna, Red Fox, Feral Cat etc. was recorded based on fresh track and gait characteristics. Additionally, Greater Bilby presence could be validated if fresh diggings at the base of shrubs and forbs for root-dwelling larvae and scats were detected.

For each track-plot, the following data were recorded:

- Site location details (i.e. site name, GPS coordinate, time etc.)
- Habitat/vegetation notes and site photograph
- Presence and cover of food indicator species – *Yakirra australiensis*, *Acacia lysiphloia*, *Acacia hilliana*, *Senna notabilis* and *Dactyloctenium radicans*
- Fire history at the site – recent (< 1 year), relatively recent (1 to 3 years), long unburnt (> 3 years)
- Variables that may affect tracking conditions, such as time since rain, cloud cover, surface soil substrate, time of day, time of year etc.
- All tracks, burrows, diggings, sightings, or scats of each species – including an age and abundance estimate of each sign.
 - Age estimate – fresh (1 to 2 days); recent (3 to 7 days); old (> 7 days)
 - Abundance estimate – abundant (signs in all 4 corners of site); common (signs in half the site); uncommon (individual signs only or found in ¼ of site).
- Aim to conduct tracking surveys with sun in front so shadows are not obscured.

Track plot sites were selected based on the following criteria:

- At all instances where putative Greater Bilby signs were identified from the air (aerial survey described above), irrespective of how far the sites were spaced apart. These sites were conducted to verify identification (therefore presence) of aurally-observed Greater Bilby sign.
- Habitat types considered to be of high value (described above) within the Project footprint. These sites were (generally) spaced at 10 km to 15 km intervals to create a spatial representation of the Project footprint. Shorter intervals (i.e. approx. 10 km) occurred between

KP 0 and KP 150 as this stretch is considered to have a higher likelihood of occurrence due to closer proximity to Tanami Desert Greater Bilby populations. High values sites were primarily selected to determine whether Greater Bilby signs were being missed during aerial survey.

- Aerially-recorded putative goanna signs were also ground-truthed at a selection of sites to verify identification is correct.

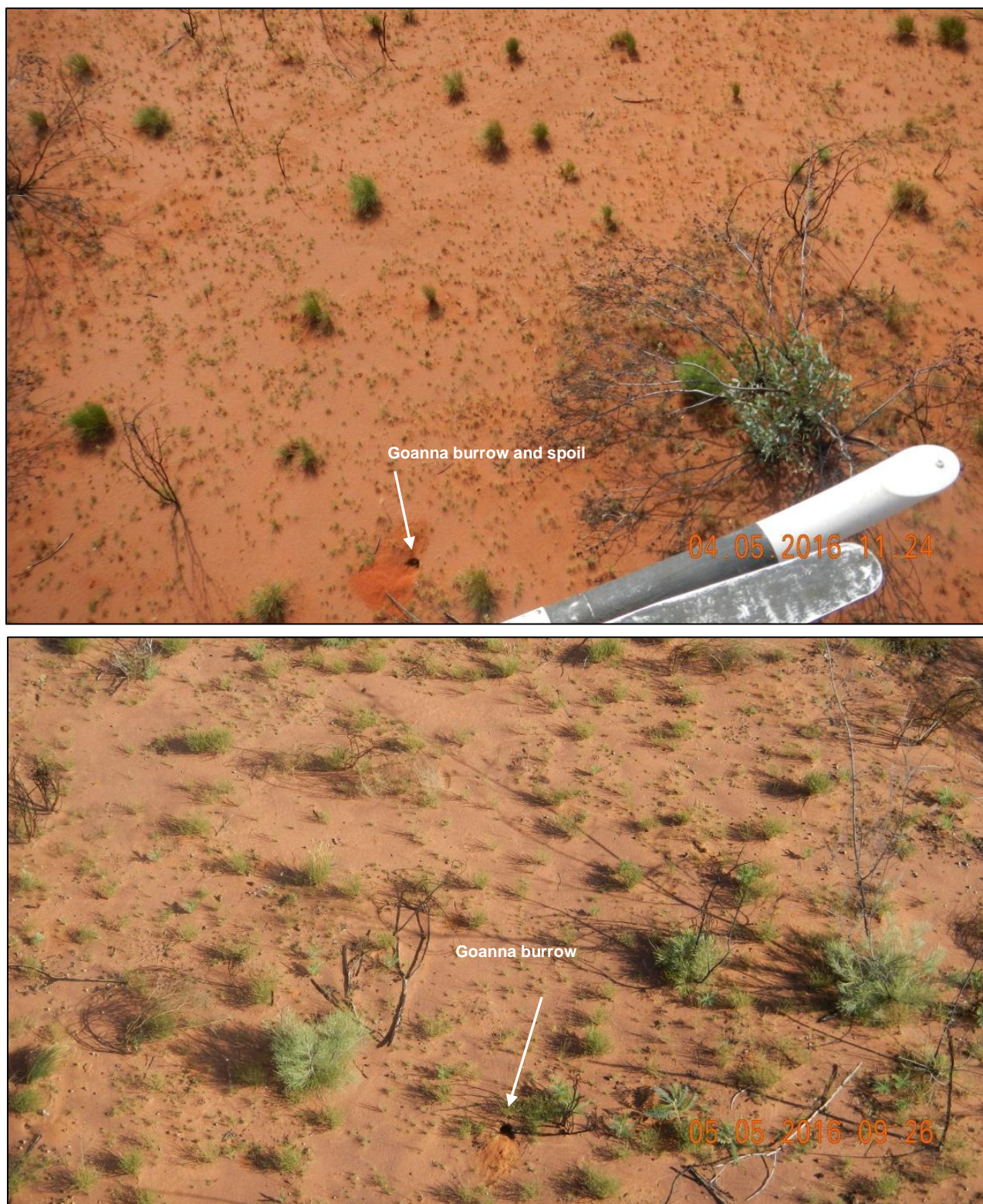


Figure 5-19. Photographs of a putative goanna sign observed during the Greater Bilby aerial survey

5.8.5 Results

Tracking conditions

- Light rainfall occurred across the survey area on the first night of the survey (2 May 2016) (however, no rainfall registered at Tennant Creek Weather Station 015135). Rainfall removed signs of fauna tracks; however, diggings and burrows from a range of fauna (large and small) were still present – which suggests that Greater Bilby signs could be identified, if present.
- Soil substrate varied between sites in terms of identifying fauna tracks. Some sites had gravelly surface or harder loams (in alluvial flood plains); however, the majority of sites had at least 50% red-sand substrate that was highly suitable for detecting fauna tracks. Burrows and diggings were assumed to be visible on 100% of the track-plots.
- Overcast conditions were experienced on the 2 and 3 May 2016, which reduced shadow visibility. Consequentially, track plots were searched for longer periods when those conditions were experienced (to ensure that trackable surfaces had been properly inspected).
- Cattle trampling of soil substrate also reduced the quality of tracking conditions in some areas (mainly reduced the visibility of tracks, not burrows and diggings). Cattle impacts were present in the western portion of the survey area in Phillip Creek Station and Tennant Creek Station (see tracking data in Table 5-7).
- The aerial transects had clear visibility of fauna signs in the recently burnt areas due to the resultant low cover of vegetation; therefore many 'Hover Sites' were used for sign confirmation rather than on-ground survey (see photographs of aerial signs in Figure 5-19 and Figure 5-20).
- Rocky rises often had low and open vegetation cover, which meant that aerial observations were very accurate in these areas.
- In summary, tracking conditions (soil surface and weather) experience during the survey period were suitable for identifying characteristic Greater Bilby sign, as all track-plots showed evidence of general fauna signs (see Table 5-7).
- All track-plots resulted in identification of fauna signs (see Table 5-7).

Aerial transect data

- Eighteen sites were recorded as 'Putative Greater Bilby Sign'. These sites required a ground-check to confirm sign identification, described in track-plot data below). One in particular (site TP60) appeared very much like a Greater Bilby sign (Figure 5-20). This site had numerous diggings and burrows consistent with Greater Bilby.
- There were 1 374 sites recorded as 'Goanna Sign', of which 1 350 were diggings and burrows from large goanna. These records were consistently recorded along the survey transect and in a variety of habitats with differing soil substrates - i.e. sand plains, low rocky rises, and Mulga red earth plains (see Figure 5-22).
- There were 65 'Hover Sites' noted (Figure 5-22). These locations had a sign that was possibly from Greater Bilby; however, it was confirmed to be from another species (in all cases goanna) once the helicopter circled or hovered at each site.
- Other species signs recorded were
 - Feral Cats (*Felis catus*) (12 sites)
 - Dingo (*Canis lupis dingo*) (2 sites)
 - Australian Bustard (*Ardeotis australis*) (7 sites)
 - Bush Stone-curlew (*Burhinus grallarius*) (2 sites)
 - Red Kangaroo (*Macropus rufus*) (1 site).

On-ground survey data

Greater Bilby evidence

- There was no definitive evidence of Greater Bilby observed during the survey.
- None of the 18 locations identified from the air as a putative Greater Bilby sign could be verified with ground-truthing. The most promising location was verified as Sand Goanna, *Varanus gouldii* (Table 5-7; Figure 5-20). This particular site, TP60, was located within a small depression within an alluvial floodplain and contained many tracks, burrows, diggings and scats from Sand Goanna.
- Of the 17 remaining putative Greater Bilby sites (see Table 5-7), 15 were confirmed to be large goanna once inspected on-ground (likely Sand Goanna, *Varanus gouldii*). Three sites (TP04, TP21, and TP24) had signs (diggings or burrows) that were not clearly attributed to any species (including Greater Bilby). At these three sites, surveyors concluded that the signs did not belong to Greater Bilby and most probably belonged to goanna (based on lack of other evidence of Greater Bilby and abundance of fresh goanna signs at the sites).
- None of the 35 habitat sites surveyed had evidence of Greater Bilby (see Table 5-7). Habitat assessment is provided in following section.

Goanna sign

- Fifteen 'goanna check sites' were surveyed (all located within 'Habitat Sites'), of which all were confirmed as goanna once assessed on-ground.
- Three out of 53 sites (5.6%) found goanna diggings and burrows during on-ground surveys that were not observed during aerial observations. These three sites (site TP15, TP40 and TP50) were all located in vegetation that had not burnt for at least 3 years (i.e. fauna sign obstructed by denser vegetation cover)
- Of the 53 track-plot sites visited, large goanna burrows, tracks or diggings were observed on 70% of the track-plot sites during the survey – most of these signs were likely from Sand Goanna (*Varanus gouldii*). Signs were spatially spread across the entire Greater Bilby survey area. Surveyors also identified potential signs of Yellow-spotted Monitor (*V. panoptes*) within the Gosse River alluvial floodplains (on Tennant Creek Station) – two large and robust individuals were observed from the helicopter and there was some evidence of large goanna burrows in the area that were assumed to be from Yellow-spotted Monitor. There are no official records of this species in the Tennant Creek region (according to Atlas of Living Australia and Northern Territory Fauna Atlas 2016); however, discussions with local naturalists suggest that the species has been periodically recorded in the alluvial floodplain environments within the region (Jesse Carpenter, pers. comm. 2016).

Predators and other introduced species

- Track-plot surveys recorded a range of introduced fauna species (see Table 5-7). Track type, abundances of sign, and age of the sign are discussed below and provided in Appendix J.
- Dingos (*Canis lupus dingo*) tracks and/or scats were observed in 8% of track-plot sites. When present, signs were uncommon and varied from fresh tracks to old scats.
- One recent Red Fox (*Vulpes vulpes*) track was possibly identified (at site GB32) (see photo in Appendix K) (see Figure 5-22). Total confirmation was not possible due to track quality and absence of other reference tracks within the track-plot.
- Evidence of Feral Cats (*Felis catus*) (either tracks, scats, and sightings) was observed in 25% of track-plot sites. Cats were also 'flushed' out of vegetation by the helicopter on a few occasions.

It is likely that cats occur across the entire survey area as signs of the species were reasonably spaced along the survey transects (see Table 5-7; Figure 5-22).

- Camel (*Camelus dromedarius*) tracks and/or scats were observed in 8% of the track plot sites. When present, signs were uncommon and old.
- As expected, Domestic Cattle (*Bos taurus*) signs (36% of track-plot sites) were fresh and abundant in the western part of the survey area (as that area is within Phillip Creek Station and Tennant Creek Station).
- No signs of Rabbit were detected, which is consistent with other studies and estimated population distribution of the species.

Signs of native species record on track-plot sites

- Track-plot surveys recorded a range of native fauna species. Fresh (and old) fauna signs were identified within each track-plot (see Table 5-7). Track type, abundances of signs, and age of the sign within each track-plot are discussed below and provided in Appendix J.
- Small goannas were observed on 34% of track-plot sites, and are most likely from *V. eremius* and *V. brevicauda*.
- Small lizard signs were commonly observed during the survey, with 7% of the track-plots sites showing evidence (often fresh) of a variety of species. Direct sightings included *Carlia munda*, *Cryptoblepharus* sp., *Ctenophorus isolepis*, *Ctenophorus nuchalis*, *Ctenotus greeri*, *Ctenotus leonhardii*, *Ctenotus pantherinus*, *Ctenotus piankai*, *Ctenotus robustus*, *Delma* sp., *Diplodactylus conspicillatus*, *Diporiphora* sp., *Heteronotia binoei*, *Lerista* sp. (likely bipes), *Lialis burtonis*, *Lucasium stenodactylum*, *Menetia greyii*, *Morethia ruficauda*, *Rhynchoedura ornata* and *Strophurus ciliaris*.
- Large snake signs were observed at 6% of the track-plot sites. Two species were observed during the survey – Black-headed Python (*Aspidites melanocephalus*) (photo in Appendix K) and Mulga Snake (*Pseudechis australis*). Small snake tracks were observed in 9% of the track-plot sites (species not identified).
- Centralian Blue-tongued Lizard (*Tiliqua multifasciata*) was observed by tracks and sightings on 6% of the track-plot sites (photo in Appendix K). When present, signs were uncommon but fresh.
- Button-quails tracks and/or day roost sites were observed in 43% of the track-plot sites (photo in Appendix K), and were found to be fairly common and widespread across the 'desert sandplains' and 'lateritic plains and rises' (observed during the aerial transect survey). The bipedal stride of button-quails was often abundant and very fresh at the sites where they were recorded. Little Button-quail (*Turnix velox*) were considered common, and Red-Chested Button-quail (*Turnix pyrrhothorax*) were only observed at three sites (TP11, 13, and 23). Brown Quail (*Coturnix ypsilophora*) was observed at site TP61 (ephemeral playa).
- Australian Bustard tracks (*Ardeotis australis*) were observed on 23% of track-plot sites, and also sighted (in pairs) on many other occasions during the aerial transect survey.
- Hopping bird tracks (i.e. from babblers, robins, finches, wrens, bell-birds etc.) were observed in the sand plains in the latter part of the survey (after initial rains had ceased).
- A large rodent – putatively identified to be Long-haired Rat (*Rattus villosissimus*) – was observed at site TP2 when flushed out of a spinifex hummock.
- Tracks of unidentified moderate to large rodents or dasyurids were observed at three track-plot sites (TP32, TP34 and TP49). Only a few tracks were present, therefore a confident identification to species level was not plausible. They most likely belonged to Long-haired Rat

(*Rattus villosissimus*) (species sighted on multiple occasions during survey), but may be Brush-tailed Mulgara (*Dasycercus blythi*) or Dunnarts (*Sminthopsis* spp.) (of which evidence of both species was not observed during surveys). Brush-tailed Mulgara are discussed further in Section 5.10 (Brush-tailed Mulgara Survey).

- Small rodent signs were observed at 38% of the track-plot sites, mostly in the second half of the survey. It was thought these signs may belong to any of the following species – *Leggadina forresti*, *Pseudomys desertor*, *Pseudomys hermannsburgensis* or *Mus musculus*. There was potential evidence of old (inactive) pebble mounds from *Pseudomys johnsoni* on the low rocky rises within the far eastern part of the survey area (photo in Appendix K).
- Spinifex Hopping Mouse (*Notomys alexis*) tracks and/or pop holes were observed in 23% of the track-plot sites. When present, signs were abundant and fresh.
- Red Kangaroo (*Macropus rufus*) tracks and/or scats were observed at 21% of the track-plot sites. When present, signs were uncommon and old.
- Northern Nailtail Wallaby (*Onychogalea unguifera*) scats and tracks were observed at 4% of the track-plot sites. When present, signs were uncommon and old.
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus*) (listed as Near Threatened under the TPWC Act, Northern Territory) scats (a few days old) were recorded (and collected) at one site (TP15). Scats were relatively fresh and scattered along the edge of an existing track over a 20 m distance. This species was found to be widespread in 1993 in the Wakaya desert (Gibson et al. 1994)

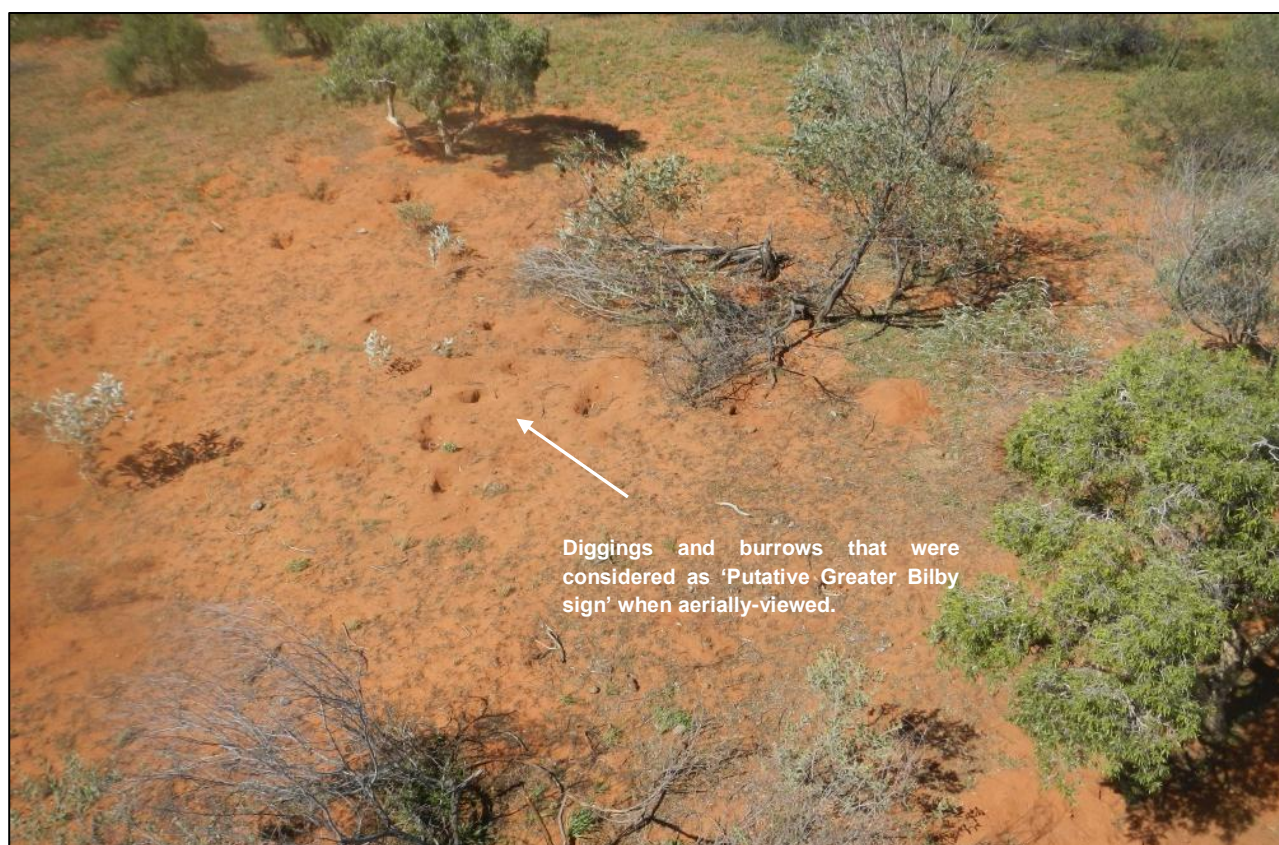


Figure 5-20. Photograph of 'Putative Greater Bilby sign' observed during the aerial survey

Habitat assessment data

- Track-plot site descriptions and photographs are provided in Appendix J. Some basic habitat descriptors are provided in Table 5-7.
- The number of track-plot sites of each landform traversed by the Project footprint within the potential Greater Bilby zone are provided in Table 5-8. General landform descriptions are provided in Section 4.
- Despite the absence of Greater Bilby sign, four indicator plant species were observed in 34 of the 53 track-plot sites – *Yakirra australiensis*, *Senna notabilis*, *Acacia lysiphloia*, *Acacia hilliiana*. These species provide seeds or grubs that form a key component of the Greater Bilby diet:
 - Desert Flinders Grass (*Yakirra australiensis*) was observed in 8 of the 53 track-plot sites, all in low densities. Six of these sites (TP17, 24, 27, 33, 34, and 35) had burnt < 1 year ago (Desert Flinders Grass is commonly found in recently burnt areas). In the other two sites (TP4 and 21) that had not experienced a recent burn, it was located in open areas.
 - Cockroach Bush (*Senna notabilis*) was observed, and occurred at varying densities, in 6 of the 53 track-plot sites – typically found in freshly burnt areas. Greater Bilby are known to feed on grubs that feed on roots of Cockroach Bush.
 - Turpentine (*Acacia lysiphloia*) was observed, and occurred at varying densities and maturity, in 14 of the 53 track-plot sites. Typically found in sandplains that had not been recently burnt. Greater Bilby are known to feed on grubs that feed on roots of Turpentine.
 - Flying-saucer Bush (*Acacia hilliiana*) was observed, and occurred at relatively high densities (although patchy) on low rocky rises, in 10 of the 53 track-plot sites. Greater Bilby are known to feed on grubs that feed on roots of Flying-saucer Bush.
- Twelve track-plot sites were surveyed in areas that had been recently burnt (i.e. < 1 year).
- Aerial transects identified that several large areas that have been recently burnt. NAFI indicates there have been 2 to 3 large-scale fires within the western portion of the survey area within the last 12 years (Figure 2-9).
- Alluvial floodplains within the survey area are not similar to palaeo-drainage channels in the Tanami Desert. They are heavily impacted by cattle and have a woodland community over tussock grasses. These areas are not considered as ideal habitat for Greater Bilby.
- Two locations along the construction ROW supported large bulbous termitaria mounds (see photograph in Figure 5-21), situated in localised depressions rather than palaeo-drainages and only 2 or 3 mounds were present.

Table 5-8. Greater Bilby sites within each habitat type (specific to bilby survey)

Landform	# sites	Track-plot site reference (TP prefix)
Sandplains – desert, lateritic	24	5, 6, 16 -18, 20, 23 - 28, 30 - 35, 40, 41, 48 - 50, 55
Sandplains – loamy, red earths	11	1, 2, 4, 7, 11, 12, 14, 15, 21, 22, 46
Low rocky rises (lateritic)	11	3, 8, 10, 13, 43, 44, 45, 47, 51, 52, 53
Alluvial plains / depressions	4	19, 42, 54, 60
Playas / seasonal swamps	2	61, 62
Sinkhole	1	56



Recently burnt hummock grassland (isolated *Corymbia setosa* trees) with a diversity of post-fire tussock grasses, herbs, and forbs - including low densities of *Yakirra australiensis* and *Senna notabilis*.



Low rocky rise (lateritic) that supports *Acacia hilliana* low shrubland surrounded by sandplains dominated by hummock (*Triodia* sp.) grassland.



Aerial view of low rocky rise within the Arruwurra Land Corporation. This particular rise did not support mature *Acacia hilliana*.



Localised small depression that supported low numbers (three) of large bulbous termitaria mounds.

Figure 5-21. Photographs (selection only) of examples of high value Greater Bilby habitat

Survey limitations

- High vegetation cover in areas that had not burnt for 3 or more years may have obstructed aerial view of burrows and diggings. In these areas, the helicopter was flown at slower speeds to enable more comprehensive aerial search effort.
- No landings were possible on proposed access tracks within the Vacant Crown Land because sacred sites clearances had not been performed in these areas. Aerial surveys and hover sites were performed on these access tracks. There were three hover sites in on the northern part of one of these tracks that was noted to require a ground-check.
- Not all access tracks were surveyed; however, access tracks selected for survey were chosen to be representative for Project footprint.

5.8.6 Discussion

The targeted surveys between KP 0 and KP 350 (plus seven access tracks) (total of 490 km transect) indicate that Greater Bilby do not utilise habitat situated within the Project footprint; however, potentially-suitable habitat is present and widespread (presence of food indicator plants and soil substrate appropriate for burrow construction). Factors that may lower habitat suitability may be lack of palaeodrainage-channels, presence of key predator species (Red Fox, Feral Cat), occurrence (and long-history) of large-scale fires, and high level of cattle impact in the western portion of the footprint.

It is likely that the range of Greater Bilby has contracted considerably since the last (and few) proximate records within the central zone of the Project footprint (KP 150 to 300), such that it is suspected the Wakaya Desert population is now extirpated. Although Greater Bilby signs were not identified along the Project footprint west of the Stuart Highway (KP 0 to KP 40), it is possible that this area is periodically utilised by the species due to the closer proximity to existing populations.

High value habitat types

The absence of large palaeo-drainage channels within the Project footprint could be a major limiting factor in terms of current occupation of Greater Bilby. The only alluvial habitat present within the survey area (associated with Gosse River) was not suitable for Greater Bilby due to high cattle impact and lack of food plants. Other water-based habitat features (i.e. depressions and playas) were marginally suitable due to their comparably small size, isolation within the broader sand plain landscape, and supporting low densities of potential food sources (grub source plants identified only on the edges of these areas).

The low rocky rises (mixture of calcrete, laterite, silcrete and sandstone gravels) within the sand plains provide suitable habitat due to an abundance of *Acacia hilliiana* (plant commonly targeted by Greater Bilby for grubs) and presence of a soil substrate appropriate for burrow construction.

Sand plains (including loamy, desert, and lateritic substrates) were widespread within the survey area and habitat suitability varied due to fire frequency and food plant availability. This habitat type included the highest ground-based survey effort (35 track-plot sites). Large-scale fires have occurred within the sandplains, which may possibly reduce the suitability of these areas for Greater Bilby.

Predator species

A potential risk of the Project on Greater Bilby is increased predation pressure or introduction of predators to new areas – as the Project footprint may provide predator access to the area (there is anecdotal evidence that predators of Greater Bilby prefer to use corridors such as tracks and fence lines; Dr Southgate, pers. comm. 2016). It is likely that presence / higher numbers of predators will lower habitat suitability.

A possible Red Fox (*Vulpes vulpes*) track was identified at site TP32, this would be on the far northern extent of the species distribution in the Northern Territory. Previous surveys in the area have also identified the presence of Red Fox (Low Ecological Services 2009; Gibson et al. 1994). Red Fox is a significant predator of the Greater Bilby and its presence in the region may form part of the reason why it was not detected

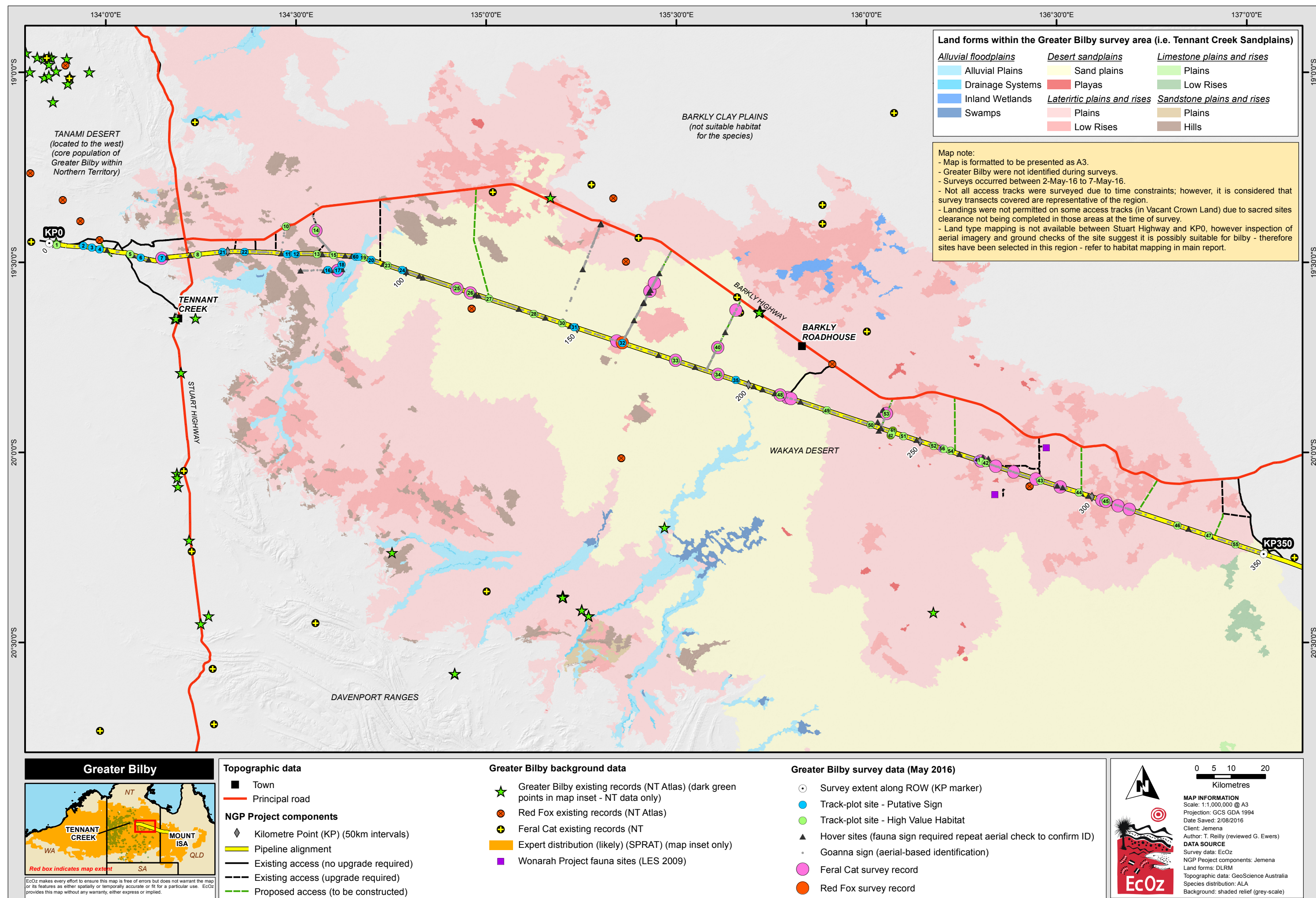
during these surveys. The Project footprint is at the northernmost limit of Red Foxes in the Northern Territory according to recent distribution estimates (National Land & Water Resources Audit 2008).

Feral Cat (*Felis catus*) tracks, scats, and sightings were consistently observed along the Project footprint and were found in a variety of habitats (13 on-ground sites; 12 aerial sites), with particular presence in the sand plains in the Wakaya Desert area (perhaps due the ephemeral playas in the region, which supply water and assumed abundant prey). Feral Cats may contribute to predation pressures on Greater Bilby, especially on females and juveniles (due to their smaller size and less defensive nature than male bilbies). It is expected their presence in the region and population numbers are linked to seasonal conditions and prey abundance, particularly to irruption of the Long-haired Rat *Rattus villosissimus* (Gibson et al. 1994). As their diet includes small mammals, birds and reptiles as well as invertebrates such as grasshoppers (Paltridge et al. 1997), predation by cats in the region likely places significant pressure on populations of native species, particularly when cat density remains high for a period after a crash in Long-haired Rat numbers.

Dingoes were observed in low numbers (6 locations) during the survey (2 aerial sightings and 4 track-plot sites), which is consistent with observations made in previous fauna surveys within the region (Gibson et al. 1994; Low Ecological Services 2009). Low Dingo (*Canis lupus dingo*) numbers may be a reason for widespread Feral Cat population, as there is evidence that areas with high Dingo populations suppress Feral Cat and Red Fox numbers (Woinarski et al. 2014; Christensen and Burrows 1994).

Pastoral impacts

The Project footprint traverses three pastoral properties (Tennant Creek Station, Phillip Creek Station and Dalmore Downs Station) within the Greater Bilby survey region (see Figure 2-12 for pastoral property boundaries). Track-plot sites observed a high presence of cattle tracks and scats in these areas, especially in alluvial areas or locations that support tussock grasses. It is possible that the impact from pastoralism in the area has degraded habitat suitability for Greater Bilby in this area, as it is listed as a potential threat factor in Woinarski et al. 2014).



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Figure 5-22. Map of Greater Bilby habitat assessment and field survey

5.9 BRUSH-TAILED MULGARA (*DASYCERCUS BLYTHI*)

5.9.1 Conservation status

- Northern Territory: Vulnerable
- Queensland: Vulnerable
- National: Least Concern

5.9.2 Background Information

Description

Brush-tailed Mulgara is one of the larger carnivorous marsupials, with a body mass of over 100 g, head body length of 15 cm and tail length of 9 cm (Masters et al. 2003). The species shows sexual dimorphism in size; males are significantly larger than females (Masters et al. 2003). The back is sandy brown and the belly is greyish-white. The short tail is enlarged and reddish near the body, tapering quickly to a point (Pavey et al. 2006c). Brush-tailed Mulgara is closely related to the Crest-tailed Mulgara (*Dasymercus cristicauda*) which lives in sand dunes within the Simpson Desert.

Ecology

Brush-tailed Mulgara is primarily nocturnal, sheltering during the day in burrows that are about 0.5 m deep. The species occurs in a range of vegetation types; however, the principal habitat is sand plains and drainage depressions that support mature hummock grasslands of spinifex, especially *Triodia basedowii* and *T. pungens* (Masters et al. 2003). The only Wakaya Desert record of this species (see below) was from a *T. pungens* hummock grassland with *Eucalyptus odontocarpa* sparse mallee shrubland overstorey. The site was a gravelly rise with light, sandy clay loam (Gibson et al. 1994).

The location of Brush-tailed Mulgara colonies may be influenced by the presence of better-watered areas such as paleo-drainage systems or drainage lines in sandplains or sand dune habitats (Masters et al. 2003; Pavey et al. 2006c). The species breeds once per year – mating in autumn or winter – with litters of 3 to 6 young being produced between October and December. Home range size of its close relative Crest-tailed Mulgara is highly variable, with extremes of 1.0 to 14.4 hectares recorded (Masters 2003), and it is assumed that Brush-tailed Mulgara is similar. Home ranges of individuals overlap extensively. Brush-tailed Mulgara can undergo wide fluctuation in numbers depending on weather conditions (Gibson et al. 1994).

According to SEWPAC 2010:

Burrows are found aggregated in complexes that can cover up to a kilometre of suitable habitat. The burrows are constructed under the raised mound of a dead spinifex hummock, and have a number of entrances, with between six to ten pop-holes located around the periphery of the raised mound (C Dickman pers. comm.). When the burrows are active, scoops of sand are seen at the pop-hole entrances and scats will also be scattered randomly around the area, including near the burrow entrances (C Dickman pers. comm.).

Brush-tailed Mulgara demonstrates remarkable flexibility in its use of resources and aspects of its behaviour and physiology that protect it from periods of food shortage. The species is both carnivorous and insectivorous, taking a range of prey including scorpions, centipedes, rodents, small marsupials and reptiles. Unlike smaller dasyurids, it is able to excavate prey from burrows (Masters and Dickman 2012). Brush-tailed Mulgara reduce energy expenditure *in situ* by entering daily torpor. During periods of drought Brush-tailed Mulgara is able to tolerate reduction in bodyweight and condition by drawing on substantial reserves of fat stored in its tail. The depth of Brush-tailed Mulgara burrows provides additional protection from environmental disturbances, including climatic extremes and intrusions from predators such as the Feral Cat (*Felis catus*) and Red Fox (*Vulpes vulpes*) (Masters and Dickman 2012).

Distribution

Most historical mulgara records did not distinguish between the two species now recognised, and so there is ambiguity about the distribution of both species. The Brush-tailed Mulgara is known from the Western and Simpson Deserts, with confirmed records in the Northern Territory from Haasts Bluff, Uluru, Papunya, Tanami Desert, Illamurta, Charlotte Waters and Crown Point (Woolley 2005; Woolley 2006). The species was once widespread and common throughout the central deserts region of Australia; however, it began to decline in the 1930's, and now has a more restricted and fragmented distribution (Pavey et al. 2006c).

There is one record 25 km south of the Project footprint (KP 240) from the Wakaya Desert fauna survey undertaken in 1993 (Gibson et al. 1994), and two records for Tennant Creek from 1901 and 1904 (see Figure 5-24). Apart from these, all other records are from a significant distance to the south and west of the Project footprint.

Threatening processes

The cause of decline in the Brush-tailed Mulgara is unknown and, therefore, it has not been possible to identify threatening processes. However, it is likely that the processes of environmental degradation and habitat homogenisation that have occurred throughout arid Australia following European settlement have negatively affected the mulgara. Changes in fire regimes, grazing by introduced herbivores including cattle and rabbits, and predation by introduced predators are all likely threatening processes (Pavey et al. 2006c).

5.9.3 Survey context

Purpose

If present within the Project footprint, Brush-tailed Mulgara could be impacted by Project construction works – primarily by land clearing and trenching. The purpose of the survey was to identify whether any populations of this species occur within the vicinity of the Project footprint.

Brush-tailed Mulgara was not listed as a focus species in the NGP Terms of Reference. It has been included in the threatened species survey program due to the results of the comprehensive threatened species 'likelihood of occurrence' assessment (Section 5.1). The species was only surveyed for in the Northern Territory part of the Project footprint because it is not nationally listed.

Overview

To achieve the abovementioned purpose, the survey was designed to:

- a) Identify potentially-suitable habitat using desktop mapping datasets.
- b) Visit sample sites within that habitat by helicopter to confirm whether it is suitable habitat, and to assess habitat quality (specifically impact by cattle)
- c) Ground-survey sample sites within suitable habitat for signs of Brush-tailed Mulgara.

5.9.4 Survey methodology

Survey design

Brush-tailed Mulgara surveys occurred in conjunction with Greater Bilby surveys (described in Section 5.8.4) between the 2 and 7 May 2016, and covered a distance of approximately 490 km (between KP 0 to KP 350, and along 7 proposed access tracks) (Figure 5-24).

A targeted survey program that incorporates existing survey guidelines for Brush-tailed Mulgara was not undertaken because it was considered that the comprehensive Greater Bilby track-based survey (detailed in Section 5.8.4) would also detect (potential) Brush-tail Mulgara signs if present. Burrows and tracks from Brush-tailed Mulgara are readily identifiable to adequately trained personnel. Consequently, the survey

approach focused on tracking for signs and general habitat suitability – particularly tracks and potential burrows. This methodology forms an important part of the standard survey guidelines for the species; however, it is normally supplemented by Elliott and pitfall trapping at a number of sites for a three or four night period.

Survey area and target habitat

It is assumed that Brush-tailed Mulgara (if still extant in the region) will be restricted to the Tennant Creek Sandplains within the Northern Territory, which encompasses the following components of the Project footprint (see Figure 5-24):

- Construction ROW – KP 0 to 350 (i.e. 350 km)
- Access tracks (existing, requires widening) x 8 – total length of 102 km
- Access tracks (to be constructed) x 8 – total length of 145 km
- Camp locations x 3 – 12 ha each

Brush-tailed Mulgara are not expected to occur in the Barkly Clay Plains (of the Northern Territory) nor in Queensland parts of the Project footprint.

Project footprint habitat mapping (see Section 4), reconnaissance survey aerial footage (see Section 3), and publications on Brush-tailed Mulgara habitat and diet (Masters et al. 2003) were reviewed to identify target habitat types within the survey area. These areas are considered to have a higher chance of Brush-tailed Mulgara occupancy in order to infer if the species is present within the Project footprint:

- Sandplains that support mature (long unburnt) hummock grasslands (preferably *Triodia pungens* as *T. basedowii*, the other key spinifex species generally associated with Brush-tailed Mulgara, is not commonly encountered in the region).
- Sandplains that are in close proximity to drainage depressions or seasonal swamps.

NAFI fire scar mapping (250 m resolution) identified that the majority of Tennant Creek Sandplains has burnt at least once within the last 5 years; however, there are large areas of potential habitat within this region that has not burnt for 4 years which may support mature *Triodia pungens* grasslands – a key habitat component for Brush-tailed Mulgara which will be targeted during field studies (Figure 2-9).

Aerial assessment

The intent of aerial assessment was to identify suitable sites for targeted on-ground searches for signs of Brush-tailed Mulgara (discussed below). The aerial assessment allowed for identification of suitable habitat (see above) and was able to observe if small mammal tracks were present on the sandplains.

The aerial assessment was conducted between KP 0 and KP 350, and along seven proposed access tracks within the survey area (see Figure 5-24). The helicopter was flown at a speed of 18 – 30 knots (33 to 55 km/hr) and at a height of 15 to 20 m above ground level. Two surveyors (Tom Reilly and Mark Carter, refer to Section 5.3.1 for experience) were seated on either side of the helicopter, each observing a search strip approximately 30 m wide (to make a total search strip of 60 m).

On-ground survey (i.e. track-plots)

On-ground surveys used track-plot methodology described in Moseby et al. (2012), which is a standardised technique designed to assist in recording information on a range of fauna species in arid and semi-arid habitat types. This method is commonly used in central Australia (pers. comm. Richard Southgate 2016) and information can be readily added to the national database on arid zone fauna (Moseby et al. 2012). Furthermore, Brush-tailed Mulgara produce relatively conspicuous signs (i.e. burrows and tracks) in arid zone habitats, which makes this method applicable for this Project area.

Track-plot sites were selected based on the Greater Bilby field survey methodology (see Section 5.8.4) and aerial assessment (discussed above). Sites were spatially representative within the survey area and included a range of habitat types and fire ages suitable for Brush-tailed Mulgara.

Plots dimensions were ~100 x 200 m (i.e. 2 ha), and avoided existing roads and cleared areas. Each plot was surveyed for a 30-minute period zig-zagging up one side and back down the other. The aim was to conduct tracking surveys with the sun in front so that shadows were not obscured.

For each track-plot, the following data were recorded:

- Site location details (i.e. site name, GPS coordinate, time etc.)
- Habitat/vegetation notes and site photograph
- Fire history at the site – recent (< 1 year), relatively recent (1 to 3 years), long unburnt (> 3 years)
- Variables that may affect tracking conditions, such as time since rain, cloud cover, surface soil substrate, time of day, time of year etc.
- All tracks, burrows, diggings, sightings, or scats of each species – including an age and abundance estimate of each sign.
 - Age estimate – fresh (1 to 2 days); recent (3 to 7 days); old (> 7 days)
 - Abundance estimate – abundant (signs in all 4 corners of site); common (signs in half the site); uncommon (individual sign only or found in ¼ of site).

5.9.5 Results

Tracking conditions

- Tracking conditions for detecting small mammal tracks (such as dasyurids like Brush-tailed Mulgara) were poor at the start of the survey, but became ideal between the 4 and 6 May 2016 – which was when the majority of suitable habitat for Brush-tailed Mulgara was surveyed.
- Refer to Section 5.8.5 (part of Greater Bilby survey) for a more detailed assessment of tracking conditions experienced during the survey.

Track-plot data

Fifty-three track-plot sites were surveyed. Results of the track-plot survey are:

- No definitive evidence of Brush-tailed Mulgara was observed during the survey.
- Fifty-three track-plots were surveyed within the Tennant Creek Sandplains, covering a variety of habitat types and fire scar ages – loamy sandplains, desert sandplains, laterite plains, alluvial plains, low rocky rises, drainage depressions, and seasonal swamps / playas.
- Possible dasyurid tracks were found at three sites – TP32, TP34 and TP49 (Figure 5-24). These tracks were not definitive to one species; however, they all had a quadrupedal bounding overstep track pattern with measurements within the range of Brush-tailed Mulgara (foot length ~ 20 mm; group width ~ 60 mm; group length ~ 120 mm). The track pattern and size could not be separated from the more likely (and ubiquitous) Long-haired Rat (*Rattus villosissimus*), as there were only a few average quality tracks present on the soil surface to make judgement. Long-haired Rat was sighted at several locations during the track-plot surveys. Tracks were scarce at each of these three sites. Searches at these sites did not locate potential burrows for Brush-tailed Mulgara.

- Evidence of Feral Cats (*Felis catus*) (either tracks, scats, and sightings) was observed in 25% of track-plot sites. Cats were also 'flushed' out of vegetation by the helicopter on a few occasions. It is likely that cats occur across the entire survey area.

Habitat assessment data

Track-plot habitat descriptions and photographs are provided in Appendix J.

Results are summarised below:

- Thirty-two of the 53 track-plots supported mature hummock grassland understory:
 - Sandplains (13 sites – TP5, 16, 18, 25, 28, 30, 31, 32, 40, 48, 49, 50 and 55)
 - Loamy sandplains (7 sites – TP1, 2, 4, 7, 15, 21 and 46)
 - Low rocky rises (9 sites – TP3, 8, 13, 43, 44, 45, 47, 51 and 53)
 - Depressions (3 sites – TP42, 54 and 60)
- Two of the three potential Brush-tailed Mulgara tracks were located in areas that had mature spinifex (*Triodia pungens* and/or *Triodia schinzii*). These areas had not burnt for at least 3 to 4 years. The other track was observed in a location that had burnt within the last year; however, the tracks were sighted close to an unburnt area that supports a dense cover of mature spinifex and Acacia shrubland.
- Potential food resources for Brush-tailed Mulgara were commonly observed during the track-plot surveys (i.e. they are carnivorous and insectivorous, taking a range of prey including scorpions, centipedes, rodents, small marsupials and reptiles).
- Broad-scale fires have recently occurred within the potential habitat zone for Brush-tailed Mulgara within the Project footprint. The areas burnt in 2011 now support mature *Triodia pungens* hummock grasslands.
- Seasonal swamps and depressions were present within the extensive sand plain hummock grasslands (many of which has not been burnt for at least 3 to 4 years).

Survey limitations

- Trapping surveys (i.e. Elliott and pitfall traps) – which are a commonly used survey methodology for Brush-tailed Mulgara – were not conducted during the survey program (reasons described in Section 5.9.4).
- Light to moderate rainfall occurred over most of the Project area on the 2 and 3 May 2016 (13.8 mm at Tennant Creek Airport). This may have removed tracks from the soil surface. Conditions improved between the 4 and 7 May 2016, with numerous fauna tracks observed in sandy substrate
- No landings were possible on proposed access tracks within the Vacant Crown Land because land access arrangements were not in place. As expected, numerous small mammal tracks were observed during Greater Bilby aerial surveys; however, surveyors were not able to confidently identify smaller mammal tracks without a ground-based assessment.
- Not all access tracks were surveyed; however, the access tracks selected for the survey were chosen to be representative for Project footprint.

5.9.6 Discussion

Survey results suggest that Brush-tailed Mulgara are absent or scarce within the region of the Project footprint due to the following reasons:

- No track-based evidence of the species within 53 spatially representative ground survey sites
- Presence of marginal habitat quality
- Long-term presence of predator species (mainly associated with Feral Cats, *Felis catus*)
- Paucity of records in the region (i.e. only one recent record from 1993 – Gibson et al. 1994).

Although the weight of evidence suggests that this species is absent in the region, additional trapping effort would be required for a more definite conclusion. Surveys indicated that suitable habitat (i.e. sandplains that support mature hummock grasslands) is present within the Tennant Creek Sandplains of the Project footprint. However, as the region has experienced frequent broad-scale fire activity (i.e. 3 to 4 burns within a 15-year period) it is possible that habitat suitability is only marginal, or perhaps restricted to hummock grasslands that have a lower burning frequency.

The presence of predator species (Red Fox and Feral Cat) and impacts from cattle are likely to reduce the habitat suitability for Brush-tailed Mulgara. In particular, track-plot surveys determined that Feral Cats were present across the entire survey area. Cats were also recorded from previous surveys in 1993 and 2009 (Gibson et al. 1994; Low Ecological Services 2009). The long-term presence of Feral Cats in the region suggests predation pressure may play a significant role in the viability (or indeed presence) of any local Brush-tail Mulgara population.



Figure 5-23. Photographs of habitat considered as suitable for Brush-tailed Mulgara

5.10 GOULDIAN FINCH (*ERYTHRURA GOULDIAE*)

5.10.1 Conservation status

- Northern Territory: Vulnerable
- Queensland: Endangered
- National: Endangered

5.10.2 Background information

Description

Gouldian Finch is an easily recognisable bird species due to its bright colours. The species has three distinct colour morphs associated with head colour – black head (most common), red head (moderately common), and yellow head (rarely observed) (Palmer et al. 2012). Juveniles do not present bright plumage and may be mistaken for other finch species (Palmer et al. 2012).

Ecology

The critical components of suitable habitat for the Gouldian Finch vary seasonally. In the dry season, the critical components are hollow-bearing Eucalyptus trees (especially *E. tintinnans*, *E. brevifolia* and *E. leucophloia*) (Higgins et al. 2006; O'Malley 2006; Tidemann 1996; Tidemann et al. 1999) with an understorey of the favoured annual grass (*Sorghum* spp., *Schizachyrium* spp.) and a nearby (within 4 km) source of surface water. In the wet season, Gouldian finches rely on a variety of perennial grass species, and birds will move from area to area as the seeds from each species become available (Dostine and Franklin 2002; Dostine et al. 2001).

The breeding season extends from February to April, with a longer season (January to August) in years of extended wet season rainfall (1984; Woinarski & Tidemann 1991; Tidemann & Woinarski 1994; Tidemann et al. 1999). Individuals or groups appear to first select patches of habitat with high densities of potential nesting sites, and breeding pairs then select specific nest sites based on a suite of preferred hollow morphometric attributes (Brazill-Boast et al. 2010).

In the non-breeding season birds can disperse widely (Garnett et al. 2011), greatly increasing the possible range of this species. Gouldian Finches can occur in flocks of hundreds, but are usually observed in much smaller numbers.

Distribution

The Gouldian Finch was formerly widespread across the northern savannas from the Kimberley to eastern Queensland including Cape York (O'Malley 2006). It has disappeared from most of its previous Queensland distribution, and is now only recorded occasionally and in small numbers from a few sites around the Atherton Tableland and Gregory Range, and in far western Queensland (Barrett et al. 2003; Holmes 1995, 1998). A number of breeding populations are known from the Kimberley. In the Northern Territory, most known breeding populations occur in the Top End with some isolated records in the Barkly Tableland and in coastal areas of the Gulf of Carpentaria. Some sources believe that Gouldian Finch populations may have recently stabilised, and perhaps begun to increase and spread (Garnett et al. 2011).

The Northern Territory section of the Project footprint is not considered to be within the Gouldian Finch distribution. In addition, despite the Mount Isa area being fairly heavily surveyed by birders interested in the local, endemic grasswren species, there are only two existing records of Gouldian Finch in the region – one approximately 23 km to the north-east of the construction ROW (although the coordinate uncertainty of this record is 10 km) and the other approximately 54 km to the north (see Figure 5-27). Nevertheless, because of those records, the *expert distribution (likely)* of Gouldian Finch includes the length of pipeline between KP 609 and KP 622 (13 km) (Commonwealth of Australia 2016).

Threatening processes

The main contemporary threats to this species are frequent widespread fires and introduced herbivores, both of which, through different pathways, cause reduced availability of grass seed important in the species' diet. High frequencies of intense fires may also reduce the availability of suitable breeding hollows at local breeding sites (Brazill-Boast et al. 2010), as fires can burn down suitable trees and/or stunt growth.

5.10.3 Survey context

Purpose

The purpose of the survey was to provide field data to inform an assessment of the potential impact of the Project on Gouldian Finch.

If suitable habitat (breeding or non-breeding) is present within the Project footprint, and is being used by Gouldian Finches, Project construction works could impact that population. Specifically, the impacts could include:

- Loss of wet season foraging habitat
- Destruction of nesting trees at breeding sites

It is unlikely that the construction activities could have a significant impact on the dry season foraging habitat for the Gouldian Finch as the grasses relied on during the dry season are very widespread and abundant in the region. However, if potential breeding habitat is present and/or if potential wet season foraging areas are present, vegetation clearing activities associated with construction of the NGP could impact an existing Gouldian Finch population (if present) because, in both cases, the critical resource (trees, perennial grasses) tends to be patchily distributed, and the loss of even a small area could have a disproportionately large impact

Overview

To achieve the abovementioned purpose, the survey was designed to:

- a) Identify potentially-suitable habitat using desktop mapping datasets.
- b) Identify whether any suitable breeding habitat and/or potential wet season foraging habitat occurs along the construction ROW.
- c) If potential habitat was found, evaluate the quality of that habitat

5.10.4 Survey methodology

Existing survey guidelines

Federal survey guidelines for Gouldian Finch are provided in the following references:

- Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010c, *Survey Guidelines for Australia's Threatened Birds*. EPBC Act survey guidelines 6.2 (l), Commonwealth of Australian, 2010.
- Department of the Environment 2016, *Erythrura gouldiae in Species Profile and Threats Database*, Department of the Environment, Canberra.

The method described for Gouldian Finch surveys is to conduct targeted searches and watches at waterholes (for a total of 12 hours over 4 days). It is recommended that such surveys be undertaken in the dry season when Gouldian Finch and other finches congregate around waterholes to drink (Bell 1996; Evans & Bougher 1987). In areas < 50 ha, area searches in suitable habitat may be useful (20 hours over 5 days).

Survey design

Given the linear nature of the NGP Project, EcOz consulted with Gouldian Finch expert – Associate Professor Sarah Legge (University of Queensland and Australian National University) to develop an assessment methodology that ensured survey effort was performed in the most effective and comprehensive manner (see Section 5.3.1 for an overview of her expertise and experience).

The following methodology was developed in consultation with, and endorsed by, Legge.

Survey area and target habitat types

Legge reviewed high-resolution aerial footage collected as part of the reconnaissance survey (see Section 3) to identify potentially suitable breeding areas and/or wet season foraging areas for Gouldian Finch. Legge analysed the footage against the backdrop of Google Earth Pro imagery and regional ecosystem vegetation mapping, to select survey areas to assess habitat suitability for the species within the Project footprint. This resulted in a survey area for Gouldian Finch between KP 580 and KP 622 of the construction ROW (in Queensland) (see Figure 5-27). Gouldian Finch are not expected to occur in the Northern Territory section of the Project footprint.

The survey targeted habitat associated with two main behavioural components of the Gouldian Finch:

- Potentially suitable breeding areas. These areas support mature Snappy Gum (*Eucalyptus leucophloia*), which are trees known to provide nesting hollows for Gouldian Finch in the region.
- Wet season foraging areas. Areas likely to support the range of perennial grass species relied on by Gouldian Finch during the wet season, with key species including *Alloteropsis semialata*, *Triodia* spp. *Chrysopogon fallax*, *Panicum decompositum* and *Xerochloa laniflora* (O'Malley 2006). The Project footprint falls outside the distribution for *Alloteropsis semialata*.

Legge also provided the following observations (based on review of aerial footage):

- All the potentially-suitable sites were towards the eastern end of the proposed pipeline route.
- The incidence of patches of suitable trees for nesting Gouldian Finch was low.
- The patches of suitable trees were small in extent, and with low tree densities.
- The patches of trees were sometimes in flat areas, but also on land with some slope.
- The eastern end of the pipeline shows signs of a history of frequent and intense fires; this would tend to discourage Gouldian Finches from using those areas (if, indeed, they were present initially).

Ground survey – breeding habitat assessment

Legge identified that the construction ROW intersected four main areas that contained a suitable density of trees that could be used for nesting (i.e. Snappy Gums or equivalent) (see Figure 5-27). These areas were searched for suitable nesting hollows at six survey transects between 11 and 15 May 2016.

Transects were selected via helicopter and were chosen in areas that presented the larger Snappy Gum trees with reasonable densities. Generally, they were located on ridges in the patches of highest density of Snappy Gum, except for one transect that was located through a low-lying area with a higher density of Snappy Gums than the surrounding landscape. Transects were 250 m and surveyed the presence and quality of hollows in Snappy Gums (and equivalent species), and whether these hollows had been used by finches for nesting.

For each transect, surveyors checked every tree within 25 m of the central line, thus covering approximately 1.25 ha. Every tree was examined to check whether a hollow was present or absent. If hollows were present, then data was collected for assessment of the potential suitability of that hollow for Gouldian Finch,

which have relatively specific hollow preferences (Harden et al. 1986, Brazill-Boast 2010 and Brazill-Boast et al. 2011, Tidemann et al. 1992). The following characteristics were collected at each suitable hollow:

- Number of hollows greater than 25 mm diameter entrance
- Hollow height (estimated to ± 0.5 m)
- Whether the hollow is within living tissue
- Angle of hollow entrance (90° being straight up, 0° being horizontal)
- Entrance diameter (if possible)

In the few instances in which it was not possible to measure certain characteristics of hollow-bearing trees (due to safety concerns), an estimation of those characteristics was made.

Suitable tree hollows were also checked for evidence of finch use, by examining the hollow for nesting material. Gouldian Finches, Long-tailed Finches, Zebra Finches and Double-barred Finches may all breed in hollows, although only the Gouldian Finch is an obligate hollow-nester. These finches all line the hollows with fine grass to create their nest. Gouldian Finches build the simplest structure – a flat grass platform or shallow cup at the base of the cavity, whereas Long-tailed and Double-barred Finches build a more elaborate grass nest dome with a short tunnel. For all finch species, the presence of nestling faecal material indicates a nest that has successfully produced nestlings.

Ground survey – wet season foraging habitat assessment

Gouldian Finches rely on a number of perennial grass species during the wet season, *Triodia* species are the dominant grasses along the entire route. Given the loss of *Triodia* spp. areas to the pipeline will be very small, this species is not a target species of concern.

Legge identified 10 sites which, based on general terrain, could contain wet season foraging habitat (although none of these could be described as ‘classic’ areas for foraging habitat). These areas were very small strips besides creeks that are more likely to support the range of perennial grass species relied on by Gouldian Finch during the wet season.

Sites were surveyed between 11 and 15 May. This included collecting the following information:

- Site photographs and geolocation
- Vegetation community assessment
- Landform
- Presence of Gouldian Finch preferred grass species.

If suitable grass species were identified, surveyors extended the assessment for 200 m either side of where the construction ROW crosses the creek to determine the extent of those grasses.

General bird survey

During transects, ecologists also kept a continuous lookout for Gouldian Finches and other birds, and recorded all species encountered.

5.10.5 Results

Breeding site assessment

Vegetation

Field assessment confirmed that, along the construction ROW, Snappy Gum was concentrated towards the rocky hills at the east of the alignment (KP 590 to KP 622). As the construction ROW transitions from the plains to rocky hills landform, areas of Snappy Gum are patchy and interspersed with Gidgee (*Acacia cambagei*) and open hummock grasslands. At the very eastern end, *A. cambagei* gives way to more uniform stands of *E. leucophloia*, *E. leucophylla* and *Corymbia terminalis*, with *E. camaldulensis* located along watercourses and drainage lines.

All of the sites surveyed were dominated by Snappy Gum (*Eucalyptus leucophloia*) with *E. leucophylla*, *Corymbia terminalis* and *C. aparrerinja* dispersed throughout (see Figure 5-25 and detailed site descriptions in Appendix L). The ground level vegetation was uniformly open hummock grassland of *Triodia pungens* with a limited mid-storey of *Acacia chisholmii* (where any mid-storey was present). At all sites, the *Triodia* hummocks were generally of uniform age and structure. Sites were all rocky, with high quartzite content amongst sandstone and siltstone with outcroppings of laterite.

All of the survey sites and surrounds showed significant impact from fire. The impact of fire has affected both the structure of the trees with potential breeding hollows, and the structure and mosaic of the understory *Triodia* hummocks. The Snappy Gum showed signs of fire impact, with most trees having multiple thin stems around a larger, degraded, burnt stem.



Figure 5-25. Photographs of typical habitat within survey sites for Gouldian Finch breeding habitat

Trees

A summary of trees present at each site is presented in Table 5-9. Trees in site B2S1 – which ran up a low quartzite ridgeline – were the largest of all the sites surveyed (based on average cross-sectional area at breast height per number of trunk stems, Tidemann 1992). Site B3S1 – which was on the western slope of a rocky hill near Mica Creek – also had some larger trees.

Table 5-9. Summary of tree morphometrics from the six Gouldian Finch transects

Site	Coordinates (decimal degrees)		No. trees	Trees per ha	Average tree height (m)	Average no. stems	Average cross- sectional area at breast height (cm ²)	Average cross- sectional area/stem (cm ²)
B1S1	-20.82531	139.25009	52	42	4.0	5	560	112
B1S2	-20.82890	139.29696	21	17	4.5	3	450	150
B1S3	-20.82445	139.26852	60	48	4.8	4	688	172
B2S1	-20.81252	139.39555	63	50	4.5	2	493	246
B3S1	-20.82523	139.45702	73	58	5.6	3	577	192
B4S1	-20.79295	139.46659	53	42	3.9	3	383	127

Hollows

Despite the relatively thin and ‘mallee-like’ growth of Snappy Gum within the survey areas, there was a relatively high density of hollows (18 to 26 per hectare) compared to other studies – 4.6 hollows per hectare (Brazill-Boast et al 2011) and 2 to 27 per hectare across all habitats (Gibbons and Lindenmayer 2002) – at all but two sites (see Table 5-10). The hollows were primarily located in burnt, old timber or dead ‘spouts’ stemming off living trees; only eight hollows were located within living tissue. As the results of previous studies have shown that Gouldian Finches have strong preferences for hollow characteristics (Brazill-Boast 2010, Tidemann et al. 1992), the suitability of nests within transects was assessed against the criteria determined in these earlier studies.

Based on Brazill-Boast et al (2010), Gouldian Finches select hollows that are located in living tissue, are located in robust trees, are higher off the ground, have smaller entrances and are deep into the trunk, and are closer to horizontal. For the purposes of this assessment, potentially-suitable Gouldian Finch hollows were conservatively defined as being in living tissue, being at least 2 m above the ground, and no more than 45° from horizontal. Using this definition, there were only two suitable nesting hollows within the six survey sites (see Table 5-10), out of 115 hollows in total. Neither of these hollows showed evidence of nesting by finches. Approximately 30% of hollows could not be inspected because of their height.

Table 5-10. Summary of hollow characteristics from each of the six Gouldian Finch transects

Site	Trees per ha	Total no. hollows	Hollows per ha	Average hollow height (m)	Average hollow diameter (cm)	Average hollow angle (°)	No. hollows in living tissue	Evidence of breeding	Density of suitable hollows
B1S1	42	31	25	3.1	6.2	45	4	No	1
B1S2	17	4	3	2.8	5.75	80	1	No	0
B1S3	48	33	26	2.7	6	45	1	No	1
B2S1	50	22	18	2.1	5	53	2	No	0
B3S1	58	22	18	2.5	4.9	45	0	No	0
B4S1	42	3	2	3.0	3.7	45	0	No	0

Nests

Across the six sites, only one nest was detected in a hollow. This nest was located in a burnt-out spout 1.5 m above the ground, with an entrance diameter of 15 cm. The nesting material was thick, coarse grass and was not constructed in the arrangements typical of Gouldian Finches. It may have been constructed by a Zebra Finch. In addition, there was no faecal material found within the nest.

Wet season foraging habitat assessment

Searches for potential wet season foraging habitat were undertaken at 10 locations on, or near to, the construction ROW (Table 5-11). Each of these searches was located in low-lying areas associated with banks of drainage lines or watercourses. All sites had sandy soil – graduating from red soil on the surrounding plains, to reddish-brown or grey on the watercourse beds. Soil was generally shallow (except for at Mica Creek) though deeper than the surrounding plains. Descriptions of each of the surveys sites are detailed in Appendix M.

Generally, introduced tussock grasses (Buffel Grass – *Cenchrus ciliaris* and Annual Mission Grass – *Pennisetum pedicellatum*) dominated the areas along drainage lines and watercourses searched. Cattle had heavily grazed the tussock grasses along the banks of most watercourses, and all sites showed a degree of erosion caused by cattle. In addition to the introduced grass species, Kapok Bush (*Aerva javanica*) was common.

Black Spear Grass (*Heteropogon contortus*) and Kangaroo Grass (*Themeda triandra*) were identified at a number of sites. These grasses were confined to the edge of the bank or within the drainage line, and only occupied a small area of the total search area. Apart from *Triodia spp.* – which were abundant – no other grass species that are critical wet season resources for Gouldian Finches were identified at any of the survey sites.

Table 5-11. Wet season Gouldian Finch foraging habitat survey sites

Site	Easting	Northing
GFF1	-20.81188	139.40677
GFF2	-20.81338	139.41005
GFF3	-20.81181	139.41435
GFF4	-20.83126	139.34287
GFF5	-20.80571	139.41926
GFF6	-20.82153	139.43936
GFF7	-20.82094	139.46167
GFF8	-20.81044	139.42471
GFF9	-20.80975	139.42321
GFF10	-20.81473	139.43266

General bird survey

Surveys were carried out for a total of 12.5 hours over 7 days. No Gouldian Finches were detected whilst conducting surveys (nor at any time during the fieldwork 10 – 17 May and 21 – 23 June). Only two species of finch were detected during the surveys – Zebra Finch (*Taeniopygia guttata*) and Painted Finch (*Emblema pictum*).



Figure 5-26. Photographs of typical habitat at survey sites for Gouldian Finch foraging habitat

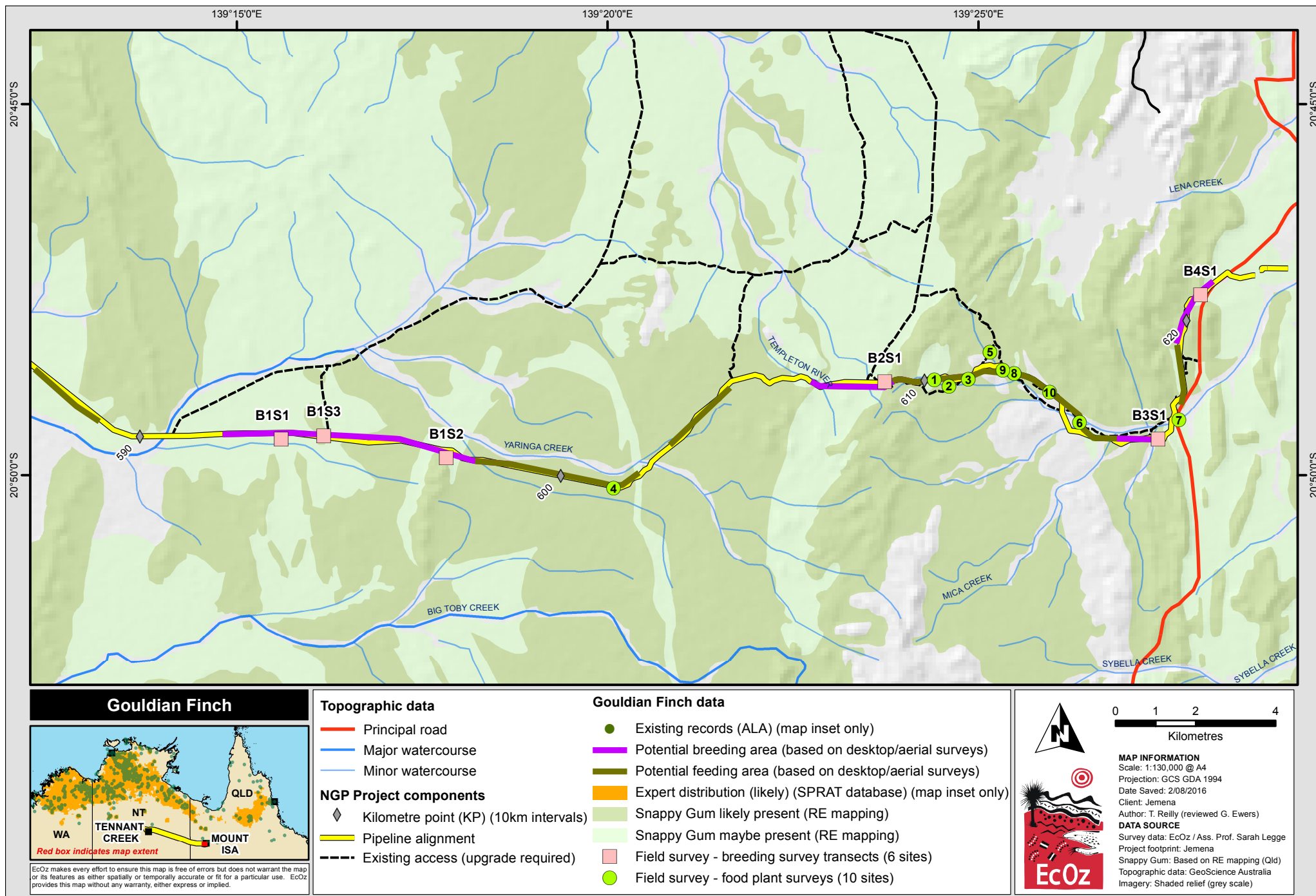
5.10.6 Discussion

As Gouldian Finches are obligate hollow-nesters, hollow limitation (or abundance of nest sites) is a predictor of breeding areas at the landscape scale (Brazill-Boast et al 2011). Surveys of the only sites with clusters of *E. leucophloia* within the construction ROW did not reveal any evidence of breeding use by the Gouldian Finch. This conclusion is based on the very low density of hollows with characteristics preferred by Gouldian Finches, and no evidence of Gouldian finch breeding (indeed, little evidence of any finch species breeding in these hollows).

It is notable that fire impact along the construction ROW is high – few areas showed significant spinifex hummocks and most sites had limited to no mid-storey. At all sites, the preferred nesting species – *E. leucophloia* – exhibited ‘mallee-like’ growth after fire, with multiple regrowth stems surrounding a central, dead and burnt trunk. These regrowth stems were short and thin, and had formed few hollows. Those hollows that were present were located in dead spouts rather than in the tree’s living tissue.

Searches along drainage lines and watercourses for potential wet season foraging habitat indicated that sites were generally dominated by introduced pasture grasses, and were heavily impact by grazing and erosion caused by cattle. Native grasses were confined to within the watercourse or the very margin of the bank. Fire has also influenced the structure (and likely functioning) of the spinifex understory. In surveyed sites, hummocks tended to be small and sparse, having been recently burnt. The site with the greatest availability of wet season foraging grasses was GFF5: native grass species were located at limited spots along the watercourse margin on grey sandy soil.

The pipeline lies south of the southern edge of the Gouldian Finch’s known distribution (O’Malley 2006). This, coupled with the absence of any contemporary sightings by bird watchers and survey teams in recent years, makes it seem highly unlikely that Gouldian Finches are present along the route of the pipeline. If finches ever were historically present in the surveyed areas, it is likely that contemporary land management (of cattle and fire) has now made these areas unsuitable.



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Figure 5-27. Map of Gouldian Finch habitat assessment and field survey

5.11 PAINTED HONEYEATER (*GRANTIELLA PICTA*)

5.11.1 Conservation status

- Northern Territory: Vulnerable
- Queensland: Vulnerable
- National: Vulnerable

5.11.2 Background information

Description

Painted Honeyeater is a medium-sized honeyeater (approximately 16 cm in length) with black upper parts, underparts with black spots on its flanks, and yellow outer edges to the wing primaries, secondaries and coverts and tail feathers. The species has a distinctive pink bill.

Ecology

Painted Honeyeater inhabits Eucalypt forests/woodlands, riparian woodlands of Black Box and River Red Gum, Box Ironbark / Yellow Gum woodlands, Acacia-dominated woodlands, paperbarks, Casuarina, Callitris and trees on farmland or gardens (TSSC 2015b). The species prefers mature trees and is more common in blocks of remnant vegetation rather than narrow strips (Garnett et al. 2011). Unlike other honeyeaters, the species is dependent on mistletoe berries during the breeding season (Barea & Herrera 2009; Watson 2012), although insects and nectar are also taken. The diet relies less on mistletoe and more on other food sources (especially arthropods) during the non-breeding season (Oliver et al. 2003; Garnett et al 2011). Nest selection is concentrated in habitats with high occurrence of mistletoe (Barea 2008); however, nesting success is generally low (Barea and Watson 2013).

Distribution

Painted Honeyeater occurs through the eastern states, from the eastern Northern Territory through south-west Queensland to northern Victoria. Generally uncommon through its range, concentrations of the species are located on the inland slopes of the Victorian and New South Wales alpine regions, and in Roma, Queensland (Morecombe 2003). The species breeds between Victoria and south-east Queensland southern regions between October and March (BirdLife International 2016; Pizzey and Knight 2012) and migrates to the drier interior – including near Mount Isa – outside of these times (Garnett et al 2011). However, the use of habitat in north-west Qld is becoming increasingly uncommon (TSSC 2015b).

There are three records from the Mount Isa region – from 1932, 2006 and date unknown – including one within the Project footprint at Mica Creek (see Figure 5-29). There is a population of the endemic Kalkadoon Grasswren adjacent to Mica Creek which is well-known to birdwatchers wishing to 'sight' the species. As such, there have been 123 documented bird surveys (ALA 2016) at the junction of Mica Creek and the Diamantina Developmental Road, from which there is only a single Painted Honeyeater record. Nevertheless, the Project footprint between KP 570 and the Mica Creek Compressor Station (KP 622) lies within the *expert distribution* of this species (BirdLife International 2016). Records from the Northern Territory are sparse and uncommon, and are expected to be occasional occurrences of the species moving from the critical habitat for a short period.

Threatening processes

The main threat to Painted Honeyeater is habitat loss through the clearing of woodland habitat with the species' preferred mistletoe species (Watson 2012; Garnett et al 2011; TSSC 2015b). Preferred habitat is generally located on rich fertile soils that are also valued as farmland.

Habitat loss through continued degradation of woodland by inappropriate fire and grazing regimes also threatens the species. Frequent fires reduce mistletoe densities through woodland – reducing the key food

source for the Painted Honeyeater (Watson 2012). Inappropriate grazing regimes prevent recruitment of woodland species, causing a change in woodland structure and leading to a future loss of mistletoe resources (Watson 2012; TSSC 2015).

5.11.3 Survey context

Purpose

If present within the Project footprint, Painted Honeyeater could be impacted by Project construction works. It is unlikely that the construction activities will have an impact on breeding of the species, as the closest known breeding area is located in southern Queensland. However, if present, construction activities will disturb woodland areas into which the Painted Honeyeater may occur following breeding.

The purpose of the Painted Honeyeater survey is to determine whether the species occurs within the Project footprint and to assess the suitability of the habitat for use by Painted Honeyeater.

Overview

To achieve the abovementioned purpose, the survey was designed to:

- a) Identify areas of potential habitat using desktop mapping datasets.
- b) Visit sample sites within that habitat to confirm whether it is suitable habitat, and to assess habitat quality.
- c) Undertake bird surveys, searching for Painted Honeyeater and habitat con-specifics.

5.11.4 Survey methodology

Existing survey guidelines

There are no federal survey guidelines for Painted Honeyeater.

The Queensland Government has developed survey guidelines for the Painted Honeyeater (Rowland 2012) which lay out the following survey approach:

Area searches (during breeding season) involve systematically searching for birds and signs of their presence (e.g. nesting habitat), as well as listening for their calls, throughout the Project area (DEWHA 2010c). Surveys for this species should be conducted on foot and target foraging and breeding habitat, which includes woodlands where mistletoes are abundant, and in particular, when they are in fruit (Watson 2012).

Outside of the breeding season, Painted Honeyeater occurs in a wide area outside their critical habitat – usually in association with fruiting mistletoe, but in random locations. The guidelines recommended that survey effort be increased outside of breeding season.

Survey effort recommends a minimum of four hours searching over four days (i.e. 1 hour per day over 4 days) based on a 50 ha Project area.

Survey area and target habitat

Given the *expert distribution* (BirdLife International 2016) of the species does not extend west of KP 570, the survey area was confined to between KP 570 and KP 622. Occurrence of Painted Honeyeater west of this point – including all of the records from the Northern Territory – is sporadic, as the species occasionally moves far away from its breeding range outside of breeding season.

A review of the regional ecosystem mapping datasets for Queensland was undertaken to select mapped polygons containing riparian woodland with Red River Gum (*Eucalyptus camaldulensis*). These areas were selected as they are expected to provide both the most fertile country within the region, the highest density of trees and associated mistletoe, and thus provide the most suitable habitat for the species.

Vegetation mapping indicates that the construction ROW intersects 8.7 km of mapped polygons containing riparian vegetation between KP 570 and KP 622. The area of mapped polygons containing riparian vegetation within the 30 m wide construction ROW is 26.1 ha.

Survey timing

Painted Honeyeater surveys occurred between 14 – 17 May and 21 – 23 June 2016. Although the species is likely only present in the north-west of Queensland seasonally, conducting surveys in May and June was expected to optimise detection probability. The species breeds between October and March (Pizzey and Knight 2012) and migrates to the drier interior outside of these times (including May and June). Additionally, the recent record of the species was from July and, although the dates of the surveys were earlier than the record, the survey dates were comparable in terms of seasonality.

Site selection

Thirteen targeted surveys at seven sites were conducted through open woodland along the construction ROW. Riparian woodland with *E. camaldulensis* bordered by *E. leucophloia*, *E. leucophylla* and *Acacia spp.* were selected as preferred sites. Details of survey sites are shown in Table 5-12 and locations of surveys are shown on Figure 5-29.

Table 5-12. Dates of targeted Painted Honeyeater surveys

Site	Coordinates		14 May	15 May	16 May	17 May	21 June	22 June	23 June
BC1	-20.82154	139.44061	X	-	X	-	X	-	-
BC2	-20.82638	139.44663	X	-	-	-	-	-	-
BC3	-20.80996	139.42268	-	-	-	X	X	-	-
BC4	-20.81531	139.43190	-	-	-	X	X	-	-
BC5	-20.82113	139.45901	-	-	-	X	-	X	-
BC6	-20.79395	139.46533	-	-	-	X	-	-	X
BC7	-20.8253	139.235	-	-	-	-	-	X	-

Habitat assessment

Habitat features of each site were described to assess the suitability for Painted Honeyeater. The following information was collected:

- Landform
- Vegetation (including regional ecosystem descriptions)
- Habitat values (including the presence of Mistletoe, the presence of water, habitat structure which would provide shelter)
- Level of disturbance (including cattle impact, fire and weed presence)

Targeted survey

Following habitat assessment, surveys were conducted at locations with the most suitable habitat in the local area. Each survey was conducted for 20 minutes on foot by two field ecologists and consisted of walking slow transects (typically along watercourses) covering approximately 200 m. Ecologists recorded all bird species identified along the transects. Surveys totalled 4.3 hours over 6 days, exceeding the recommended survey effort (i.e. 2 hours based on an area 26.1 ha).

5.11.5 Results

Habitat assessment

- Surveys were conducted along riparian margins of watercourses and drainage lines.
- Soils were reddish brown and sandy with high rock content adjacent to the watercourse.
- Dominant vegetation consisted of *Eucalyptus camaldulensis*, *E. leucophylla* and *E. leucophloia* with *Acacia cambagei* away from riparian zone.
- Understory consisted of annual tussock grasses at the stream margins (predominately introduced Buffel Grass – *Cenchrus ciliaris*) with *Triodia pungens* forming low, open hummocks beyond (but occasionally extending to the top of the watercourse bank). These sites were selected as they had the highest density of mistletoe observed; however, mistletoe was only scattered through each of the sites.
- Site BC1 had the greatest abundance of mistletoe present and had a small amount of water flowing through the watercourse (see Figure 5-28 for general picture of BC1).
- Details of habitat assessment are provided in Appendix N.
- Sites surveyed along the construction ROW were not significantly different to areas outside the construction ROW.
- There is 8.7 km of preferred habitat (riparian vegetation) for Painted Honeyeater between KP 570 and KP 622 along the construction ROW.
- Very few *Eucalyptus* spp. were observed flowering during the May surveys and no mistletoe was observed to be fruiting. However, pre-flowering bud formation in *Eucalyptus* spp. was observed at the time of surveys (May and June). Mistletoe was observed to be fruiting during the June surveys, however, very few *Eucalyptus* spp. were flowering.

Targeted bird surveys

- Surveys did not detect Painted Honeyeater at any of the search sites, nor was Painted Honeyeater detected at any time during other fieldwork in the area.
- Targeted surveys detected five honeyeater species as well as Mistletoebird.
- Honeyeaters were detected at six of the seven sites, and Mistletoebird was detected at two sites (Table 5-13).
- Although there were no targeted Painted Honeyeater surveys conducted within the Northern Territory, the 65 on-ground surveys conducted for other threatened species did not detect Painted Honeyeater. For a complete list of bird species seen during surveys, see Appendix O.

Table 5-13. Honeyeater species & Mistletoebird records during targeted Painted Honeyeater surveys

	BC1	BC2	BC3	BC4	BC5	BC6	BC7
Grey-headed Honeyeater (<i>Ptilotula keartlandi</i>)	2	-	1	1	-	7	-
Grey-fronted Honeyeater (<i>Ptilotula plumulus</i>)	-	-	-	-	-	7	-
Yellow-tinted Honeyeater (<i>Ptilotula flavescens</i>)	3	-	-	-	2	2	1
White-plumed Honeyeater (<i>Ptilotula penicillata</i>)	12	-	-	-	12	1	2
Brown Honeyeater (<i>Lichmera indistincta</i>)	-	-	-	-	-	3	-
Mistletoebird (<i>Dicaeum hirundinaceum</i>)	2	-	-	-	-	-	1



Figure 5-28. Photograph of most suitable Painted Honeyeater survey site

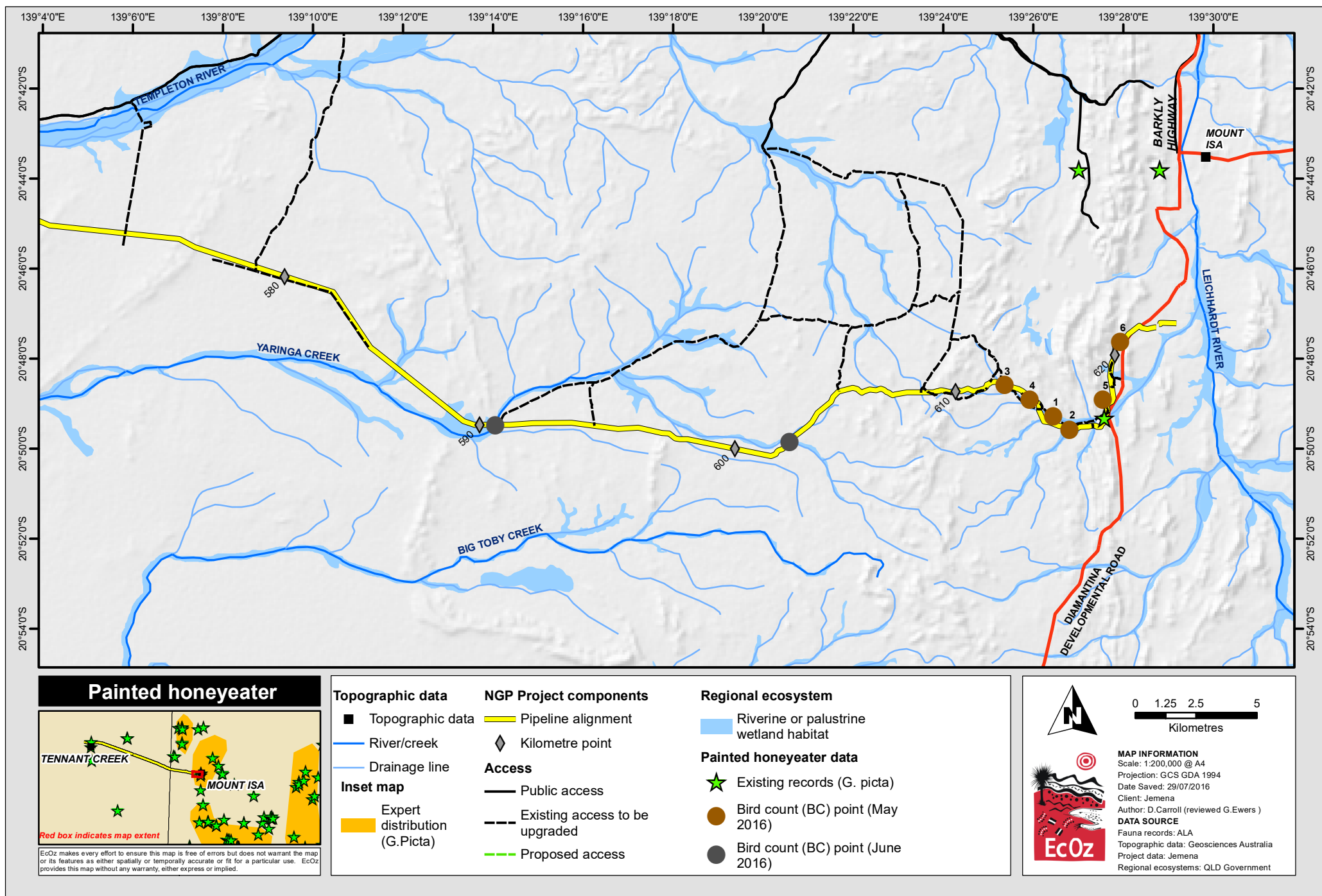
5.11.6 Discussion

Painted Honeyeater was not detected during the targeted surveys in Queensland or general bird surveys in the Northern Territory. Survey effort was above that recommended in the Queensland guidelines for the species.

Site BC6 had the highest number of bird species (including honeyeaters). This was likely due to an established and unburnt understory that provides additional habitat for a range of bird species. Surveys at this site detected four honeyeater species; however, no mistletoe was detected at the site, indicating sub-optimal foraging resource availability for the Painted Honeyeater.

The site with the greatest concentration of mistletoe was BC1. Although the mistletoe was not fruiting at the time of survey, that site presents the most suitable habitat of all the sites. The increased density of mistletoe at this site is likely due to the larger size of the watercourse, presence of permanent to semi-permanent water and the longer time since the last fire.

In general, the sites surveyed contained limited numbers of mistletoe. Although Painted Honeyeater utilises alternative food sources (especially outside the breeding season), the reliance on mistletoe as a primary food source, and the paucity of local records despite a high number of surveys, indicates that the woodland through which the construction ROW passes constitutes only marginal habitat used occasionally by the species. The occurrence of this species (in an ecologically-meaningful way) is considered unlikely.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-21. Map of Painted Honeyeater habitat and records.mxd

Figure 5-29. Map of Painted Honeyeater habitat assessment and field survey

5.12 GREY FALCON (*FALCO HYPOLEUCOS*)

5.12.1 Conservation status

- Northern Territory: Vulnerable
- Queensland: Vulnerable
- National: Not Listed

5.12.2 Background information

Description

The Grey Falcon is a medium-sized, compact, pale falcon. The head and upperparts are a light blue-grey, with darker grey flecking on the wings and barring on the tail. The wing tips are black, the cheeks and chin are white (except for a faint grey tear under each eye), and the underparts are white with fine dark streaks. The bill is grey with a dark tip. The cere, eye-ring and legs are bright yellow. (Ward 2012)

Ecology

The Grey Falcon is known to occur in areas of lightly-timbered lowland plains, typically on inland drainage systems, where the average annual rainfall is less than 500 mm (Ward 2012). This species occupies nests (often built by other bird species) in the tallest trees along watercourses (Garnett et al. 2011), as well as on telecommunications towers. Nesting is normally between June to November (Ward 2012). The Grey Falcon is generally a solitary bird, sometimes found in pairs or family groups (Debus 2012).

Distribution

The Grey Falcon is always found in low densities (Garnett et al. 2011), primarily throughout arid and semi-arid areas (Ward 2012), including the Northern Territory and Queensland. Most records are in the Tanami Desert and in the lower third of the Northern Territory (Northern Territory Fauna Atlas database 2015).

There are six known records proximate to the Northern Territory section of the Project footprint (see Figure 5-2), as well as many others in the Queensland section (mostly concentrated around Mount Isa) and the region in general. Many records are from the Barkly Highway, along which there are many telecommunications towers suitable for Grey Falcon nests.

Threatening processes

According to Ward (2012):

Threats to the Grey Falcon are not clearly defined. In the Northern Territory, landscape-scale changes in fire-regimes or grazing by feral or domestic herbivores may, in the long-term, reduce the availability of nesting trees and appropriate prey species. To a lesser extent habitat alteration and destruction through clearing for grazing and agriculture probably lead to declines in the species' southern and eastern ranges early last century, and confined them more to the arid parts of its range.

5.12.3 Survey context

Purpose

Given the small area of land disturbed during construction, the impact of Project activities on foraging habitat for Grey Falcon will be negligible. This species could only be impacted in the unlikely situation that the Project footprint intersects with an active Grey Falcon nest.

The purpose of the Grey survey is to identify potential nesting habitat, potential nest sites, and assess habitat suitability, within the Project footprint.

Overview

To achieve the abovementioned purpose, the survey was designed to:

- a) Identify areas of potential nesting habitat
- b) Visit sample sites within that habitat to confirm if active nests are present and whether it is suitable nesting habitat for Grey Falcon.

5.12.4 Survey methodology

There are no species-specific guidelines applicable to surveying Grey Falcon.

The survey area for Grey Falcon includes the entire Project footprint as it is listed as threatened in Northern Territory and Queensland, and the distribution of the species covers most of inland Australia.

Target nesting habitat for Grey Falcon within the Project footprint is considered to be limited to vegetation types associated with drainage systems, as these areas are the only habitat types that consistently provide suitably sized trees that may be utilized as nest sites. All habitat types within the Project footprint are considered as potential foraging habitat for the species, these areas will not be targeted during field studies.

The survey effort required to determine presence/absence of Grey Falcon within the Project footprint is not commensurate with the low risk that the Project activities will negatively impact upon this species. Therefore, targeted bird watching surveys for Grey Falcon was not undertaken (however, opportunistic bird watching occurred as part of other field activities). Instead, the potential presence of Grey Falcon was assessed by undertaking the following activities:

- Review of habitat mapping survey results (see Section 4) to identify alluvial / drainage habitats that may support trees potentially-suitable for nest sites.
- Review of high-resolution aerial footage obtained during the reconnaissance survey (see Section 3)
- Raptor nest sightings made during surveys for other threatened species described in this report, which included visitation of all major watercourses intersected by the construction ROW.

Whilst in the field, ecologists undertaking targeted surveys for other threatened species made a record of all bird species encountered. These ecologists have previous experience in identification of Grey Falcon.

5.12.5 Results

The following points summarise the main results from the Grey Falcon survey:

- No Grey Falcon or nests were identified within the Project footprint.
- Grey Falcon was opportunistically recorded on three occasions during field surveys in May and June 2016. All were single bird observations assumed to be either foraging or transiting (i.e. no nests were seen) (see Figure 5-31):
 - Barkly Homestead airstrip approximately 17 km north of KP 210.
 - Austral Downs Station near Georgina River approximately 21 km north of KP 439.
 - May Downs Station approximately 10 km north of the KP 603.
- The entire Project footprint constitutes suitable foraging habitat for Grey Falcon.
- The following watercourses supported trees suitable for nesting purposes (tree species included *Eucalyptus microtheca* and *E. camaldulensis*) – Ranken River, James River, Georgina River, Minger Creek, Templeton River, Yaringa Creek and Mica Creek (see Figure 5-30 for photographs of representative habitat).
- Throughout the region there are also many telecommunications towers which present suitable nesting structures for Grey Falcon.

5.12.6 Discussion

There are many records of Grey Falcon in the region and the entire Project footprint constitutes suitable habitat, including sighting of the species at three locations during field studies (foraging, fly-over observation). However, Grey Falcon is a solitary bird (only occasionally found in pairs or family groups) occurring in low densities throughout its broad distribution. A few individuals may include the Project footprint within their ranges, but there was no evidence of a breeding pair being extant during field surveys.

The entire Project footprint is classed as foraging habitat for the species; however, project impacts to Grey Falcon foraging is regarded to be negligible. Therefore, disturbance of nest sites is a focus in terms of impact assessment for the species. For the region of the Project footprint, nesting habitat is likely to be restricted to larger drainage systems (as these areas may support trees large enough for nests) – which equates to 3.7 ha within the Northern Territory (see Table 5-14). Alluvial plains adjacent to drainage systems may also provide nesting opportunities for the species, this equates to approximately 103 ha (within the Northern Territory) but is regarded as marginal nesting habitat for the species (see Table 5-14). Nesting habitat within Queensland will be assessed under separate documentation relevant to Queensland environmental approvals (note that habitat mapping of alluvial areas indicated that 124.2 ha is proposed to be intersected by the Project footprint within Queensland, see Table 5-14).

Table 5-14. Potential nesting habitat for Grey Falcon within the Project footprint

Alluvial-based habitat		Disturbance Area (ha)			Grand Total
		ROW	Access tracks	Other	
NORTHERN TERRITORY					
	Drainage Systems (nesting habitat)	2.9	0.8	0.0	3.7
	Alluvial Plains (marginal nesting habitat)	61.6	12.8	28.6	103.0
QUEENSLAND					
	Alluvium (assessed in separate document)	53.2	22.1	48.9	124.2
Grand Total		117.7	35.7	77.5	230.9

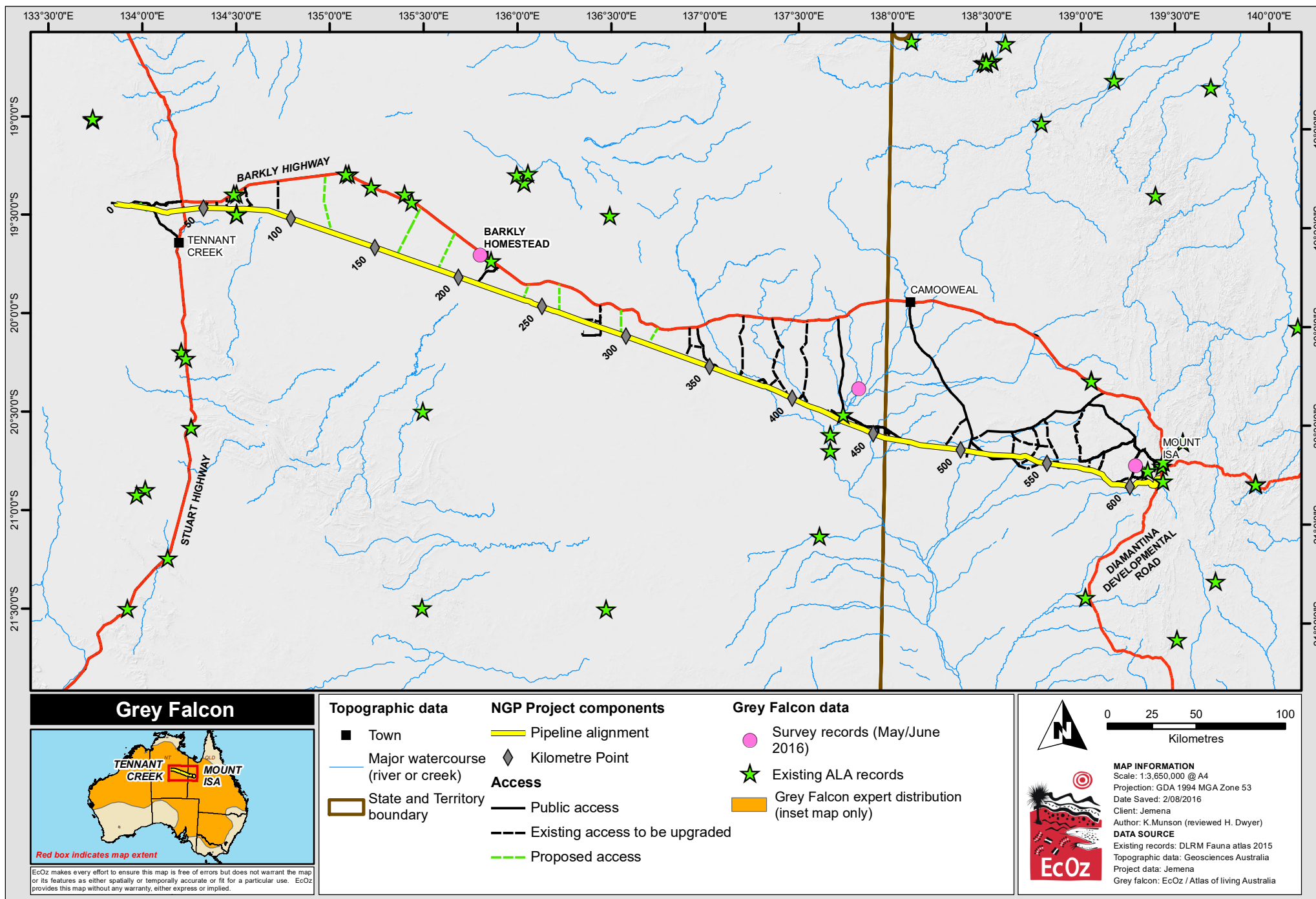


*Ranken River (Northern Territory) – lined by Coolabah (*Eucalyptus microtheca*)*



*Templeton River (Queensland) – lined by Red River Gum (*Eucalyptus camaldulensis*)*

Figure 5-30. Photographs of potential Grey Falcon nesting habitat along rivers and creeks



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-24. Map of Grey Falcon habitat and records.mxd

Figure 5-31. Map of Grey Falcon habitat assessment and records

6 MIGRATORY SPECIES

The Protected Matters Search Tool (Appendix C) resulted in a list of 20 migratory species that are either known to, or have potential to, occur in the region of the Project footprint.

The likelihood of each migratory species occurring within the Project footprint was determined using the same process as that for threatened species (described in Section 5.2.2). These are summarised in Table 6-1, with a full assessment table provided in Appendix P.

Table 6-1. Summary of migratory species analysis

Likelihood	Common name	Scientific name
High	Rainbow Bee-eater	<i>Merops ornatus</i>
	Great Egret	<i>Ardea alba</i>
	Cattle Egret	<i>Ardea ibis</i>
	Fork-tailed Swift	<i>Apus pacificus</i>
	Oriental Plover	<i>Charadrius veredus</i>
	Oriental Pratincole	<i>Glareola maldivarum</i>
Low	Eastern Osprey	<i>Pandion cristatus</i>
	Sharp-tailed Sandpiper	<i>Calidris acuminata</i>
	Common Greenshank	<i>Tringa nebularia</i>
	Wood Sandpiper	<i>Tringa glareola</i>
	Marsh Sandpiper	<i>Tringa stagnatilis</i>
	Red-necked Stint	<i>Calidris ruficollis</i>
	Black-tailed Godwit	<i>Limosa limosa</i>
	Little Curlew	<i>Numenius minutus</i>
	Pacific Golden Plover	<i>Pluvialis fulva</i>
	Lesser Sand Plover	<i>Charadrius mongolus</i>
	Whimbrel	<i>Numenius phaeopus</i>
	Barn Swallow	<i>Hirundo rustica</i>
	Grey Wagtail	<i>Motacilla cinerea</i>
	Yellow Wagtail	<i>Motacilla flava</i>

As shown in Table 6-1, six EPBC-listed migratory bird species were identified within the *EPBC Act* Protected Matters Search Report as having a high chance of occurring in the Project footprint:

- Fork-tailed Swift (*Apus pacificus*)
- Rainbow Bee-eater (*Merops ornatus*)
- Oriental Plover (*Charadrius veredus*)
- Oriental Pratincole (*Glareola maldivarum*)
- Great Egret (*Ardea alba*)
- Cattle Egret (*Ardea ibis*)

Each of these species are discussed below

6.1.1 Fork-tailed swift (*Apus pacificus*)

The Fork-tailed Swift is an aerial feeder, flying between 1 m to 300 m above the ground to forage (Higgins 1999). It is a non-breeding visitor to Australia that has been recorded throughout the country (Higgins 1999). Given its wide distribution and high mobility, it is likely that the species will be present from time-to-time in the sky above the Project footprint.

6.1.2 Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is a widely distributed species that uses a range of habitat types – including woodlands, shrublands, and various cleared and semi-cleared habitats (Simpson and Day 2004). It is likely that the woodland vegetation communities within the Project footprint constitute suitable foraging habitat for the Rainbow Bee-eater.

6.1.3 Oriental Plover (*Charadrius veredus*)

The Oriental Plover is a summer migrant in much of northern Australia. The species has a wide distribution and uses a range of habitat types (DOE 2016d). Upon arrival from Northern Hemisphere breeding grounds, the Oriental Plover spends a few weeks in coastal habitats before dispersing further inland (Storr 1977). Whilst in Australia, the species does not maintain territories or home ranges (DOE 2016d). This species could occur throughout the flat areas of the Project footprint (particularly in clay plains of the Barkly Tablelands).

6.1.4 Oriental Pratincole (*Glareola maldivarum*)

The Oriental Pratincole occurs at many widespread sites in northern Australia, especially near the coasts of northern Western Australia and the NT, and in inland areas north of 20° S in those states (Blakers et al. 1984, Barrett et al. 2003). The species is generally gregarious, occurring flocks which, in northern Australia, can comprise thousands of birds (Higgins & Davies 1996). The Oriental Pratincole usually inhabits open plains, floodplains or short grasslands (Garnett 1986). This species could occur throughout the flat areas of the Project footprint (particularly in clay plains of the Barkly Tablelands).

6.1.5 Egret species (*Ardea alba* & *Ardea ibis*)

These two egret species are common wetland birds that are widespread across Australia. Individuals of the species occupy large areas and utilise a variety of inundated areas without strong preference for vegetation type (Marchant & Higgins 1990). The black soil plains area at the southern extent of the Barkly Tableland region contain inundated areas during the wet season – which constitute suitable habitat for these species – as does all riverine habitat within the Project footprint.

7 SUMMARY OF THREATENED SPECIES

Preliminary assessment of threatened species occurrence in Section 5.2.3 determined that nine threatened species (relevant to Northern Territory and/or Commonwealth) had potential to occur within the region of the Project footprint. Of these, targeted field surveys and/or habitat suitability assessment determined the following:

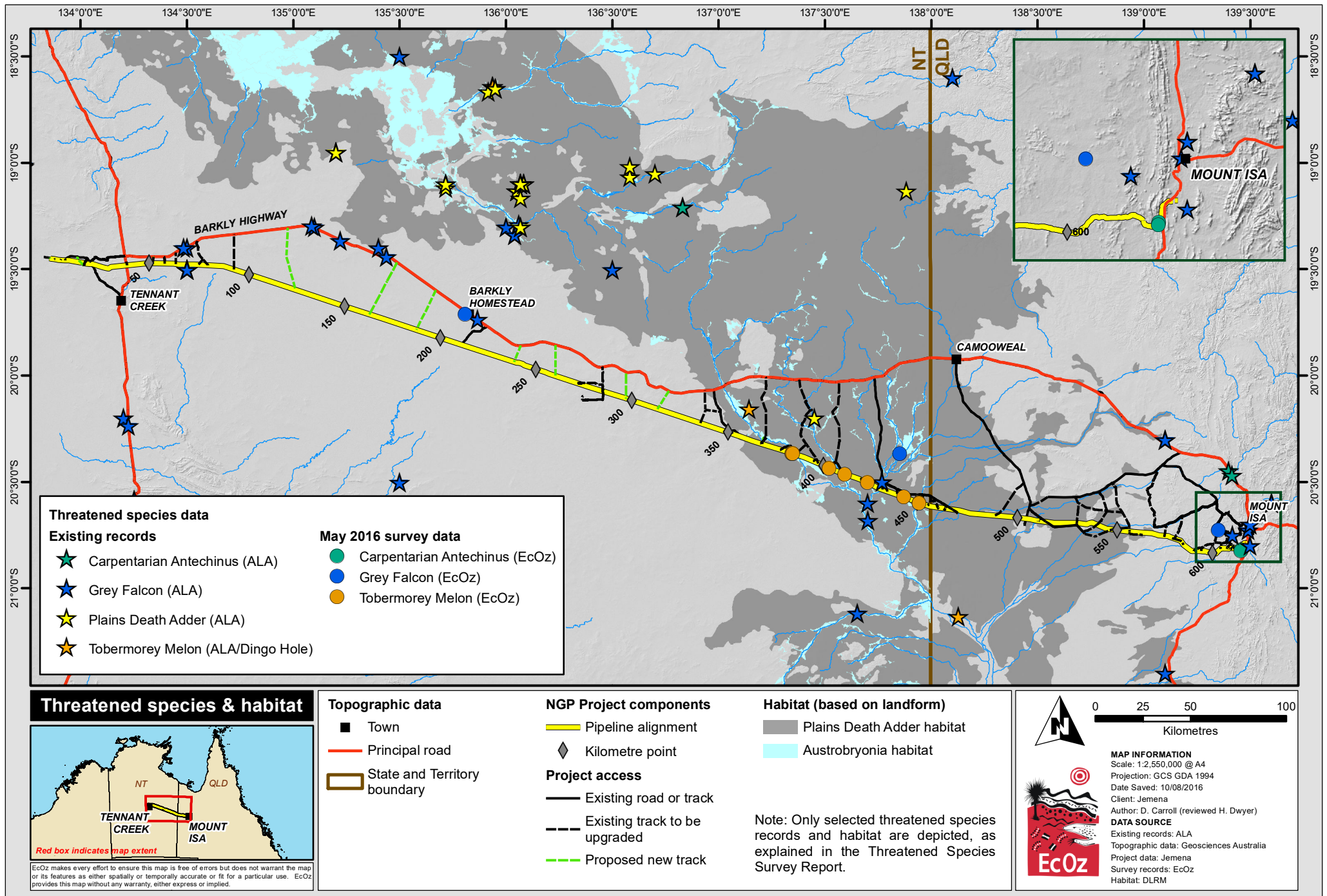
- Two threatened species were recorded within the Project footprint.
- Two threatened species were not identified during the surveys within the Project footprint; however, it is considered likely they occur within the Project footprint.
- Five threatened species that were considered by the likelihood assessment in Section 5.1 to have a medium to high chance of occurring within the Project footprint are – post-field surveys – considered unlikely occur within the Project footprint:

These results are shown in Figure 7-1. These species' 'likelihood of occurrences' have been revised accordingly – see Table 7-1.

Table 7-1. Post-survey threatened species 'likelihood of occurrence' within the Project footprint

Revised likelihood	Species name	EPBC status	TPWC status	Area of habitat within Project footprint	
				Temporary	Permanent
Known	Carpentarian Antechinus (<i>Pseudantechinus mimulus</i>) #	VU	VU	1.04 ha	0 ha
	Tobermorey Melon (<i>Austrobryonia argillicola</i>) *	-	VU	106.7 ha	0 ha
Likely	Grey Falcon (<i>Falco hypoleucos</i>) *	-	VU	3.7 ha	0 ha
	Plains Death Adder (<i>Acanthophsis hawkei</i>)	VU	VU	798.8 ha	21.3 ha
Unlikely	Gouldian Finch (<i>Erythrura gouldiae</i>)	EN	VU	N/A	
	Painted Honeyeater (<i>Grantiella picta</i>)	VU	VU	N/A	
	Brush-tailed Mulgara (<i>Dasycercus blythi</i>)	-	VU	N/A	
	Latz's Grass (<i>Sporobolus latzii</i>)	-	VU	N/A	
	Greater Bilby (<i>Macrotis lagotis</i>)	VU	VU	N/A	

* Relevant to Northern Territory only; # Relevant to Queensland only



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-X. Map of records and habitat for species considered as 'known' or 'likely' to occur within the Project footprint.mxd

Figure 6-12. Map of records and habitat for species considered as 'known' or 'likely' to occur within the Project footprint

8 ASSESSMENT OF SIGNIFICANCE

The objective of this chapter is to undertake a qualitative assessment of the importance of biodiversity values that have been identified to occur, or are considered likely to occur within the Project footprint, in order to determine their conservation significance. Such an assessment of conservation significance will inform the EIA process, as well as Project design and management.

The three biodiversity values assessed are:

- Threatened flora and fauna species
- Migratory bird species
- Sensitive vegetation types.

8.1 IMPORTANCE OF THREATENED SPECIES' POPULATIONS

As detailed in Section 4.1, targeted surveys and habitat assessments were undertaken for nine species that are listed under the *TPWC Act* and/or the *EPBC Act*. The result – as summarised in Section 7 – is that five species were not found during the surveys or suitable habitat was not identified within the Project footprint. Therefore, these species are considered unlikely to occur within the Project footprint, and have not been considered further.

Four species were recorded, or are considered likely to occur, within the Project footprint. The importance of the populations of these species is discussed in sections below.

When assessing the risk of impacts to threatened species that are known or likely to occur within the Project footprint, it is necessary to first establish whether local populations are 'important' as defined in *EPBC Significant Impact Guidelines 1.1* (DOE 2013).

All the threatened species that are 'known' or 'likely' to occur within the Project footprint are listed as Vulnerable under NT and/or Commonwealth legislation. In accordance with the guidelines, for Vulnerable species, an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity
- Populations that are near the limit of the species' range.

'Important populations' are considered, within this report, to be of conservation significance and will be addressed in the EIS risk assessment.

8.1.1 Plains Death Adder (*Acanthophis hawkei*)

This species is listed as Vulnerable under the *TPWC Act* and under the *EPBC Act*.

There are no records of Plains Death Adder within the Project footprint. Field surveys confirmed that 206 km of Plains Death Adder habitat is intersected by construction ROW between KP 355 and KP 561 (plus approximately 108 km of existing access tracks that will require 5 m widening) – which equates to approximately 820.1 ha of disturbance (of which 21.3 ha will be permanent). This is part of a continuous band of potentially-suitable habitat for the species which continues for many hundreds of kilometres to the north-west (see Figure 5-11). Within that habitat, there is one record (from 1978) approximately 22 km north of the construction ROW from the Wonardo land system, the only record from that land system. There are also many records 100+ km to the north-west of where the Project footprint intersects with suitable Plains Death Adder habitat. A high proportion of these records occur within the Barkly land system which is relatively uncommon in the Project footprint.

The presence – within the Project footprint – of suitable habitat to that known to support Plains Death Adder indicates a reasonable likelihood that the species occurs within the Project footprint. This would represent an extension (to the southwest) of the known range of an existing population this species. It seems reasonable to infer that such an occurrence would be part of the same population as that containing the record proximate to the Project footprint. What is unclear is whether that population is contiguous with the population that hosts the occurrence records from 100+ km further north in a different land system. Applying the precautionary principle, it is assumed that, if extant, occurrences of Plains Death Adder within the Project footprint would constitute a separate population (i.e. no gene flow) to that containing the multiple records of the species 100+ km to the north. A population of Plains Death Adder within the Project footprint can therefore be considered near the limit of the species' known range and, as such, necessary for maintaining the species genetic diversity.

For these reasons, the likely population of this species within the Project footprint is considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*).

Acknowledging the many uncertainties associated with determining the area of occupancy of this population, a conservative estimate of suitable habitat is 1.6 million ha (16 000 km²). This is based on the area of habitat containing the Wonardo land system and all other suitable black soil country to the south of that land system, as per Figure 5-11.

8.1.2 Carpentarian Antechinus (*Pseudantechinus mimulus*)

This species is listed as Vulnerable under the *TPWC Act* and under the *EPBC Act*.

Carpentarian Antechinus were identified near to the construction ROW in the rocky hills near Mica Creek, and at an isolated boulder outcrop (see Figure 5-18). These records represent a range extension to the south and south-west of other known occurrences. It is expected that they could occur throughout the eastern end of the Project footprint (between KP 609.5 and KP 620.5) wherever rocky outcrops, boulder piles or rocky hills are intersected. Habitat mapping indicates that a total area of 1.04 ha is proposed to be directly disturbed by construction activities (of which none will be permanent disturbance). There is a variety of rock types exposed in the region and it is unknown whether some of these comprise more preferred habitat for Carpentarian Antechinus.

It is not clear the degree to which occurrences of Carpentarian Antechinus are connected (in terms of population boundaries) in this part of its distribution (coupled with low level of existing ecological knowledge of the species). Based on survey evidence and advice from experts, it is inferred that all occurrences within the Project footprint form part of one population, as this assumes that there is dispersal and genetic flow between isolated boulder piles and more substantial rocky ridge lines.

Historically, Carpentarian Antechinus has not been widely surveyed for and may be locally common in the rocky country surrounding Mount Isa (given it has often been recorded when suitable habitat is surveyed – such as for this project). Nevertheless, the records of Carpentarian Antechinus within the Project footprint from the targeted survey represent an extension of the known range of this species and, applying the precautionary principle, it cannot be concluded that the population of the species within the Project footprint is contiguous with any other known populations in the Mt Isa area. The population of Carpentarian Antechinus within the Project footprint can therefore be considered near the limit of the species' known range and, as such, necessary for maintaining the species' genetic diversity.

For these reasons, the known population of this species within the Project footprint is considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*).

Acknowledging the many uncertainties associated with determining the area of occupancy of this population, a conservative estimate of suitable habitat is 4 369 ha. This is based on the area of rocky habitat depicted in Figure 5-18.

8.1.3 Grey Falcon (*Falco hypoleucos*)

This species is listed as Vulnerable under the *TPWC Act* and is not listed under the *EPBC Act*.

Grey Falcon (Vulnerable *TPWC Act*) or potential nests were not identified within the Project footprint during field surveys; however, the species was incidentally observed (foraging / flyover) on three occasions during field surveys outside the Project footprint – confirming their presence in the region. The entire Project footprint constitutes suitable foraging habitat. However, Grey Falcon is a solitary bird (only occasionally found in pairs or family groups) occurring in low densities throughout its broad distribution. As such, it is likely that a few individuals of this species have home ranges that intersect the Project footprint.

Grey Falcon could conceivably nest within the Project footprint; however, its preference for tall trees means that – regionally – suitable nesting habitat will be restricted to watercourses (or telecommunication towers). The limited number of watercourse crossings, relatively narrow Project footprint and short construction timeframe, all combine to suggest there is a low likelihood that a nest site would occur directly in the construction ROW during construction. Potential nesting habitat within the Northern Territory intersected by the Project footprint equates to 3.7 ha (temporary disturbance). Alluvial plains adjacent to drainage systems may also provide nesting opportunities for the species, this equates to approximately 103 ha (within the Northern Territory) but is regarded as marginal nesting habitat when compared to drainage systems. Nesting habitat within Queensland will be assessed under separate documentation relevant to Queensland environmental approvals.

General occurrence of a Vulnerable species in a region does not meet the definition of an ‘important’ population of a Vulnerable species as per the *EPBC Significant Impact Guidelines 1.1*. The Project footprint is within the *expert distribution* range of Grey Falcon, but there is no evidence that individual Grey Falcon in central-eastern Northern Territory and/or central-western Queensland constitute a key source population, or one that is necessary for maintaining genetic diversity.

For these reasons, the occurrence of a few individuals of this species within the Project footprint is not considered ‘important’ (as defined in *EPBC Significant Impact Guidelines 1.1*).

8.1.4 Tobermorey Melon (*Austrobryonia argillicola*)

This species is listed as Vulnerable and was previously listed as Endangered under the *EPBC Act*. The Commonwealth Threatened Species Scientific Committee (in 2010) determined that this species was eligible for delisting due to recent information that better defines its taxonomic status, and consequently establishes a much larger known range and number of occurrences. Furthermore, the TSSC stated that there are no listed threatening factors known to affect this species. Tobermorey Melon was subsequently de-listed as an *EPBC*-listed threatened species in December 2013.

Tobermorey Melon was recorded at 7 out of 12 targeted survey sites within the Project footprint, plus an incidental record adjacent to Austral Downs airstrip (adjacent to Georgina River). These records were spread across four catchments of the Ranken River, James River, Georgina River and Blue Bush Creek. There was one previous record of the species 15 km north of the construction ROW; with the remaining Northern Territory records from approximately 200 km south and 200 km to the north of the Project footprint. In Queensland, in very similar habitat, this species occurs in numerous locations south of the Project footprint. The *Commonwealth Listing Advice on Austrobryonia argillicola* (TSSC 2013) states that this species has an extent of occurrence of 800 000 km² and an unknown area of occupancy. In 2006, Kerrigan and Albrecht estimated that, in the Northern Territory, Tobermorey Melon has an area of occupancy of 20 km²; however, this was before additional records were found and also seems low because the then known population extent only just overlapped into the Northern Territory (see Figure 5-8).

TSSC (2013) asserts that although this species’ known distribution appears fragmented, this non-continuous distribution may be an artefact of limited collection effort (Kerrigan & Albrecht 2006). This has been re-affirmed during recent discussions with the Northern Territory Herbarium (Peter Jobson pers. comm. 2016).

As such, Tobermorey Melon could be a candidate for de-listing as a threatened species in the Northern Territory.

Survey results suggest that Tobermorey Melon is likely to be widespread in drainage habitat within the region, but is scarce (i.e. occurs in low densities) at each location. Approximately 106.7 ha of suitable habitat will be temporarily disturbed (no permanent disturbances will occur within drainage habitat). Given the large area of contiguous habitat and multiple records of this species when targeted in surveys, it seems reasonable to infer that there is a single population of Tobermorey Melon dispersed throughout the river systems in the Mitchell Grass Downs area. Occurrences of this species within the Project footprint should not be considered as populations of this species, but individual members of a single population. The criteria for that population being an 'important' one (as defined in the *EPBC Significant Impact Guidelines 1.1*) are not satisfied.

8.1.5 Conclusion

After due assessment, important populations of two threatened species are considered to occur, or likely to occur, within the Project footprint:

- Carpentarian Antechinus (*Pseudantechinus mimulus*) in the rocky country between KP 609.5 and KP 620.5
- Plains Death Adder (*Acanthophis hawkei*) in clay plains of the Mitchell Grass Downs bioregion between KP 355 and KP 561

8.2 IMPORTANCE OF MIGRATORY SPECIES' POPULATIONS

As detailed in Section 5.12.1, six EPBC-listed migratory bird species were also identified within the *EPBC Act* Protected Matters Search Report as having a high chance of occurring within the Project footprint.

When assessing if a project will significantly impact upon a migratory species, the key considerations under the *EPBC Significant Impact Guidelines 1.1* (DOE 2013) are whether an important habitat for a migratory species or an ecologically-significant population of a migratory species is involved.

In the case of migratory shorebirds – in this instance Oriental Plover and Oriental Pratincole – these two considerations are largely inter-related. This is demonstrated in the *EPBC Act Policy Statement 3.21* (DEWHA 2009a) which defines the criteria for important habitat for migratory shorebirds as sites that support any of the following:

- At least 0.1 per cent of the flyway population of a single species.
- At least 2 000 migratory shorebirds.
- At least 15 migratory shorebird species.

Apart from Lake Moondarah near Mount Isa (which is outside of the Project footprint by at least 15 km), there are few records of migratory shorebirds in the region, and none of those criteria are met for any migratory shorebird.

Oriental Plover, and particularly Oriental Pratincole, occur frequently throughout the clay grasslands of the Barkly Tableland at certain times of year (and individual flocks of Pratincoles could number a few thousand individuals). Although this implies that the second criterion for important habitat for migratory shorebirds is met, the occurrence of a flock of Oriental Pratincole could be anywhere in the vast area of the Barkly Tableland, not confined to a particular 'site'. The rationale behind the *EPBC Significant Impact Guidelines* (DOE 2013) criteria for important habitat is to identify sites that require protection. The Barkly Tableland is not a 'site' *per se* and, as such, this criterion is not met for Oriental Pratincole. Moreover, the suitable habitat for these species within the Project footprint is a tiny proportion of the regional total.

The four other relevant migratory bird species have very different habitats and ecologies, they are all similar in that the Project footprint neither represents important habitat for them, nor are ecologically-significant

populations likely to be present. All the species likely occur – seasonally – across the Project footprint in numbers commensurate with the region. Habitat for these species is widespread in the region, including within the Project footprint.

8.3 SENSITIVE VEGETATION (NORTHERN TERRITORY ONLY)

In the Northern Territory, sensitive vegetation types are those considered significant under the *Northern Territory Land Clearing Guidelines* (DNRETAS 2010). These vegetation types are either unique to the region and/or have high biodiversity values. The region of the Northern Territory in which the Project footprint occurs contains two of these sensitive vegetation types – ‘riparian vegetation’ and ‘wetlands’.

Riparian vegetation occurs along the larger creeks and rivers, of which all are located within the Mitchell Grass Downs bioregion (i.e. black soil plains) and were considered to be in relatively poor ecological condition (due to presence of erosion, weeds, and cattle). Four intersection points along the construction ROW were identified (associated with Ranken River, James River, Georgina River and Blue Bush Creek) plus several minor crossings associated with access tracks (noting that proposed access tracks are positioned on existing tracks that require 5 m widening). Vegetation associated with these watercourses is mostly Coolabah (*Eucalyptus microtheca*) woodland along the banks with sparse ground layer of tussock grasses and Blue Bush (*Chenopodium auricomum*). No aquatic vegetation (such as lily pads) was observed within the Project footprint. These areas are currently impacted by cattle, weed infestation (varying levels), and erosion.

Seasonal lakes and swamps (i.e. wetlands) occur in the region of the Project footprint; however, none are intersected or are expected to be impacted upon by construction activities.

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<UV]hUha Udd]b['XYgW]dh]cbg'fBcf\ Yfb'HYff]hcfmL

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<UV]HJha Udd]b['XYgW]dh]cbg'ĒBcfH Yfb'HYff]hcfm(based on DLRM Land Type mapping)'

@bXgWUdY'WUgg. Alluvial Floodplains'

@bXZ:fa 'i b]h Drainage system'

@bX'HndYfY[]cb.'Barkly Clay Plains'



8 YgW]dh]cb/ 'cVgYf j U]cbg.'

- Also referred to as 'Riparian Area' in terms of consideration of sensitive vegetation types within the Northern Territory.
- Uncommon with Project footprint and occurs only within Barkly Clay Plains land type region (i.e. Mitchell Grass Plains) and is not intersected within the Tennant Creek Sandplains land type region.
- The main drainage systems traversed are Ranken River, Georgina River, James River and Blue Bush Creek, plus some major tributaries with defined channels.
- Drainages often contain a main drainage channel with additional smaller (braided) channels and associated floodplains.
- Become flooded for short periods; some areas pool for extended periods after flooding.
- Floodouts adjacent to drainage systems are described as a different landform class – Alluvial Plains.
- Weed infestations (such as Noogoora Burr) were observed on banks of some drainages.

Gc]'hmdYg.'

Vertosols; sandy, silty and clay soils on Quaternary alluvium

J Y[YH]cb' hmdYfgL'

Land Type geor3: Low Open Woodland – Mixed species low woodland over tussock grasses. Dominant species include *Eucalyptus microtheca*, *Acacia stenophylla*.
No other vegetation types described within DLRM dataset

<UV]HJha Udd]b['XYgW]dh]cbg'ĒBcfH Yfb'HYff]hcfm(based on DLRM Land Type mapping)

@bXgWUdY'WUgg. Alluvial Floodplains'

@bXZ:fa 'i b]h Alluvial Plains'

@bX'HndYfY[]cb.'Tennant Creek Sandplains'



8 YgW]dh]cb/ 'cVgYfj U]cbg.'

- Land Type amma2 was the best descriptor of alluvial plains traversed by the Project footprint.
- *Corymbia aparrerinja* was also present in the upper canopy in low densities.
- Uncommon within the Project footprint and are confined to west on Tennant Creek Station and Phillip Creek Station.
- High cattle presence was observed; grasses were heavily grazed.

Gc]'hndYg.'

Kandosols; sandy, silty and clay soils on Quaternary alluvium'

JY[YH]cb' hndYf]t.'

Land Type = amma2: Low Open Woodland – mixed species low open woodland over tussock grassland. Dominant species – *Eucalyptus microtheca*, *Acacia aneura* and *Acacia georginae*.

Land Type = amma1: Tussock Grassland – mixed species tussock grassland with low isolated trees. Dominant species – *Fimbristylis dichotoma*, *Enneapogon polyphyllus* and *Eragrostis xerophila*.

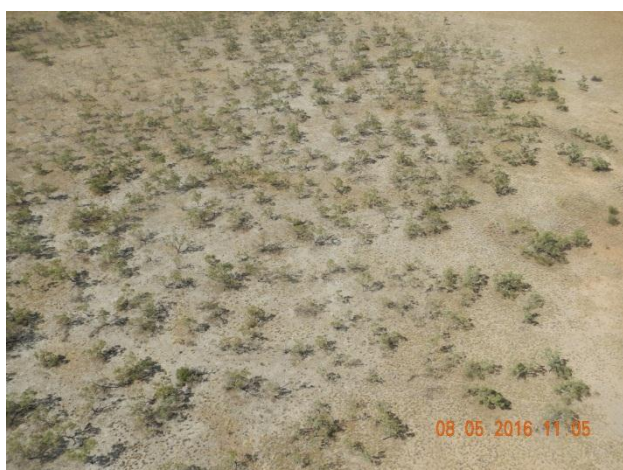
Land Type = amma1b: Low Open Woodland – mixed species low open woodland over tussock grassland. Dominant species – *Eucalyptus microtheca*, *Atalaya hemiglauca* and *Acacia estrophiolata*.

<UV]Hua Udd]b['XYgW]dljcbg'ĒBcfH Yfb'HYff]lcfm(based on DLRM Land Type mapping)

@bXgWUdY'WUgg. Alluvial Floodplains

@bXZ:fa 'i b]h Alluvial Plains

@bX'HndYfY[]cb.'Barkly Clay Plains'



8 YgW]dljcb/ 'cVgYfj U]cbg.

- Mainly associated with floodout areas of major watercourses; however also include tributaries and drainages without distinct drainage channel.
- Floodouts and depressions may support an upper canopy of *Eucalyptus microtheca*, *Excoecaria parvifolia*, *Acacia stenophylla*, or *Acacia georginae*.
- Tributaries only supported a shrub layer (no dominant trees)
- Weeds infestation likely to be present, such as Mesquite and Prickly Acacia.
- High cattle presence was observed; grasses were heavily grazed.

Gc]'lmdYg.'

Vertosols; sandy, silty and clay soils on Quaternary alluvium

JY[YH]cb' hndYfbL

Land Type = dry1: Low Open Woodland – Eucalypt low open woodland over tussock grasses. Dominant species – *Eucalyptus microtheca*, *Eucalyptus coolabah*, *Excoecaria parvifolia*.



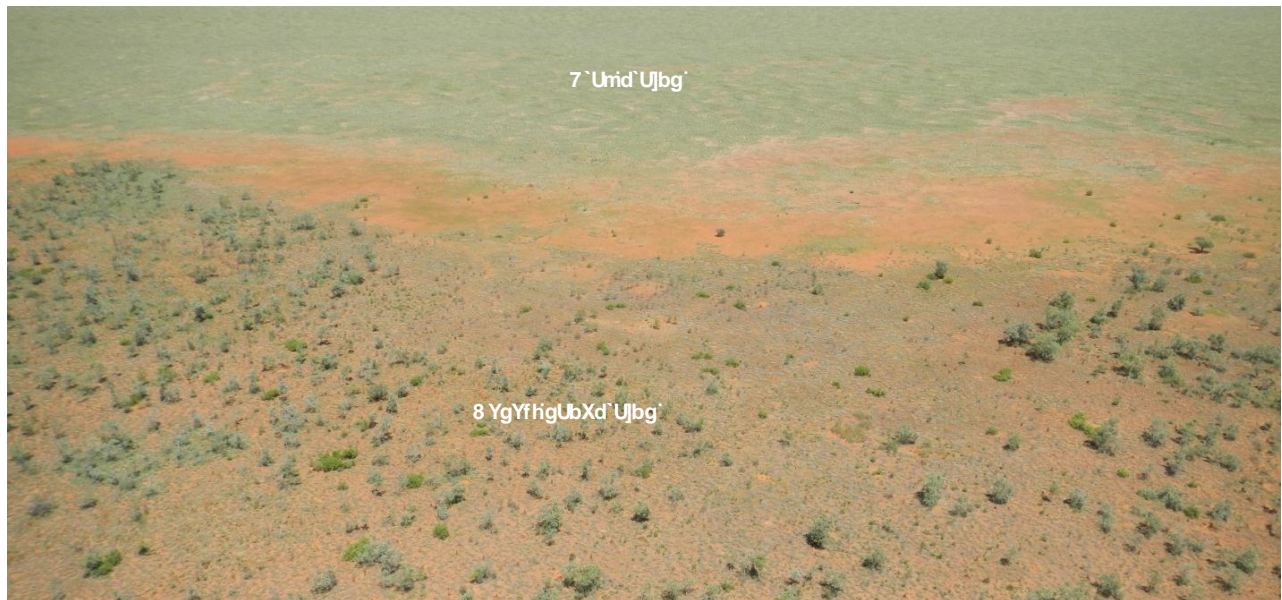
Land Type = dry1b: Tussock grassland – *Astrebla* tussock grassland. Dominant species – *Astrebla pectinata*, *Eulalia aurea*, *Aristida latifolia*.

Land type = geor1: Tussock grassland – *Astrebla* tussock grassland. Dominant species – *Astrebla pectinata*, *Astrebla elymoides*, *Chenopodium auricomum*.

Land Type = joan1: Low Open Woodland – Mixed species low open woodland over tussock grasses. Dominant species – *Eucalyptus microtheca*, *Excoecaria parvifolia*, *Bauhinia cunninghamii*.

Land Type = joan2: Low Open Woodland – Eucalypt low open woodland over tussock grasses. Dominant species – *Eucalyptus microtheca*, *Excoecaria parvifolia*.

Land Type = joan4: Low Open Woodland – Mixed species low open woodland over tussock grasses. Dominant species – *Eucalyptus microtheca*, *Excoecaria parvifolia*, *Acacia stenophylla*.

<UV]HJha Udd]b['XYgW]d]h]cbg'ĒBcfH Yfb'HYff]hcfm(based on DLRM Land Type mapping)'	
@bXgWUdY'WUgg. Desert Sandplains	@bXZ:fa 'i b]h Plains
@bX'HmdYfY[]cb.'Tennant Creek Sandplains'	.
	
8 YgW]d]h]cb/' cVgYfj U]h]cbg.	<ul style="list-style-type: none"> • Uncommon within the construction footprint. • Three sections were identified – totalling 13.1 km, all west of the Stuart Highway on Phillip Creek Station. • A reasonably high cattle impact was observed within these areas; tussock grasses were heavily grazed. • This are the only areas were patches of <i>Acacia aneura</i> were observed along the NT section of the construction footprint.
Gc]'hmdYg.'	Kandosols; red sands; higher loam and clay content in soils compared to sandplains.
JY[YH]h]cb' hmdYf]g.	<u>Land Type = bushy:</u> Tussock Grassland – mixed species tussock grassland with scattered shrubs of <i>Acacia aneura</i> . Dominant species – <i>Acacia aneura</i> , <i>Aristida contorta</i> , <i>Enneapogon polyphyllus</i> and <i>Triodia pungens</i>
@bX'HmdYfY[]cb.'Barkly Clay Plains'	.
	
8 YgW]d]h]cb/' cVgYfj U]h]cbg.	<ul style="list-style-type: none"> • Small 'islands' within clay plains that are not often intersected by Project footprint. • No ground-survey occurred during field studies.
Gc]'hmdYg.'	Tenosols; red sands
JY[YH]h]cb' hmdYf]g.	<u>Land Type = camil1:</u> Hummock grassland – <i>Triodia hummock</i> grassland +/- shrubs. Dominant species – <i>Triodia pungens</i> , <i>Triodia schinzii</i> , <i>Eragrostis eriopoda</i> .

<UV]Hua Udd]b['XYgW]dh]cbg'ĒBcfH Yfb'HYff]hcfm(based on DLRM Land Type mapping)

@bXgWUdY'WUgg. Desert Sandplains

@bXZ:fa 'i b]h'Sandplains

@bX'HndYfY[]cb. Tennant Creek Sandplains



8 YgW]dh]cb/
cVgYfj U]cbg.

- Extensive area within the Project footprint; only intersected within the Tennant Creek Sandplains.
- *Eucalyptus setosa* and *Acacia lysiphloia* were identified consistently across the Project footprint.
- *Eucalyptus gamophylla* tended to occur when soils has a higher loam/clay sub-layer.
- Very similar to the 'plains' landform unit within 'lateritic plains and rises'; however, there is a distinct lack of depressions/drainages and associated low rocky rises in the desert sandplains.
- Low to no cattle presence was observed.
- Experienced large fires at a moderately high frequency for the region (2 to 3 fires within 12 years).

Gc]'hndYg.

Tenosols; red sands

JY[Y]U]cb'
hndYf]g.

Land Type = sing: Tussock Grassland – Acacia/Eucalypt open woodland over hummock grassland.
Dominant species – *Acacia sericophylla*, *Corymbia opaca* and *Eucalyptus gamophylla*.

<UV]HJha Udd]b['XYgW]dHjcbg'ĒBcfH Yfb'HYff]Jcfm(based on DLRM Land Type mapping)

@bXgWUdY'WUgg. Lateritic Plains and Rises

@bXZ:fa 'i b]h'Plains

@bX'HndYfY[]cb. Tennant Creek Sandplains'



8 YgW]dHjcb' /
cVgYfj UHjcbg.'

- Extensive area within the Project footprint; only intersected within the Tennant Creek Sandplains.
- Land Type 'elli1' best describes vegetation traversed by the Project footprint; however, hummock grasses (*Triodia* sp.) were dominant. Land Types 'aligna' and 'pren2' not observed during surveys.
- Similar to the 'sandplains' landform unit within 'desert sandplains'; however often only located when rocky rises were present in the region. Lateritic plains also have fairly regular depressions / temporary swamps compared to desert sandplains.
- *Eucalyptus gamophylla* became more common within the eastern area of lateritic plains.
- Low to no cattle impact was observed.
- Experienced large fires at a moderately high frequency for the region (2 to 3 fires in some areas within 12 years).

Gc]'hndYg.'

Kandosols (soils which lack strong texture contrast, have massive or only weakly structured B horizons, and are not calcareous throughout); red sandy and earth soils

JY[YHjcb'
hndYfjL'

Land Type = elli1: Low open woodland – *Corymbia* spp. low open woodland over mixed tussock and hummock grassland. Dominant species – *Corymbia setosa*, *Corymbia aparrerinja*, *Corymbia opaca*.

Land Type = aligna: Tall sparse shrubland – *Acacia* spp. tall sparse shrubland over mixed tussock and hummock grassland. Dominant species – *Acacia aneura*, *Acacia georginae*.

Land Type = pren2: Low open woodland – *Corymbia* spp. low open woodland over tussock grassland. Dominant species – *Corymbia terminalis*, *Atalaya hemiglauca*, *Corymbia aparrerinja*.

C

<UV]HJha Udd]b['XYgW]dh]cbg'ËBcfH Yfb'HYff]hcfm(based on DLRM Land Type mapping)

@bXgWUdY. Lateritic plains and rises

@bXZ:fa 'i b]h'Low rises

@bX'HndYfY[]cb. Tennant Creek Sandplains'



8 YgW]dh]cb /
cVgYf j U]cbg.

- Land Type 'pren3' best describes vegetation traversed by the Project footprint. Areas similar to Land Type 'elli2' were observed in small area; however, only included *Corymbia aparrerinja* (not *Acacia aneura* or *Corymbia dichromophloia*)
- *Acacia hilliana* was commonly observed as a co-dominant species within Land Type 'pren3'. *Eucalyptus leucophloia* (low open woodland) was observed in some rises in the western region of the Project footprint.
- Extensive area within the Project footprint.
- Note that the total area mapped for this habitat type is exaggerated due to scale of mapping. It indicates a higher concentration of low rocky rises rather than the total area of low rocky rise. In general, rock rises were small and surrounded by lateritic (sandy) plains.
- Low to no cattle impact was observed.
- The area has experienced large fires at a moderately high frequency for the region (2 to 3 fires in some areas within 12 years).
- Low rises became slightly more elevated to the east; and were also associated with calcrete/limestone outcropping with a variety of different gravels.

Gc]'hndYg.'

Rudosols; red soils with high gravel content

J Y[YH]cb'
hndYfgL'

Land Type = pren3: Mid closed shrubland – *Acacia lysiphloia* closed shrubland over tussock grassland. Dominant species – *Acacia lysiphloia*, *Corymbia terminalis*, *Atalaya hemiglauc*.

Land Type = elli2: Woodland or Open woodland or Tall sparse Shrubland – Eucalypt/Acacia open woodland over hummock grassland. Dominant species – *Corymbia aparrerinja*, *Acacia aneura*, *Corymbia dichromophloia*.

<UV]HJha Udd]b['XYgW]dljcbg'ĒBcfH Yfb'HYff]Jcfm(based on DLRM Land Type mapping)

@bXgWUdY. Lateritic plains and rises

@bXZ:fa 'i b]h'Playas

@bX'HndYfY[jcb. Tennant Creek Sandplains'



8 YgW]dljcb/
cVgYfj U]jcbg.

- No playas are crossed by the Project footprint; however, some playas are close (i.e. within 500 m of Project footprint) and are therefore included in habitat description as these areas are considered as important refuge habitat types for the region (at least) and may support threatened species (such as Latz's Grass, *Sporobolus latzii*).
- Low to no cattle impact was observed.
- Experienced large fires at a moderately high frequency for the region (2 to 3 fires in some areas within 12 years).
- The DLRM dataset used for habitat descriptions included playas within the 'Desert Sandplains' landscape class; however, observations within the Project footprint better placed playas within 'Lateritic Plains and Rises' due to more consistent observations. Nonetheless, playas are described the same whether they are within either landscape class 'Desert Sandplains' or 'Lateritic Plains and Rises'.
- No weeds were observed in playas landed during surveys.

Gc]'lmdYg.'

Vertosols; clay soils; heavy loams

JY[YH]jcb
lmdYfjL

Land Type = playa: Tussock grassland – Mixed species tussock grassland with isolated *Eucalyptus microtheca* or *Eucalyptus victrix*. Dominant species – *Eragrostis australasica*, *Eucalyptus microtheca* or *Eucalyptus victrix*.

<UV]Hua Udd]b['XYgW]dl]cbg'ĒBcfH Yfb'HYff]lcfm(based on DLRM Land Type mapping)'

@bXgVUdY. Sandstone plains and rises

@bXZ:fa 'i b]h'Rises

@bX'HndY'fY[]cb. Tennant Creek Sandplains'



8 YgW]dl]cb' /
cVgYfj U]cbg.

- Small area within the Project footprint
- Only intersected within the western region of the Tennant Creek Sandplains.
- No ground-survey occurred during field studies.

Gc]'hndYg.'





Rudosols

JY[YH]cb'
hndYf]t.

Land Type = cherry 1a: Hummock grassland – *Triodia pungens* hummock grassland with low isolated trees and shrubs. Dominant species – *Triodia pungens*. (LT = cherry1a)

Land Type = tenck1: Hummock grassland – hummock grassland with isolated trees of *Corymbia aparrerinja* and other species. Dominant species – *Triodia pungens*. (LT = tenck1)

Land Type = cherry1b: Tussock grassland (sparse) – Mixed species sparse tussock grassland (or low open woodland) with low isolated trees/shrubs of *Acacia aneura* and *A. georginae*. (LT = cherry1b)

<UV]Hha Udd]b['XYgW]dh]cbg'ĒBcfH Yfb'HYff]lcfm(based on DLRM Land Type mapping)'	
@bXgWUdY. Clay plains	@bXZfa 'i b]h'Plains
@bX'HndYfY[]cb. Barkly Clay Plains'	.
   	
8 YgW]dh]cb/ ' cVgYfj U]cbg.'	<ul style="list-style-type: none"> • Extensive area within the Project footprint • Only intersected within the Barkly Clay Plains. • Generally similar to other landform unit 'Downs Plains'; however, 'Plains' shows less variation in microtopography and floristic variation. • Rarely supported trees. • Some areas contained surface rocks, cracks, and had evidence of minor sinkholes. • High presence of cattle. • No observation of weed infestations.
Gc]'lmdYg.'	Vertosols; black soil plains; cracking clay soils; heavy grey clays
JY[YH]cb' hndYf]k.'	<u>Land Type = wond:</u> Tussock grassland – <i>Astrebla</i> tussock grassland. Dominant species – <i>Astrebla pectinata</i>

<UV]Hua Udd]b['XYgW]dh]cbg'ĒBcfH Yfb'HYff]hcfm(based on DLRM Land Type mapping)

@bXgWUdY. Clay plains

@bXZ:fa 'i b]h'Downs Plains

@bX'HmdYfY[]cb. Barkly Clay Plains'



8 YgW]dh]cb' /
cVgYfj U]h]cbg.'

- Extensive area within the Project footprint
- Only intersected within the Barkly Clay Plains.
- Generally similar to other landform unit 'Plains'; however, 'Downs Plains' shows more variation in microtopography and floristic variation, and increased areas of surface rock/gravel.
- Only supports trees in minor depressions (not encountered within Project footprint)
- Some areas contained surface rocks, cracks, and had evidence of minor sinkholes.
- High presence of cattle.
- No observation of weed infestations.

Gc]'hmdYg.'

Vertosols; black soil plains; cracking clay soils



JY[YH]h]cb'
hmdYf]g'

Land Type = barklyA, barklyB: Tussock Grassland – *Astrebla* tussock grassland. Dominant species – *Astrebla pectinata*, *Aristida latifolia*, *Eulalia aurea*

Land Type = barklyC: Tussock Grassland – mixed species tussock grassland. Dominant species – *Aristida latifolia*, *Astrebla pectinata*, *Brachyachne convergens*

Land Type = cres2: Tussock Grassland – mixed species tussock grassland. Dominant species – *Aristida latifolia*, *Eulalia aurea*, *Dichanthium fecundum*

Land Type gidgee: Low Woodland – *Acacia* low woodland over tussock grasses. Dominant species – *Acacia cambagei*, *Acacia georginae*

<UV]HJha Udd]b['XYgW]dijcbg'ËBcfH Yfb'HYff]hcfm(based on DLRM Land Type mapping)'	
@bXgWUdY. Clay plains	@bXZ:fa 'i b]h'Inland Wetlands
@bX'HndYfY[]cb. Barkly Clay Plains'	.
	
8 YgW]dijcb' / cVgYfj U]cbg.'	<ul style="list-style-type: none"> • Small area intersected by the Project footprint. • The ROW intersects a temporary depression swamp that supports <i>Eucalyptus microtheca</i>, not considered to be of significance. • One access track intersects the edge of one area described as an Inland Wetland (it should be noted that this access track already exists and will require 5 m widening to allow access for construction operations). • These areas are considered important for biodiversity; however no wetlands of regional, state, or national significance occur within the vicinity of the Project footprint. • High presence of cattle; however unknown impact as no ground-survey was conducted during field studies.
Gc]'hndYg.'	Vertosols; black soil plains; cracking clay soils
J Y[YH]hcb' hndYfgL'	<p><u>Land Type = syl1, syl3:</u> Chenopod Open Shrubland – Chenopod open shrubland. Dominant species – <i>Chenopodium auricomum</i>, <i>Muehlenbeckia florulenta</i>.</p> <p><u>Land Type = syl2:</u> Low Woodland – Eucalypt low woodland over tussock grasses. Dominant species – <i>Eucalyptus microtheca</i>, <i>Eucalyptus coolabah</i>, <i>Acacia stenophylla</i>.</p>

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<UV]Hha Udd]b['XYgW]dH]cbg'ĒE i YYbg'UbX' (based on regional ecosystem land zones)

@bX'ncbY' . Alluvial river and creek flats

Recent Quaternary alluvial systems, including closed depressions, paleo-estuarine deposits currently under freshwater influence, inland lakes and associated wave built lunettes. Excludes colluvial deposits such as talus slopes and pediments.



Photographs taken during field studies

GcJ' hmdYg.

Includes a diverse range of soils, predominantly Vertosols and Sodosols; also with Dermosols, Kurosols, Chromosols, Kandosols, Tenosols, Rudosols and Hydrosols

Mt Isa Inlier bioregion

% " . *Corymbia aparrerinja*, *Corymbia terminalis* open woodland on sandy terraces (RE polygons indicate - 1.3.6a, 1.3.6x1c).

% "+. *Eucalyptus camaldulensis* woodland on channels and levees (RE polygons indicate - 1.3.7b)

Mitchell Grass Downs bioregion

(" "% *Eucalyptus camaldulensis* +/- *Melaleuca* spp. woodland on drainage lines (RE polygons indicate - 4.3.1).

(" " . *Eucalyptus coolabah*, *E. camaldulensis* +/- *Lysiphyllum gilvum* open woodland on drainage lines (RE polygons indicate - 4.3.3).

(" "%\$. *Corymbia terminalis* +/- *Lysiphyllum gilvum* and *Acacia victoriae* low open woodland on alluvium (RE polygons indicate - 4.3.10).

(" "%& . *Chenopodium auricomum* +/- *Muehlenbeckia florulenta* open shrubland on swamps (RE polygons indicate - 4.3.12).

(" "% . *Astrelba elymoides* +/- *A. squarrosa* +/- *Aristida latifolia* grassland on alluvium (RE polygons indicate - 4.3.16).

(" "%+. *Astrelba pectinata* +/- *Astrelba* spp. +/- *Aristida latifolia* grassland on alluvium (RE polygons indicate - 4.3.17).

(" "% . *Dichanthium* spp., *Eulalia aurea*, *Astrelba* spp. grassland on alluvium (RE polygons indicate - 4.3.19).

F Y[]cbU' .
Yw'gnghYa .
j Y[YU]cb .
hmdYfgL .

(note only RE1 & RE2 descriptions are referenced)

7 ca a Ybh .

• The Project footprint intersects rivers, creeks, tributaries, and associated floodout areas of those drainage systems.

• All drainages are ephemeral and no permanent pools were observed.

• May support EPBC, NT, & Qld threatened species – Painted Honeyeater (*Grantiella picta*)

• May support Qld threatened species – Yellow Chat (Gulf) (*Epthianura crocea crocea*)

<UV]Hua Udd]b['XYgW]d]cbg'ĒĒi YYbg'UbX' (based on regional ecosystem land zones)

@bX'ncbY' . Clay plains

Tertiary-early Quaternary clay deposits, usually forming level to gently undulating plains not related to recent Quaternary alluvial systems. Excludes clay plains formed in-situ on bedrock.



Photographs taken during field studies

GcJ' hmdYg.'

Mainly Vertosols with gilgai microrelief, but includes thin sandy or loamy surfaced Sodosols and Chromosols with the same paleo-clay subsoil deposits.

FY[jcbU'
YVt gngHYa'
j Y[YH]cb'
hmdYfgt'

(note only RE1 & RE2 descriptions are referenced)

Mt Isa Inlier bioregion

(' "% *Astrebla pectinata* +/- *Aristida latifolia* +/- *Eulalia aurea* grassland on Tertiary sediments overlying limestone (RE polygons indicate 4.4.1)

Mitchell Grass Downs bioregion

(' "% *Astrebla pectinata* +/- *Aristida latifolia* +/- *Eulalia aurea* grassland on Tertiary sediments overlying limestone (RE polygons indicate 4.4.1, 4.4.1a, and 4.4.1c)

(" "% . *Astrebla elymoides* +/- *A. squarrosa* +/- *Aristida latifolia* grassland on alluvium (RE polygons indicate 4.3.16)

(" "% . *Astrebla pectinata* +/- *Astrebla* spp. +/- *Aristida latifolia* grassland on alluvium (RE polygons indicate 4.3.17)

7ca a Ybh'

- Majority within Mitchell Grass Downs (226 ha).
- Most extensive vegetation type traversed by project footprint is RE 4.4.1.
- Some clay plains contained minor depressions but the majority were flat to gently undulating plains.
- May support EPBC threatened species - Plains Death Adder (*Acanthophis hawkei*).

<UV]Hua Udd]b['XYgW]d]h]cbg'ĒĒ i YYbg'UbX' (based on regional ecosystem land zones)

@bX'ncbY' . Old loamy and sandy plains

Tertiary-early Quaternary extensive, uniform near level or gently undulating plains with sandy or loamy soils. Includes dissected remnants of these surfaces. Also includes plains with sandy or loamy soils of uncertain origin, and plateau remnants with moderate to deep soils usually overlying duricrust. Excludes recent Quaternary alluvial systems, exposed duricrust, and soils derived from underlying bedrock.



Photographs taken during field studies

GcJ' hmdYg.'

Soils are usually Tenosols and Kandosols, also minor deep sandy surfaced Sodosols and Chromosols. There may be a duricrust at depth.

FY] jcbU'
Yw'gngHYa'
j Y] YH]cb'
hmdYfgL'

(note only RE1 & RE2 descriptions are referenced)

Mt Isa Inlier bioregion

%) " . 'Eucalyptus leucophloia low open woodland on red earths on plateaus (RE polygons indicate - 1.5.3)

%) "(. 'Eucalyptus leucophylla low open woodland on red earths in valleys (RE polygons indicate - 1.5.4x1a)

%) "* . 'Atalaya hemiglauc, Ventilago viminalis, Grevillea striata low open woodland on red earth plains (RE polygons indicate - 1.5.6; 1.5.6a; 1.5.6x2)

%) "+ . 'Corymbia terminalis and/or Acacia aneura low open woodland on sandy red earth plains (RE polygons indicate - 1.5.7; 1.5.7a)

%) "% . 'Corymbia terminalis low open woodland on basic metamorphics (RE polygons indicate - 1.11.3x1b)

%) "*" . 'Corymbia aparrerinja, Corymbia terminalis open woodland on sandy terraces (RE polygons indicate - 1.3.6a)

Mitchell Grass Downs bioregion

%) "* . 'Atalaya hemiglauc, Ventilago viminalis, Grevillea striata low open woodland on red earth plains (RE polygons indicate - 1.5.6; 1.5.6x2)

%) "+ . 'Corymbia terminalis and/or Acacia aneura low open woodland on sandy red earth plains (RE polygons indicate - 1.5.7; 1.5.7a; 1.5.7x1)

%) "+% . 'Eucalyptus leucophloia low open woodland on skeletal soils on lateritic scarps and plateaus (RE polygons indicate - 1.7.1; 1.7.1c)

7 ca a Ybh'

- Relatively common within the footprint and occur in both bioregions intersected.
- Showed variation in vegetation assemblage but low variation in terms of landform.
- Not considered to support threatened species within the Project footprint.

<UV]Hha Udd]b['XYgW]d]hcbg'ĒE i YYbg'UbX' (based on regional ecosystem land zones)

@bX'ncbY+. Ironstone jump-ups

Cainozoic duricrusts formed on a variety of rock types, usually forming mesas or scarps. Includes exposed ferruginous, siliceous or mottled horizons and associated talus and colluvium, and remnants of these features, for example low stony rises on downs.



Photograph taken during field studies

GcJ' hmdYg.

Soils are usually shallow Rudosols and Tenosols, with minor Sodosols and Chromosols on associated pediments, and shallow Kandosols on plateau margins and larger mesas.

FY] jcbU'
Yw' gngHYa
j Y[YH]cb
hmdYfbL

(note only RE1 & RE2 descriptions are referenced)

Mt Isa Inlier bioregion

%+%' *Eucalyptus leucophloia* low open woodland on skeletal soils on lateritic scarps and plateaus (RE polygons indicate - 1.7.1).

%) " : *Eucalyptus leucophloia* low open woodland on red earths on plateaus (RE polygons indicate - 1.5.3)

Mitchell Grass Downs bioregion

%+%' *Eucalyptus leucophloia* low open woodland on skeletal soils on lateritic scarps and plateaus (RE polygons indicate - 1.7.1; 1.7.1c).

%) "+. *Corymbia terminalis* and/or *Acacia aneura* low open woodland on sandy red earth plains (RE polygons indicate - 1.5.7)

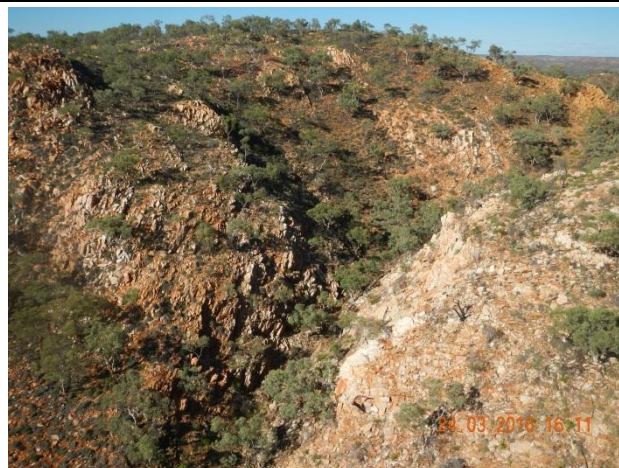
7ca a Ybh

- Uncommon within Project footprint and mostly occurs in Mitchell Grass Downs bioregion.
- Only present as low stony rises within the Project footprint.
- No mesa or scarp structures are present.
- Not considered to support threatened species within the Project footprint.

<UJ]Uha Udd]b['XYgW]d]h]cbg'ĒĒ i YYbg'UbX' (based on regional ecosystem land zones)

@bX'ncbY'%% Hills and lowlands on metamorphic rocks

Metamorphosed rocks, forming ranges, hills and lowlands. Primarily lower Permian and older sedimentary formations which are generally moderately to strongly deformed. Includes low- to high-grade and contact metamorphics such as phyllites, slates, gneisses of indeterminate origin and serpentinite, and interbedded volcanics.



Photographs taken during field studies

GcJ' hmdYg.'

Soils are mainly shallow, gravelly Rudosols and Tenosols, with Sodosols and Chromosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility.

FY[]cbU'
YWtgnghYa'
j Y[YH]cb'
hmdYfgL'

(note only RE1 & RE2 descriptions are referenced)

Mt Isa Inlier bioregion

%%&'. *Eucalyptus leucophloia* low open woodland (RE polygons indicate - 1.11.2a, 1.11.2b, 1.11.2x1).

%%&'. *Corymbia terminalis* low open woodland on basic metamorphics (RE polygons indicate - 1.11.3a, 1.11.3b, 1.11.3x1; 1.11.3x1b)

%' '*'. *Corymbia aparrerinja*, *Corymbia terminalis* open woodland on sandy terraces (RE polygons indicate - 1.3.6x1a).

%) '*'. *Atalaya hemiglauca*, *Ventilago viminalis*, *Grevillea striata* low open woodland on red earth plains (RE polygons indicate - 1.5.6).

Mitchell Grass Downs bioregion

Not applicable

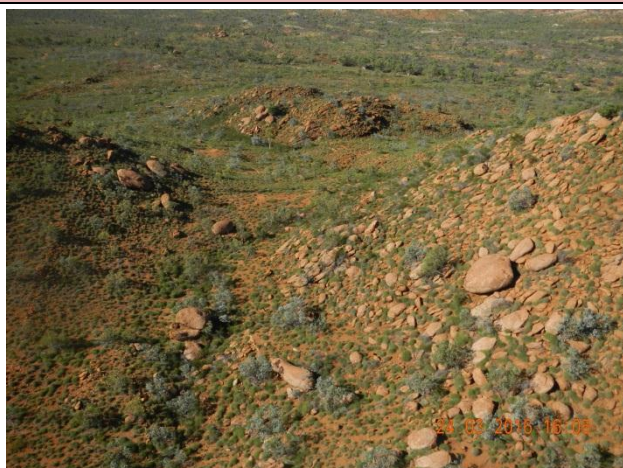
7ca a Ybh'

- Only intersected within Mt Isa Inlier bioregion.
- There were three main landform units observed within the Project footprint:
 - Rocky linear ridges and steep gullies, with outcrop and / or scree
 - Rounded rocky hills and shallow gullies, with or without outcrop
 - Lowlands in between hills and ridges, undulating to flat
- Rocky habitats within this land zone may support EPBC threatened species - Carpentarian Antechinus (*Pseudantechinus mimulus*).
- Rocky habitats within this land zone may support Qld threatened species - Northern Leaf-nosed Bat (*Hipposideros stenotis*), and Purple-necked Rock-wallaby (*Petrogale purpureicollis*).

<UVJHua Uddjb['XYgWjdHjcbg'ĒE i YYbg'UbX' (based on regional ecosystem land zones)

@bX'ncbY%& Hills and lowlands on granitic rocks

Mesozoic to Proterozoic igneous rocks, forming ranges, hills and lowlands. Acid, intermediate and basic intrusive and volcanic rocks such as granites, granodiorites, gabbros, dolerites, andesites and rhyolites, as well as minor areas of associated interbedded sediments. Excludes serpentinites (land zone 11) and younger igneous rocks (land zone 8).



Photographs taken during field studies

GcJ' hmdYg.

Soils are mainly Tenosols on steeper slopes with Chromosols and Sodosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility.

FYI jcbU'

YwgnghYa

j YI YHjcb

hmdYfgL

(note only RE1 & RE2 descriptions are referenced)

Mt Isa Inlier bioregion

%&% 'Eucalyptus leucophloia low open woodland on granites (RE polygons indicate - 1.12.1, 1.12.1x1

%&%& 'Eucalyptus melanophloia low open woodland on low hills and torfields on biotite granites (RE polygons indicate - 1.12.2; 1.12.2x1)

Mitchell Grass Downs bioregion

Not applicable

7ca a Ybh

- Only intersected within Mt Isa Inlier bioregion.
- There were three main landform units observed within the Project footprint:
 - Boulder piles
 - Hills with outcrop / boulders
 - Lowlands in between hills and boulder piles, undulating to flat
- Rocky habitats within this land zone may support EPBC threatened species - Carpenterian Antechinus (*Pseudantechinus mimulus*)
- Rocky habitats within this land zone may support Qld threatened species - Northern Leaf-nosed Bat (*Hipposideros stenotis*), and Purple-necked Rock-wallaby (*Petrogale purpureicollis*).

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 09/05/16 15:15:21

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



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[Coordinates](#)

Buffer: 50.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	14
Listed Migratory Species:	21

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	7
Commonwealth Heritage Places:	None
Listed Marine Species:	28
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	3
Regional Forest Agreements:	None
Invasive Species:	27
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
Petrogale lateralis MacDonnell Ranges race Warru, Black-footed Rock-wallaby (MacDonnell Ranges race) [66649]	Vulnerable	Species or species habitat may occur within area
Pseudantechinus mimulus Carpentarian Antechinus [59283]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Elseya lavarackorum Gulf Snapping Turtle [67197]	Endangered	Species or species habitat known to occur within area
Liopholis kintorei Great Desert Skink, Tjakura, Warrarna, Mulyamiji [83160]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Numenius minutus Little Curlew, Little Whimbrel [848]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land	[Resource Information]
The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.	
<div>Name</div> <div>Commonwealth Land - Commonwealth Land - Australian Government Solicitor Commonwealth Land - Department of Administrative Services Commonwealth Land - Department of Transport & Regional Development Defence - MT ISA TRAINING DEPOT Defence - NORFORCE DEPOT - TENNANT CREEK Defence - RSL Hall</div>	

Listed Marine Species	[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.	
Name	Type of Presence
Birds	
Apus pacificus Fork-tailed Swift [678]	Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]	Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Stiltia isabella Australian Pratincole [818]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Reptiles		
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Ballara	QLD
John Flynn	NT
Tennant Creek Telegraph Station	NT

Invasive Species	[Resource Information]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.	

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913] Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507] Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur

Name	Status	Type of Presence
Salvinia molesta		within area
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Vachellia nilotica		
Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area

Reptiles	
Hemidactylus frenatus	
Asian House Gecko [1708]	Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Austral Limestone Aggregation	QLD
Lake Moondarra	QLD

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-19.44822091 133.852283,-19.44855977 133.8545321,-19.4503931 133.8585977,-19.45643659 133.8960927,-19.45815278 133.9243363,-19.45724692 133.9408956,-19.46853348 134.000047,-19.46743058 134.0015851,-19.47056657 134.0142173,-19.47283655 134.0266194,-19.47523192 134.0473359,-19.47423283 134.0495712,-19.4915666 134.1057784,-19.4961162 134.1311467,-19.48897227 134.1427359,-19.4711135 134.3371582,-19.47290733 134.3939288,-19.47422269 134.4374149,-19.47697498 134.4600504,-19.47700134 134.5352912,-19.48523895 134.6713845,-20.28655052 137.1046338,-20.30551119 137.1563087,-20.36547976 137.3379768,-20.36525612 137.3510832,-20.38423243 137.4036859,-20.39614135 137.4312502,-20.40636758 137.4535085,-20.45971463 137.5789544,-20.45978445 137.5831031,-20.48626887 137.6629658,-20.53119373 137.7583474,-20.56985824 137.8692456,-20.57043359 137.8726622,-20.59798741 137.9398774,-20.64254988 138.0880125,-20.64775073 138.1254138,-20.65151619 138.1407643,-20.66237763 138.2000016,-20.67923579 138.3012646,-20.68706818 138.3386565,-20.70825419 138.4509219,-20.7157206 138.4748453,-20.7437725 138.6236255,-20.75039922 138.6959863,-20.75264015 138.7046632,-20.74647314 138.8891233,-20.78733639 139.0939929,-20.79599641 139.1842852,-20.79664282 139.1880269,-20.79729676 139.1897547,-20.82314387 139.2223573,-20.82460626 139.2264381,-20.82453037 139.239397,-20.8239825 139.2479854,-20.82383735 139.2622874,-20.82600762 139.2795607,-20.82554252 139.2869439,-20.8276396 139.2961915,-20.8278007 139.2983402,-20.82952139 139.300669,-20.82987076 139.3023982,-20.82994006 139.3053113,-20.83611415 139.3362119,-20.83537176 139.3379622,-20.8345009 139.3384087,-20.83402345 139.3390458,-20.83354358 139.3404013,-20.83219041 139.341644,-20.83165082 139.3426689,-20.83036586 139.3432905,-20.82481469 139.3500429,-20.82351565 139.3513301,-20.82005545 139.3533602,-20.8160612 139.3583895,-20.81422332 139.3591372,-20.81222445 139.3611604,-20.81085252 139.366448,-20.81127057 139.3680734,-20.812711 139.3697301,-20.81217882 139.3705754,-20.81150967 139.372629,-20.81174755 139.375209,-20.81116953 139.3767399,-20.81152835 139.3780109,-20.81231613 139.3788727,-20.81260662 139.3798646,-20.8135924 139.3810153,-20.81323979 139.3821632,-20.81274416 139.3849861,-20.81258739 139.3962064,-20.81207727 139.3978615,-20.81201398 139.3982712,-20.81179658 139.3988113,-20.81182642 139.3992809,-20.81258 139.403023,-20.81176731 139.405756,-20.81205175 139.4061593,-20.81205489 139.406638,-20.81116542 139.4091329,-20.81202662 139.4110218,-20.811727 139.4129556,-20.81092087 139.4153811,-20.80984433 139.4162362,-20.80890628 139.417524,-20.80858985 139.4192551,-20.80886587 139.4196592,-20.80892738 139.4203264,-20.80865924 139.4217855,-20.80888914 139.4221432,-20.80936696 139.4223436,-20.8097157 139.4228997,-20.81032238 139.4245474,-20.81124845 139.4277581,-20.81188699 139.4290229,-20.81670822 139.4353859,-20.81867656 139.4372462,-20.82024915 139.439776,-20.82321527 139.4405478,-20.82501412 139.4429295,-20.82511152 139.4467435,-20.82485406 139.4564783,-20.82529887 139.4568884,-20.82534024 139.4582005,-20.82433841 139.4586079,-20.82323037 139.4600373,-20.82263327 139.4601083,-20.82195912 139.4619941,-20.81999116 139.4614285,-20.81902184 139.461792,-20.8175544 139.4626415,-20.81708787 139.4617845,-20.81462694 139.4629754,-20.80599696 139.4620032,-20.80383272 139.4619581,-20.80214955 139.4621773,-20.80126092 139.4624428,-20.80055189 139.4629254,-20.79954615 139.4631065,-20.79903549 139.4633706,-20.7964872 139.463521,-20.79579481 139.4638662,-20.7953485 139.4634584,-20.79388788 139.4643866,-20.79344839 139.4668989,-20.79277242 139.4672599,-20.79155168 139.4681176,-20.79092015 139.4686223,-20.78455947 139.4767274,-20.78661265 139.478531

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Parks and Wildlife Commission NT, Northern Territory Government](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

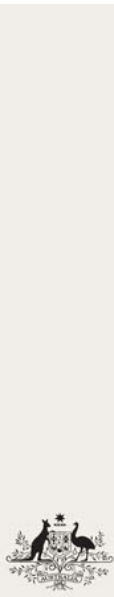
The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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Appendix D
Northern Territory NRM INFONET threatened species report
.....(Northern Territory only) (8 June 2016)

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Custom area

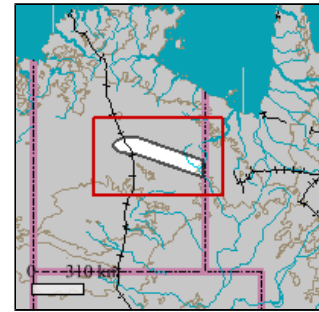
NT NRM Report



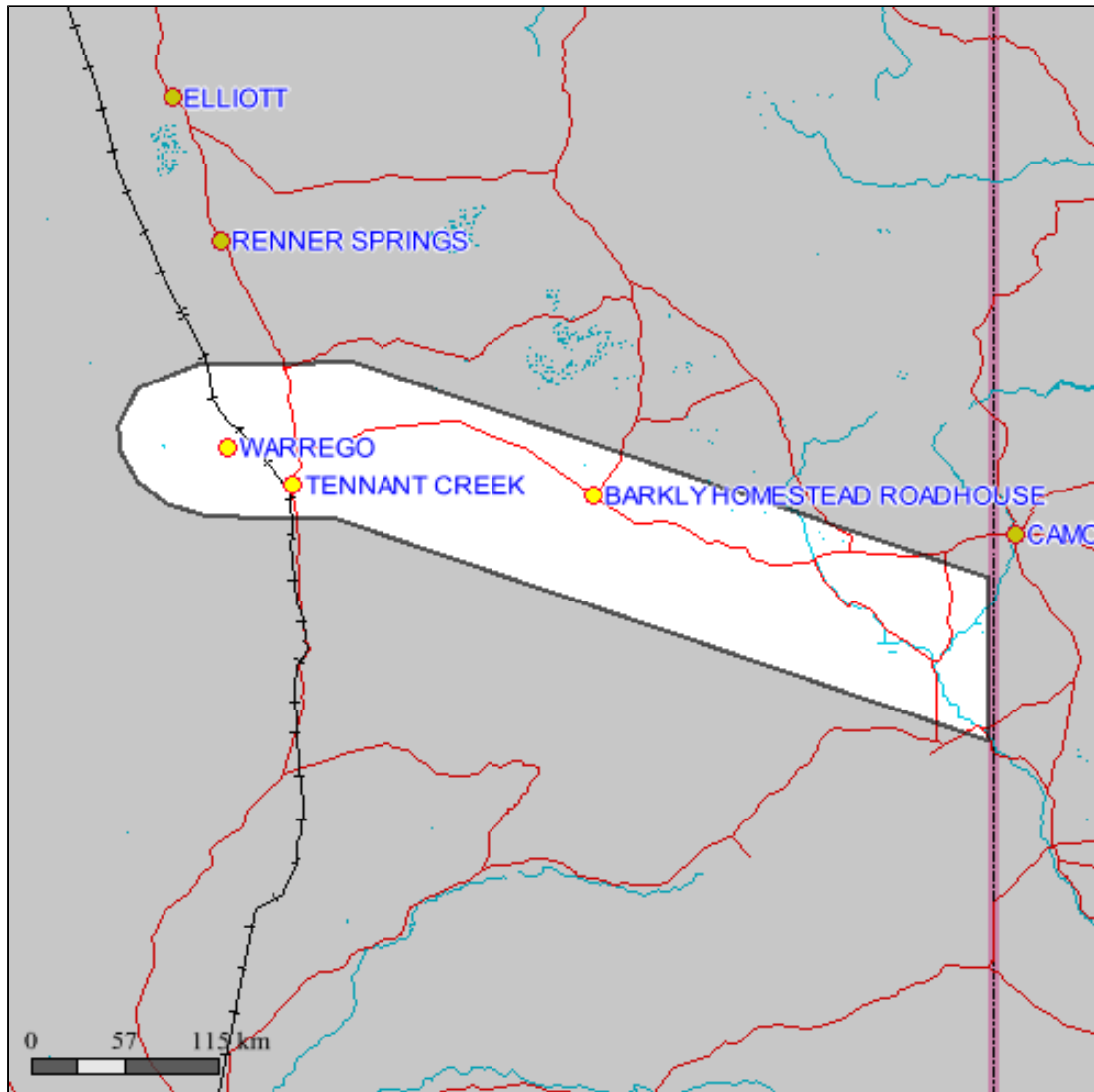
Custom area

Custom area encompasses an area of 46736.25 sq km extending from 18 deg 58.0 min to 21 deg 2.0 min S and 133 deg 14.0 min to 137 deg 58.0 min E.

Custom area is located in the Mitchell Grass Downs, Tanami, Davenport Murchison Ranges, bioregion(s)



Location of Custom area



Custom area Climate

The closest long-term weather station is WONARAH (19 deg 53.0 min S, 136.3358E) 77 km E of the center of selected area

Statistics

Mean max temp (deg C)
Mean min temp (deg C)
Average rainfall (mm)
Average days of rain

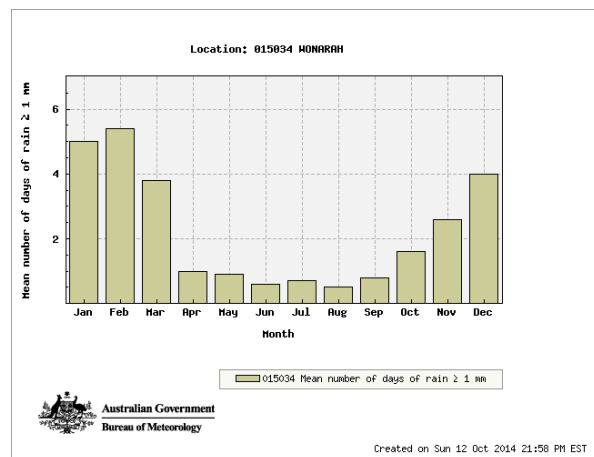
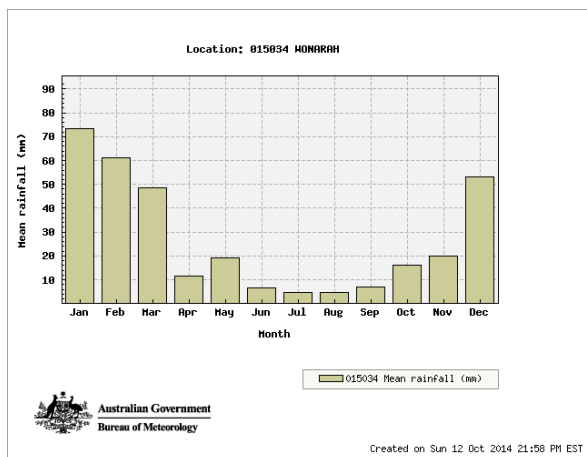
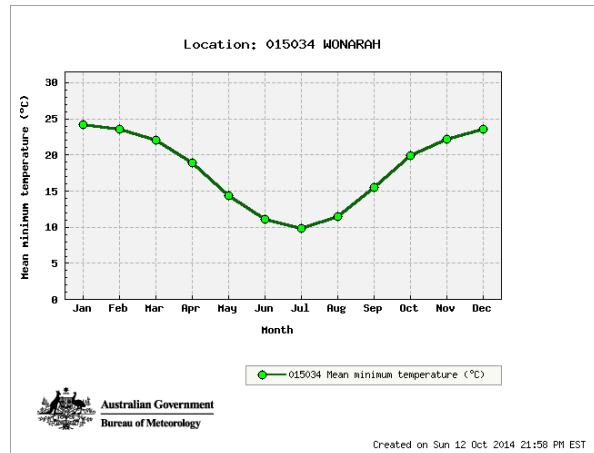
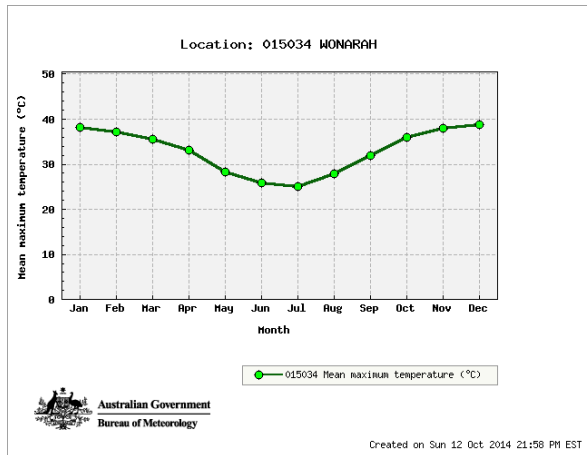
Annual Values

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18.1
322.7
26.9

Years of record

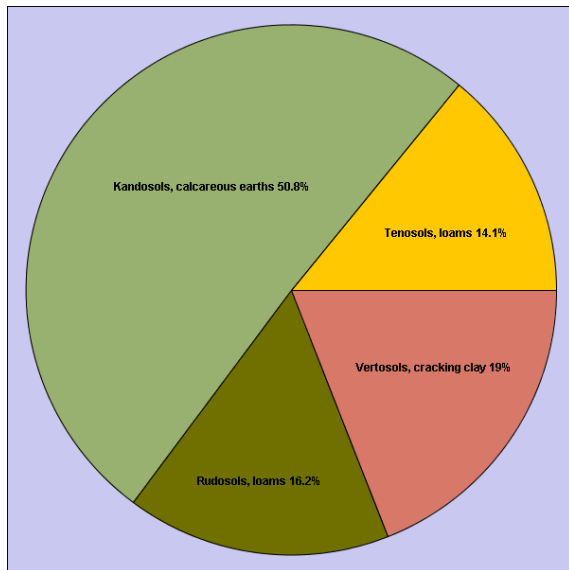
23
23
28
28

Climate summaries from Bureau of Meteorology (www.bom.gov.au)



Custom area Soils

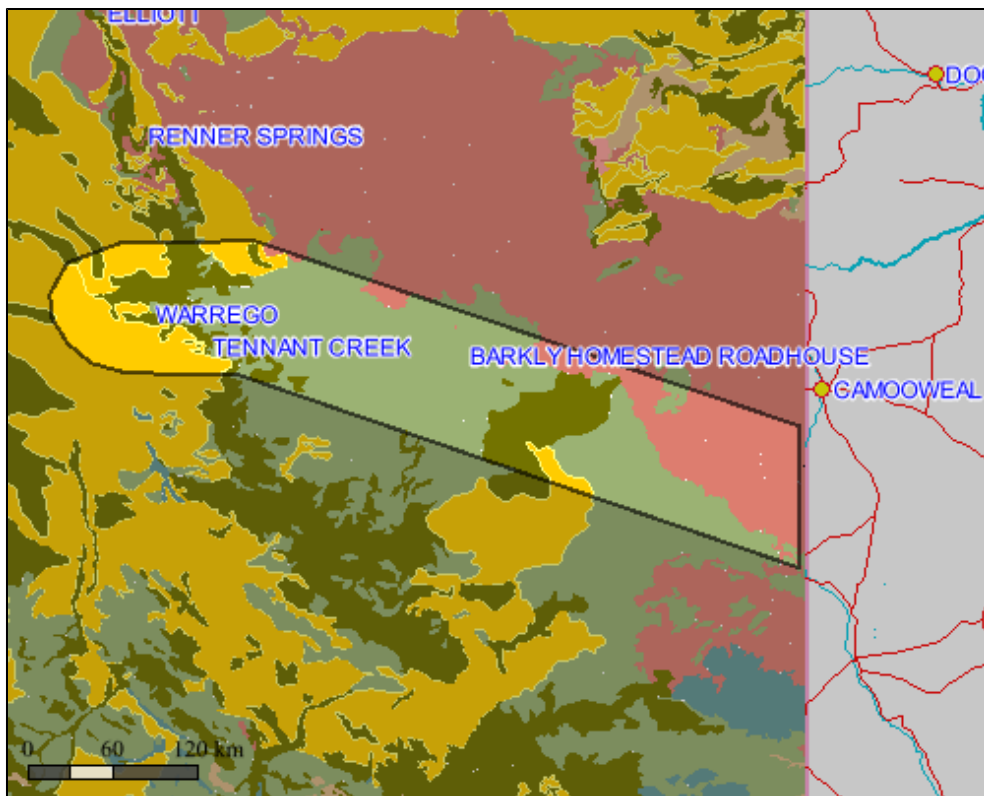
Soil Types



Area of soil types (Northcote Factual Key)

Category	Area sq km	Area%
Kandosols, calcareous earths	23725.89	50.77
Vertosols, cracking clay	8884.65	19.01
Rudosols, loams	7550.89	16.16
Tenosols, loams	6574.82	14.07

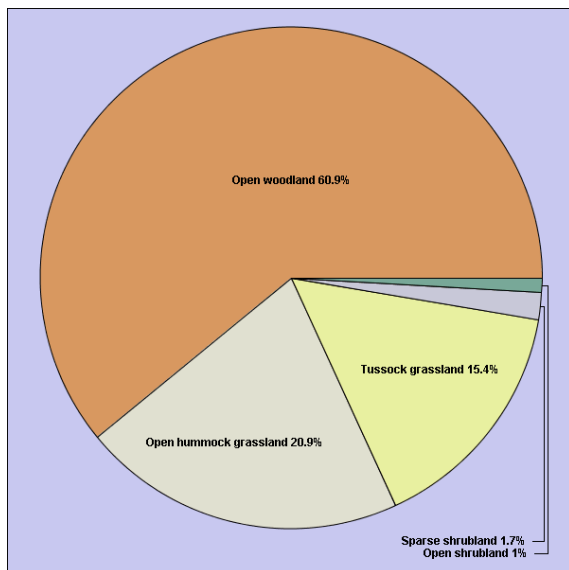
Soil Types



Soils 1:2M Layer is a copy of the NT portion (1:2,000,000 scale dataset) of the CSIRO Atlas of Australian Soils - K.H. Northcote et al. Data scale: 1:2,000,000 ANZLIC Identifier: 2DBC771205D06B6E040CD9B0F274EFE
More details: Go to www.lrm.nt.gov.au/nrmmapsnt/ and enter the ANZLIC identifier in the Spatial Data Search

Custom area Vegetation

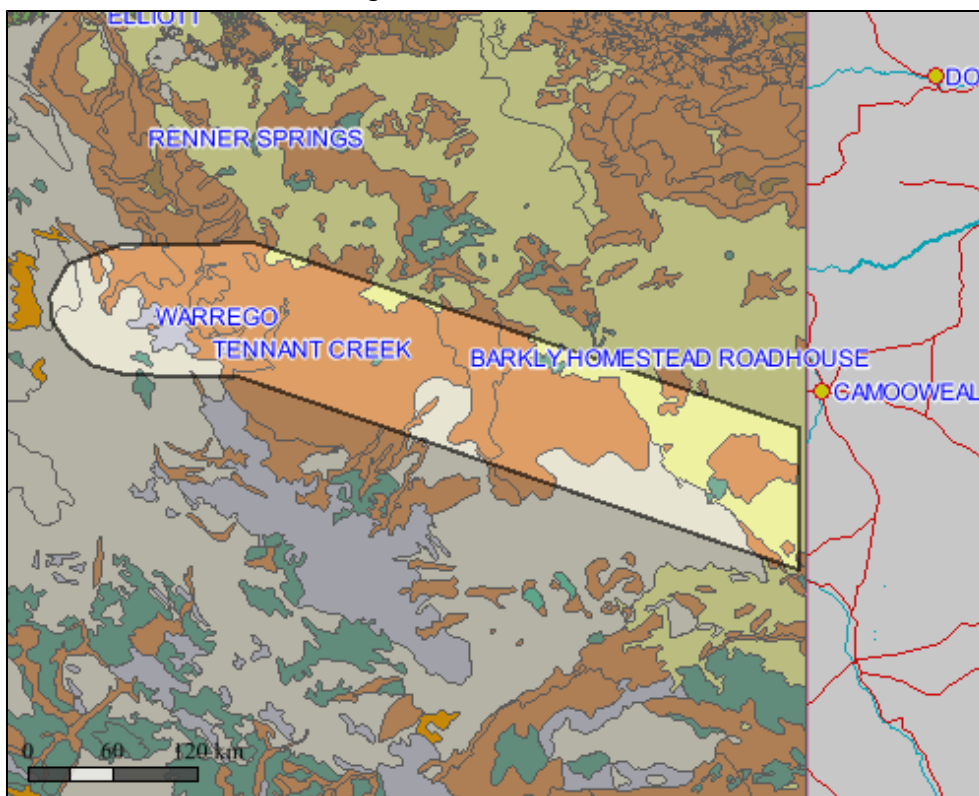
Vegetation Communities



Area of vegetation communities

Category	Area sq km	Area%
Open woodland	28475.96	60.93
Open hummock grassland	9787.89	20.94
Tussock grassland	7209.81	15.43
Sparse shrubland	816.50	1.75
Open shrubland	446.08	.95

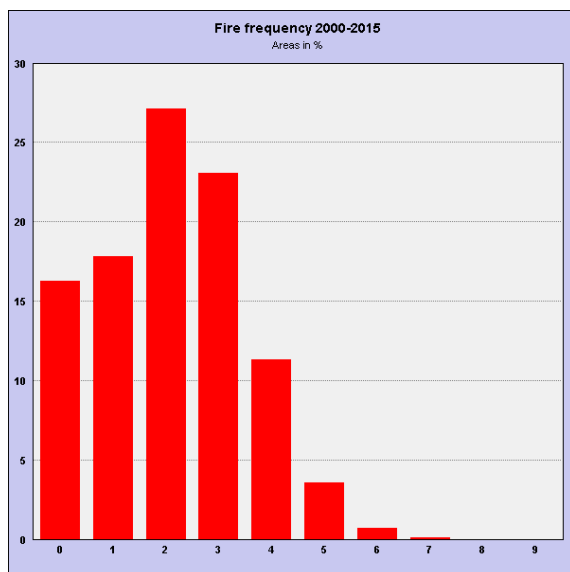
Vegetation Communities



The NVIS 2005 Layer is compiled from a number of vegetation and land unit survey maps that were recoded and re-attributed for the National Vegetation Information System (NVIS)
 Data scale variable depending on location. ANZLIC Identifier:2DBC771207006B6E040CD9B0F274EFE
 More details:Go to www.lrm.nt.gov.au/nrm/apsnt/ and enter the ANZLIC identifier in the Spatial Data Search

Custom area Fire History

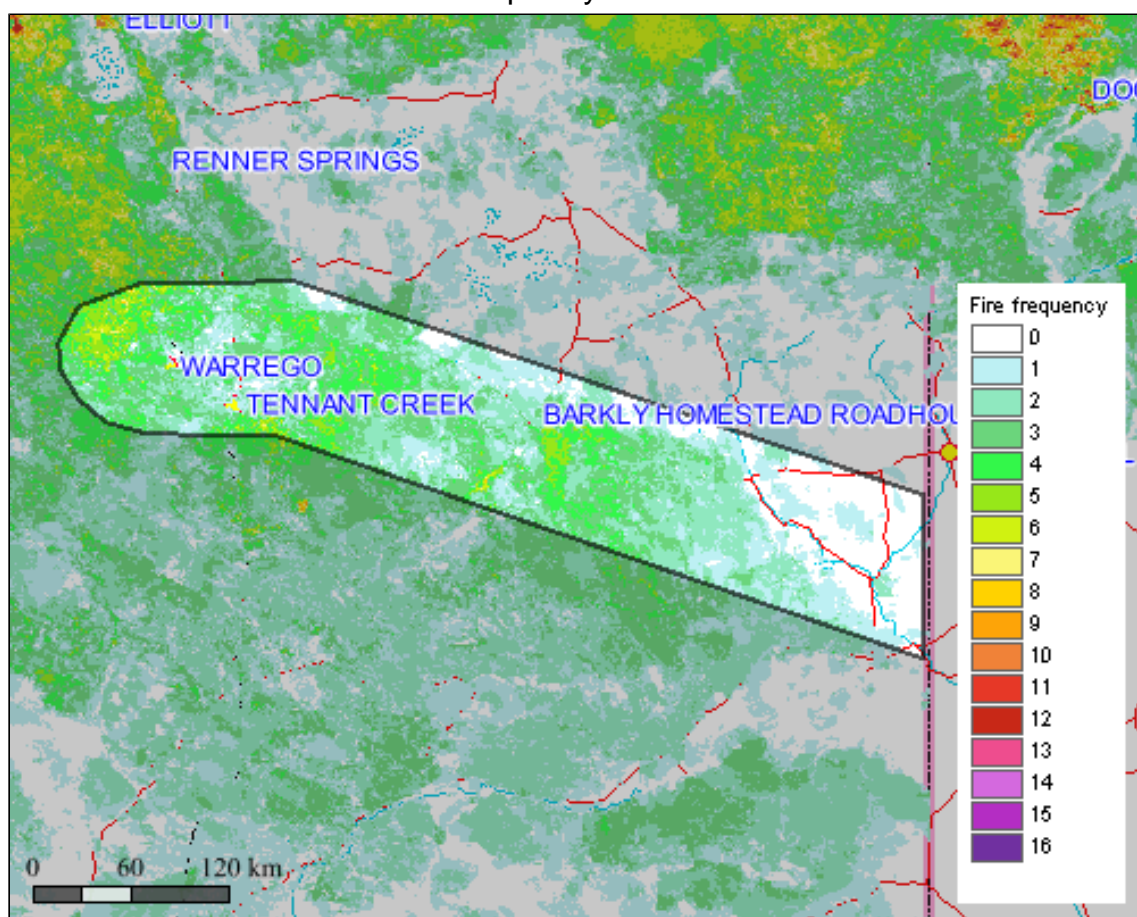
Fire frequency 2000-2015



area burnt for each fire frequency category 2000-2015

Category	Area sq km	Area%
0	7617.68	16.30
1	8325.74	17.81
2	12675.22	27.12
3	10777.60	23.06
4	5289.30	11.32
5	1660.16	3.55
6	327.85	.70
7	55.17	.12
8	7.35	.02
9	.17	.00

Fire frequency 2000-2015



The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite
Spatial Resolution: 250m x 250m pixels (at Nadir).

Custom area Threatened Species



Threatened species recorded in Custom area (Records Updated: Sept 2013)

Group	Common Name	Scientific Name	NT Status	National Status	ID	#Observations (Latest)	#Specimens (Latest)	#Surveys (Latest)
Flowering Plants	Sporobolus	<i>Sporobolus latzii</i>	VU	.	.	0 (Unknown)	1 (1993)	0 (Unknown)
Flowering Plants	Tobermorey Melon	<i>Austrobryonia argillicola</i>	VU	.	257219	0 (Unknown)	0 (Unknown)	0 (Unknown)
Snails	Spencer's Land Snail	<i>Bothriembryon spenceri</i>	VU	.	351895	0 (Unknown)	0 (Unknown)	0 (Unknown)
Reptiles	Yellow-spotted Monitor	<i>Varanus panoptes</i>	VU	.	347307	3 (1998)	0 (Unknown)	0 (Unknown)
Reptiles	Plains Death Adder	<i>Acanthophsis hawkei</i>	VU	VU	.	0 (Unknown)	1 (1978)	0 (Unknown)
Birds	Grey Falcon	<i>Falco hypoleucos</i>	VU	.	.	6 (2010)	0 (Unknown)	0 (Unknown)
Birds	Masked Owl (northern mainland)	<i>Tyto novaehollandiae kimberli</i>	VU	VU	594609	1 (2001)	0 (Unknown)	0 (Unknown)
Birds	Gouldian Finch	<i>Erythrura gouldiae</i>	VU	EN	176370	1 (1974)	0 (Unknown)	0 (Unknown)
Mammals	Brush-tailed Mulgara	<i>Dasyercus blythi</i>	VU	VU	351695	5 (1998)	2 (1901)	0 (Unknown)
Mammals	Crest-tailed Mulgara	<i>Dasyercus cristicauda</i>	VU	EN	351695	1 (1998)	3 (1905)	0 (Unknown)
Mammals	Golden Bandicoot	<i>Isodon auratus</i>	EN	VU	176421	3 (1906)	16 (1936)	0 (Unknown)
Mammals	Greater Bilby	<i>Macrotis lagotis</i>	VU	VU	177125	28 (1998)	2 (1969)	2 (2004)
Mammals	Common Brushtail Possum (southern)	<i>Trichosurus vulpecula vulpecula</i>	EN	.	177146	2 (1969)	3 (1901)	0 (Unknown)

EX = Extinct

EW = Extinct in the Wild

ER = Extinct in the NT

EN = Endangered

EN/VU = One Endangered subspecies/One Vulnerable subspecies

VU=Vulnerable

VU/- = One or more subspecies vulnerable EN/- = One or more subspecies endangered

Survey = this category refers to data collected using systematic survey methodology

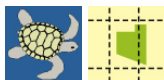
Specimen = this category refers to museum or other records where a specimen has been collected and lodged

Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to www.landmanager.org.au/view/index.aspx?id=####

where #### is the ID number from the tables above for the species of interest.

Custom area Threatened Species Grid



Threatened species recorded in the grid cell(s) in which Custom area occurs (Records Updated: Sept 2013)

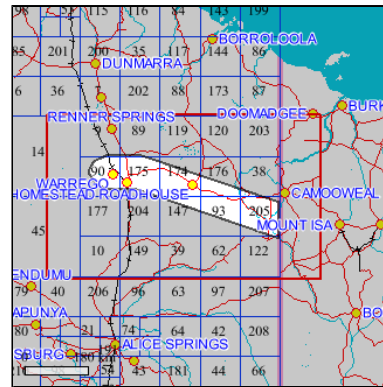
Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	Latest Observation Date	#Specimens	Latest Specimen Date	#Surveys	Latest Survey Record
Flowering Plants	Poaceae	<i>Sporobolus latzii</i>	Sporobolus	VU		0	Unknown	1	1993	0	Unknown
Flowering Plants	Cucurbitaceae	<i>Austrobryonia argillicola</i>	Tobermorey Melon	VU		0	Unknown	0	Unknown	0	Unknown
Snails	Bulimulidae	<i>Bothriembryon spenceri</i>	Spencer's Land Snail	VU		0	Unknown	0	Unknown	0	Unknown
Reptiles	Varanidae	<i>Varanus panoptes</i>	Yellow-spotted Monitor	VU		3	1998	3	1978	0	Unknown
Reptiles	Elapidae	<i>Acanthophis hawkei</i>	Plains Death Adder	VU	VU	0	Unknown	22	1985	0	Unknown
Birds	Falconidae	<i>Falco hypoleucos</i>	Grey Falcon	VU		8	2010	0	Unknown	0	Unknown
Birds	Rostratulidae	<i>Rostratula australis</i>	Australian Painted Snipe	VU	EN	0	Unknown	2	1993	1	1993
Birds	Scolopacidae	<i>Calidris ferruginea</i>	Curlew Sandpiper	VU	CE	0	Unknown	0	Unknown	1	1995
Birds	Tytonidae	<i>Tyto novaehollandiae kimberli</i>	Masked Owl (northern mainland)	VU	VU	1	2001	0	Unknown	0	Unknown
Birds	Meliphagidae	<i>Grantiella picta</i>	Painted Honeyeater	VU	VU	1	1981	0	Unknown	0	Unknown
Birds	Estrildidae	<i>Erythrura gouldiae</i>	Gouldian Finch	VU	EN	1	1974	0	Unknown	0	Unknown
Mammals	Dasyuridae	<i>Dasyercus blythi</i>	Brush-tailed Mulgara	VU	VU	5	1998	2	1901	0	Unknown
Mammals	Dasyuridae	<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	VU	EN	1	1998	3	1905	0	Unknown
Mammals	Dasyuridae	<i>Dasyurus hallucatus</i>	Northern Quoll	CR	EN	2	1903	0	Unknown	0	Unknown
Mammals	Dasyuridae	<i>Pseudantechinus mimulus</i>	Carpentarian Antechinus		VU	2	1969	0	Unknown	0	Unknown
Mammals	Peramelidae	<i>Isoodon auratus</i>	Golden Bandicoot	EN	VU	11	1969	16	1936	0	Unknown
Mammals	Thylacomyidae	<i>Macrotis lagotis</i>	Greater Bilby	VU	VU	84	2009	6	1969	2	2004
Mammals	Phalangeridae	<i>Trichosurus vulpecula vulpecula</i>	Common Brushtail Possum (southern)	EN		7	1969	3	1901	0	Unknown
Mammals	Macropodidae	<i>Petrogale lateralis</i>	Black-footed Rock-wallaby		VU	14	1992	0	Unknown	2	2004

EX = Extinct
 EW = Extinct in the Wild
 ER = Extinct in the NT
 EN = Endangered
 EN/VU = One Endangered subspecies/One Vulnerable subspecies
 VU = Vulnerable
 VU/- = One or more subspecies vulnerable EN/- = One or more subspecies endangered

Survey = this category refers to data collected using systematic survey methodology
 Specimen = this category refers to museum or other records where a specimen has been collected and lodged
 Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to www.landmanager.org.au/view/index.aspx?id=####
 where #### is the ID number from the tables above for the species of interest.

Species listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap Custom area



Custom area Weeds and Potential Weeds



Introduced plants recorded in the grid cell(s) in which Custom area occurs and that have been identified as problem weeds in one or more locations in northern Australia. Occurrence based on Northern Territory Government databases.

Family Name	Scientific Name	Common Name	NT Status	National Status	Other Status	#Surveys	Latest Record
Asteraceae	<i>Acanthospermum hispidum</i>	Starburr	B C			2	2001
Amaranthaceae	<i>Alternanthera pungens</i>	Khaki Weed	B C		DEU NSW SA	0	Unknown
Meliaceae	<i>Azadirachta indica</i>	Neem			MP K1 C&E G&M CYP WeedsAus	0	Unknown
Poaceae	<i>Bothriochloa pertusa</i>	Indian Bluegrass			DEU	0	Unknown
Brassicaceae	<i>Brassica tournefortii</i>	Mediterranean Turnip			Gr	0	Unknown
Apocynaceae	<i>Calotropis procera</i>	Rubber Bush	B C (S of 16 5 deg S)		WA1 WA2 G&M	0	Unknown
Poaceae	<i>Cenchrus biflorus</i>	Gallon`s Curse			NSW	2	2001
Poaceae	<i>Cenchrus ciliaris</i>	Buffel Grass			MP Gr G&M DEU	0	Unknown
Poaceae	<i>Cenchrus echinatus</i>	Mossman River Grass	B C		NSW	0	Unknown
Poaceae	<i>Cenchrus pedicellatus</i> subsp. <i>unispiculus</i>	Mission Grass (annual)			WeedsAus	0	Unknown
Poaceae	<i>Cenchrus setiger</i>	Birdwood Grass			DEU	0	Unknown
Poaceae	<i>Chloris barbata</i>	Purpletop Chloris			DEU	0	Unknown
Poaceae	<i>Chloris virgata</i>	Feathertop Rhodes Grass			DEU	0	Unknown
Cucurbitaceae	<i>Citrullus lanatus</i>	Camel Melon			G&M	0	Unknown
Brassicaceae	<i>Coronopus didymus</i>	Lesser Swinecress			G&M	0	Unknown
Cucurbitaceae	<i>Cucumis melo</i>	Ulicardo Melon			DEU	36	2001
Solanaceae	<i>Datura ferox</i>	Fierce Thornapple	A C		WA1 WA3 WA4 G&M	0	Unknown
Solanaceae	<i>Datura leichhardtii</i>	Native Thornapple	C		WA1 WA3 WA4	0	Unknown
Poaceae	<i>Echinochloa colona</i>	Awnless Barnyard Grass			DEU	11	2001
Boraginaceae	<i>Echium plantagineum</i>	Paterson`s Curse	A C		WA1 WA3 WA4 NSW SA	0	Unknown
Poaceae	<i>Eragrostis tenuifolia</i>	Elastic Grass			DEU	0	Unknown
Amaranthaceae	<i>Gomphrena celosioides</i>	Gomphrena Weed			DEU	1	2001
Lamiaceae	<i>Hyptis suaveolens</i>	Hyptis	B C		G&M	0	Unknown
Euphorbiaceae	<i>Jatropha gossypifolia</i>	Bellyache Bush	B C	WONS	K2 WA1 WA4 Q2 C&E G&M CYP DEU	0	Unknown
Fabaceae	<i>Leucaena leucocephala</i> subsp. <i>leucocephala</i>	Coffee Bush			MP C&E G&M CYP	0	Unknown
Fabaceae	<i>Macroptilium atropurpureum</i>	Siratro			C&E	0	Unknown
Malvaceae	<i>Malvastrum americanum</i>	Spiked Malvastrum			DEU	41	2003
Malvaceae	<i>Malvastrum coromandelianum</i>	Prickly Malvastrum			DEU	0	Unknown

Family Name	Scientific Name	Common Name	NT Status	National Status	Other Status	#Surveys	Latest Record
Poaceae	<i>Melinis repens</i>	Red Natal Grass			DEU	0	Unknown
Oxalidaceae	<i>Oxalis corniculata</i>	Creeping Wood-sorrel			NSW	0	Unknown
Fabaceae	<i>Parkinsonia aculeata</i>	Parkinsonia	B C	WONS	MP K2 WA1 WA4 Q2 G&M CYP DEU NSW SA	14	2001
Fabaceae	<i>Prosopis pallida</i>	Mesquite	A C	WONS	K2 WA1 WA2 WA4 Q2 G&M NSW SA	1	2001
Fabaceae	<i>Senna obtusifolia</i>	Sicklepod	B C		WA1 WA2 Q2 G&M CYP DEU	1	1995
Fabaceae	<i>Senna occidentalis</i>	Coffee Senna	B C		G&M DEU	1	2001
Malvaceae	<i>Sida acuta</i>	Spiny-head Sida	B C		WA1 G&M	0	Unknown
Malvaceae	<i>Sida cordifolia</i>	Flannel Weed	B C		WA1 G&M DEU	3	1995
Malvaceae	<i>Sida spinosa</i>	Spiny Sida			DEU	61	2001
Poaceae	<i>Sporobolus africanus</i>	Parramatta grass			Q2 G&M	0	Unknown
Poaceae	<i>Sporobolus coromandelianus</i>	Madagascar Dropseed			DEU	0	Unknown
Poaceae	<i>Sporobolus pyramidalis</i>	Giant Rat's Tail Grass			Q2 G&M CYP NSW	2	1995
Fabaceae	<i>Stylosanthes hamata</i>	Caribbean Stylo			DEU	0	Unknown
Fabaceae	<i>Stylosanthes humilis</i>	Townsville Lucerne			DEU	1	2003
Tamaricaceae	<i>Tamarix aphylla</i>	Athel Pine	B C	WONS	WA1 Q3 C&E G&M NSW	0	Unknown
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	B C		CYP SA	13	1996
Poaceae	<i>Urochloa mosambicensis</i>	Sabi Grass			DEU	0	Unknown
Poaceae	<i>Urochloa mutica</i>	Para Grass			MP G&M	0	Unknown
Fabaceae	<i>Vachellia farnesiana</i>	Sweet Acacia			DEU	27	2001
Fabaceae	<i>Vachellia nilotica</i>	Prickly Acacia	A C	WONS	MP K2 Q2 G&M DEU NSW	0	Unknown
Asteraceae	<i>Xanthium strumarium</i>	Noogoora Burr	B C		MP WA1 WA2 WA4 DEU NSW SA	19	2001

Status Codes:

1. NATIONAL STATUS CODES

Alert, Alert List for Environmental Weeds (Please call Exotic Plant Pest Hotline 1800 084 881 if you think you have seen this weed)

Sleeper, National Sleeper Weed

Target, Targeted for eradication. (www.landmanager.com.au/view/index.aspx?id=449837)

WONS, Weeds of National Significance

2. NT STATUS CODES

A, NT Class A Weed (to be eradicated)

B, NT Class B Weed (growth & spread to be controlled)

C, NT Class C Weed (not to be introduced) (www.landmanager.com.au/view/index.aspx?id=449869)

3. OTHER STATUS CODES

C&E, Csurhes, S. & Edwards, R. (1998) Potential Environmental Weeds in Australia. Candidate Species for Preventative Control. Environment Australia, Canberra (www.landmanager.com.au/view/index.aspx?id=394504)

CYP, Draft Cape York Peninsula Pest Management Plan 2006-2011 (www.landmanager.com.au/view/index.aspx?id=371200)

DEU, Plants listed as environmental weeds by the Desert Uplands Strategic Land Resource

Assessment (www.landmanager.com.au/view/index.aspx?id=332123)

G&M, Grice AC, Martin TG. 2005. The Management of Weeds and Their Impact on Biodiversity in the Rangelands. Cooperative Research Centre (CRC) for Australian Weed Management and CSIRO Sustainable Ecosystems. Commonwealth Australia (www.landmanager.com.au/view/index.aspx?id=163572)

Gr, Groves et al. 2003. Weed categories for natural and agricultural ecosystem management. Bureau of Rural Sciences (www.landmanager.com.au/view/index.aspx?id=388018)

K0, High Priority Weeds not yet established in the Katherine region

K1, High Priority Weeds posing environmental threats in the Katherine region

K2, High Priority Weeds posing existing threats in the Katherine region, as described in the Katherine Regional Weed Management Strategy 2005-2010 (www.landmanager.com.au/view/index.aspx?id=130286)

MP, Northern Territory Parks & Conservation Masterplan (www.landmanager.com.au/view/index.aspx?id=144141)
NAQS, North Australian Quarantine Strategy Target List (www.landmanager.com.au/view/index.aspx?id=449416)
NSW, Declared Noxious Weed in NSW (www.landmanager.com.au/view/index.aspx?id=449983)
Q1, QLD Class 1 Weed (not to be introduced, kept or supplied-
Q2, Class 2 Weed (eradicate where possible, not to be introduced, kept or supplied)
Q3, Qld Class 3 Weed (to be controlled near environmentally sensitive areas- not to be supplied/sold without a permit) (www.landmanager.com.au/view/index.aspx?id=190714)
SA, Declared Plant in South Australia (www.landmanager.com.au/view/index.aspx?id=449996)
WeedsAus, Listed as a significant weed by Weeds Australia (www.landmanager.com.au/view/index.aspx?id=14576)
WA1, WA Weed Class P1 (movement prohibited)
WA2, WA Weed Class P2 (aim to eradicate)
WA3, WA Weed Class P3 (control infestations)
WA4, WA Weed Class P4 (prevent spread)
WA5, WA Weed Class P3 (control infestations on public land) (www.landmanager.com.au/view/index.aspx?id=449884).

Survey = this category refers to data collected using systematic survey methodology
Specimen = this category refers to museum or other records where a specimen has been collected and lodged
Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to www.landmanager.org.au/view/index.aspx?id=####
where #### is the ID number from the tables above for the species of interest.

Plants listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap Custom area



Custom area Pest and Potential Pest Animals



Animals with pest potential recorded in the grid cell(s) in which Custom area occurs. Occurrence based on Northern Territory Government databases.

Common Name	Scientific Name	NT Status	National Status	ID	#Observations (Latest)	#Specimens (Latest)	#Surveys (Latest)
Asian House Gecko	<i>Hemidactylus frenatus</i>	P	.	188964	3 (1991)	4 (2000)	0 (Unknown)
Rock Dove	<i>Columba livia</i>	P	.	183336	2 (2001)	0 (Unknown)	0 (Unknown)
Red-tailed Black-cockatoo	<i>Calyptorhynchus banksii macrorhynchus</i>	N	.	223765	14 (2002)	0 (Unknown)	2 (2004)
Sulphur-Crested Cockatoo	<i>Cacatua galerita</i>	N	.	223772	1 (1998)	0 (Unknown)	1 (1995)
House Sparrow	<i>Passer domesticus</i>	P	.	183322	28 (2004)	16 (Unknown)	0 (Unknown)
Agile Wallaby	<i>Macropus agilis</i>	N	.	223786	1 (1985)	0 (Unknown)	0 (Unknown)
House Mouse	<i>Mus musculus</i>	P	.	187720	29 (1996)	39 (1996)	3 (2011)
Black Rat	<i>Rattus rattus</i>	P	.	183236	0 (Unknown)	2 (1960)	0 (Unknown)
Dingo / Wild dog	<i>Canis lupus</i>	N	.	183280	29 (2009)	180 (1973)	15 (2011)
Fox	<i>Vulpes vulpes</i>	P	.	183294	15 (2009)	0 (Unknown)	2 (2011)
Cat	<i>Felis catus</i>	P	.	183259	35 (2010)	13 (1980)	9 (2011)
Rabbit	<i>Oryctolagus cuniculus</i>	P	.	187331	11 (1992)	0 (Unknown)	0 (Unknown)
Donkey	<i>Equus asinus</i>	P	.	183287	19 (2009)	0 (Unknown)	3 (2004)
Horse	<i>Equus caballus</i>	P	.	183315	14 (1999)	0 (Unknown)	0 (Unknown)
Pig	<i>Sus scrofa</i>	P	.	183329	12 (1999)	0 (Unknown)	0 (Unknown)
Camel	<i>Camelus dromedarius</i>	P	.	183210	4 (2009)	0 (Unknown)	0 (Unknown)
Cattle	<i>Bos taurus</i>	P	.	183266	9 (2010)	0 (Unknown)	29 (2011)

NT STATUS CODES:

Int, Introduced species (all non-prohibited vertebrates, and all other exotic species (www.landmanager.com.au/view/index.aspx?id=280771))

N, Native species with pest potential.

P, Prohibited species (all exotic vertebrates except those listed as non-prohibited (www.landmanager.com.au/view/index.aspx?id=450509))

Survey = this category refers to data collected using systematic survey methodology

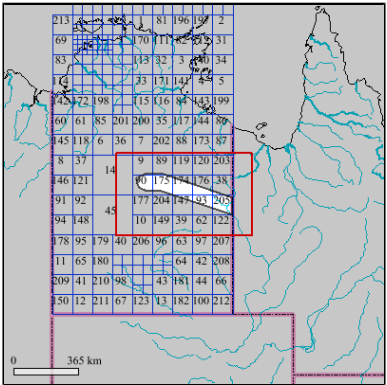
Specimen = this category refers to museum or other records where a specimen has been collected and lodged

Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to www.landmanager.org.au/view/index.aspx?id=####

where #### is the ID number from the tables above for the species of interest.

Potential pest animals listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap Custom area



Soils and vegetation graphs and tables refer to area of soils and vegetation only. Fire graphs and tables refer to entire selected area including sea if present. Calculations are derived from map images or vector data, and should be taken as a guide only. Accuracy cannot be guaranteed. For small areas, figures should be rounded to the nearest whole number.

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Appendix E

Threatened species likelihood of occurrence assessment

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Threatened species 'likelihood of occurrence' assessment

This 'likelihood of occurrence' assessment identifies which threatened species have potential to occur within the Project footprint. The following procedure was used to determine the likelihood of occurrence of threatened species:

- 1) Identify potential habitat features within the Project footprint using available desktop information (i.e. land unit mapping, existing vegetation mapping, aerial imagery, fire history etc.).
- 2) Search within a 50 km buffer of the pipeline route for
 - a. Matters of National Environmental Significance (MNES) using the Protected Matters Search Tool (most recently undertaken 9 May 2016) (Appendix C).
 - b. NT threatened species listed under the *Territory Parks and Wildlife Conservation Act* using the online tool *NT NRM Infonet* (Appendix D).
- 3) Collate the following details for each of those species – conservation status (NT and Federal), habitat requirements, distribution and number of records within the search area (from the Infonet report).
- 4) Analyse the likelihood that each species will occur in the Project footprint by applying the following likelihood classifications:
 - a. HIGH – it is expected that this species will be within the Project footprint because of the presence of suitable habitat, and/or there are recent proximate records (i.e. post-2000).
 - b. MEDIUM – this species may occur within the Project footprint; however, there is evidence that lowers its likelihood of occurrence (i.e. lack of core habitat, no recent records with the search area, habitat degradation etc.).
 - c. LOW – it is not expected that this species is supported within the Project footprint, as there is no suitable habitat for the species and/or current threats in the region are known to have significantly impacted the species.
 - d. NONE – there is strong evidence that this species will not occur within the Project footprint.

***Note:** For many threatened species, the Atlas of Living Australia provides 'likely' and 'possible' modelled expert distributions. These distributions are referred to throughout this document and mostly come from the Species of National Environmental Significance Database maintained by the federal Department of the Environment.*

The location of some threatened species records from the Atlas of Living Australia has been generalised to 0.1 degree (introducing a location variance of up to 11 km) due to concerns that revealing the actual location may lead to poaching. Spatially-generalised records have been considered in this assessment; however, use of these records has been noted where relevant.

THREATENED SPECIES LIKELIHOOD ANALYSIS				
Species	TPWC Act	EPBC Act	Species details	Likelihood of occurrence
BIRDS				
Red Goshawk <i>Erythrotriorchis radiatus</i>	VU	VU	<p>Habitat: Prefers tall, open Eucalypt forest and riparian areas. Nests in large trees, frequently the tallest and most massive in a tall stand, nest trees are invariably within 1 km of permanent water (Debus et al. 1988; Aumann et al. 1991).</p> <p>Distribution: Sparsely distributed across much of the northern Australia, from the Kimberley to south-eastern Qld. Within this range, generally occurs in taller forests characteristic of higher rainfall areas, but there are some isolated records from central Australia. However, no breeding has been recorded in central Australia and these records are thought to be of dispersive individuals (Czechura cited in DoE 2016a).</p> <p>Records: There is a single, undated record from within the Mount Isa township 9.7 km north of the construction ROW.</p>	<p>LOW (NT & Qld)</p> <ul style="list-style-type: none"> There is no suitable habitat within the Project footprint. It is not near to any tall open Eucalypt forests and, although it intersects riparian vegetation along major rivers, these do not contain, or are not near, permanent water. The single record for the region has no date associated with it and is well outside the usual range of this species. There are a few records across arid Australia, but these are almost certainly vagrants. The Project footprint is outside the <i>expert distribution (likely)</i> but within the <i>expert distribution (maybe)</i>. This is probably due to the single record discussed above.
Gouldian Finch <i>Erythrura gouldiae</i>	VU	EN	<p>Habitat: Prefers annual and perennial grasses (especially Sorghum), a nearby source of surface water and – in the breeding season – unburnt, hollow-bearing Eucalyptus trees (especially <i>E. tintinnans</i>, <i>E. brevifolia</i> and <i>E. leucophloia</i>) (Tidemann 1996; O'Malley 2006).</p> <p>Distribution: Sparsely across northern Australia from the Kimberley to north-central QLD (Dostine 1998; Franklin 1999; Barrett et al. 2003; Franklin et al. 2005). Non-breeding birds disperse widely (Garnett et al. 2011), greatly increasing the possible range of this species.</p> <p>Records: Approximately 14 birds were observed at Lady Loretta Mine Rd, approximately 100 km NW of Mount Isa in 2011. There is a second record (with a high degree of spatial uncertainty) of the species approximately 25 km north east of the construction ROW – potentially associated with Lake Moondarra. These are the nearest records to the Project footprint.</p>	<p>NONE (NT) / MEDIUM (Qld)</p> <ul style="list-style-type: none"> There is no suitable habitat within the Project footprint in the NT. In Qld, vegetation mapping indicates the Project footprint passes rocky slopes containing <i>E. leucophloia</i> near Mount Isa which could provide suitable habitat. The Project footprint is outside the <i>expert distribution (likely)</i> except for a small section at the Mount Isa end – probably due to the record discussed in Species details. The rest of the Project footprint is outside the <i>expert distribution (maybe)</i>. This species' core distribution is many hundreds of kilometres to the north of the Project footprint. The Mount Isa end of the Project footprint is the nearest to the southern extent of this species' distribution (although still a few hundred kilometres away). Therefore, the two records near to Mount Isa are likely to be dispersing, non-breeding birds.

THREATENED SPECIES LIKELIHOOD ANALYSIS				
Species	TPWC Act	EPBC Act	Species details	Likelihood of occurrence
Night Parrot <i>Pezoporus occidentalis</i>	CE	EN	<p>Habitat: Flat spinifex (<i>Triodia</i> spp.) grasslands in stony or sandy environments; and samphire and chenopod shrublands – including genera such as <i>Atriplex</i>, <i>Bassia</i> and <i>Maireana</i> – on floodplains and claypans, and on the margins of saltlakes, creeks or other sources of water (from a variety of sources cited in DoE 2016b).</p> <p>Distribution: Extremely sparsely distributed through central arid regions. In the NT sightings were made up to 1923 in the Alice Springs region (Whitlock 1924). Recently recorded in western Qld (undisclosed location).</p> <p>Records: There are no records from the Barkly Tablelands. The closest record (from 1993) to the Project footprint is 110 km to the south-east of the Project footprint in Qld.</p>	<p>LOW (NT & Qld)</p> <ul style="list-style-type: none"> There are no recent or historical records of the species within the Project footprint. The Project footprint is outside the <i>expert distribution (likely)</i> and <i>expert distribution (maybe)</i>. The <i>Triodia</i> spp. grasslands within the construction ROW are generally 'young hummock' due to relatively high frequency of fire (every 5 to 7 years) rather than the preferred dense and old <i>Triodia</i> hummocks.
Australian Painted Snipe <i>Rostratula australis</i>	VU	EN	<p>Habitat: Fringes of permanent and temporary wetlands, swamps and inundated grasslands (Taylor et al. 2013).</p> <p>Distribution: Nomadic and scattered across Australia with no predictable occurrence (Rogers 2001) but could occur at any wetland or inundated grassland across its distribution, including nearly all of the NT and Qld (Garnett et al. 2011).</p> <p>Records: Apart from records within Mount Isa township, there is one spatially-generalised record within the region attributed to nearby Barkly Homestead in Queensland.</p>	<p>LOW (NT & Qld)</p> <ul style="list-style-type: none"> There are suitable permanent and ephemeral wetlands within the region; however, there are no wetlands within the Project footprint. The Project footprint is outside the <i>expert distribution (likely)</i> but within <i>expert distribution (maybe)</i>. There is a record for this species proximate to the Project footprint, likely from one of the seasonal wetlands between the construction ROW and the Barkly Highway.
Masked Owl (Northern) <i>Tyto novaehollandiae kimberli</i>	VU	VU	<p>Habitat: Mainly in Eucalyptus tall open forests (especially those dominated by <i>Eucalyptus miniata</i> and <i>E. tetrodonta</i>), but also roosts in monsoon rainforests and forages in more open vegetation types, including grasslands (Woinarski & Ward 2006).</p> <p>Distribution: Poorly known, with few records from across its broad range in northern Australia. In the NT records known from the Top End, Kakadu, Coburg Peninsula (majority of records) and south-west Gulf country (Woinarski & Ward 2006). In Qld, records are confined to the northern coastal forests and woodlands.</p> <p>Records: There is a single Masked Owl record from the Barkly Tablelands (at Dead Dog Waterhole), approximately 20 km south of the Project Footprint (KP425).</p>	<p>NONE</p> <ul style="list-style-type: none"> There is no suitable habitat within the Project footprint. The Project footprint is well outside the <i>expert distribution (likely)</i> and <i>expert distribution (maybe)</i>. The only proximate record is considerably outside the expert distribution of this species, and is more than 500 km south of the next nearest record. This record could be a misidentification of the similar Barn Owl.

THREATENED SPECIES LIKELIHOOD ANALYSIS				
Species	TPWC Act	EPBC Act	Species details	Likelihood of occurrence
Grey Falcon <i>Falco hypoleucos</i>	VU	-	<p>Habitat: Areas of lightly-timbered lowland plains, typically on inland drainage systems, where the average annual rainfall is less than 500 mm (Ward 2012a).</p> <p>Distribution: Sparsely through much of the arid and semi-arid areas of Australia, but is recorded across the country. In the NT, the majority of records are from the southern half, but there are records all the way up to Darwin (Ward 2012).</p> <p>Records: There are four recent (after 1990) records within 15 km of the NT section of the construction ROW.</p>	<p>HIGH (NT) / NA (Qld)</p> <ul style="list-style-type: none"> There is suitable habitat within the Project footprint. The Project footprint is within the <i>expert distribution</i>. There are records for this species near the construction ROW and from within similar habitat to that within the Project footprint. Likelihood of occurrence has only been considered in NT as it is not listed as threatened in Qld on federally.
Painted Honeyeater <i>Grantiella picta</i>	VU	VU	<p>Habitat: <i>Acacia</i> and <i>Eucalyptus</i>-dominated woodlands and open forest, preferring habitats with more mature trees that host more mistletoe. Breeding times and seasonal movements (south to north) are likely governed by the fruiting of mistletoe (Garnett et al. 2011).</p> <p>Distribution: Across eastern and northern parts of the country – but nowhere very numerous (Ward 2012b). Many birds move after breeding to semi-arid regions such as north-eastern SA, central and western Qld, and central NT (TSSC 2015). Few NT records – most from the Barkly Tablelands – but no evidence of a breeding population in the NT, and the records are thought to be of irregular visitors from the south-east (Ward 2012b).</p> <p>Records: There are two records from the NT – one in 2014 from Three Ways, one in 2016 from south of Tennant Creek, that are 4.8 km and 20 km from the construction ROW respectively. There is one spatially-verified record within the Project footprint at Mica Creek (from 2006), and two other records (1932 and date unknown) from the Mount Isa region.</p>	<p>LOW (NT) / HIGH (Qld)</p> <ul style="list-style-type: none"> There is no suitable habitat within the Project footprint in the NT. The records from the NT are generally accepted to be irregular visitors. There is suitable at the Mount Isa end of the Project footprint in the Qld. The Project footprint is within the <i>expert distribution</i> at the Mount Isa. There is a record for this species in the Project footprint at Mica Creek.
Princess Parrot <i>Polytelis alexandrae</i>	VU	VU	<p>Habitat: Occurs in swales between sand dunes with a shrub layer of vegetation and scattered trees (Pavey 2006a).</p> <p>Distribution: Confined to arid regions of Western Australia, the Northern Territory, and South Australia (Barrett et al. 2003; Blakers et al. 1984; Higgins 1999). There have been unconfirmed reports of the species from western Queensland (Britton 1992; Higgins 1999).</p> <p>Records: There is one record from the</p>	<p>LOW (NT & Qld)</p> <ul style="list-style-type: none"> There is no suitable habitat within the Project footprint. The Project footprint is well outside of the <i>expert distribution</i>. There is a single proximate record; however, this species is highly nomadic. It is noted in DoE (2016c) that the species is an irregular visitor (sometimes at intervals of more than 20 years) to

THREATENED SPECIES LIKELIHOOD ANALYSIS				
Species	TPWC Act	EPBC Act	Species details	Likelihood of occurrence
			Barkly Highway, 21 km north of KP 98.	most sites in its range and its movements are largely unknown. For these reasons, it is not possible or practical to provide an estimate of the number of locations at which the species occurs.
Curlew Sandpiper <i>Calidris ferruginea</i>	VU	CE	<p>Habitat: Mostly inhabits coasts and estuaries, but also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand (DoE 2016d).</p> <p>Distribution: A summer migrant from the northern hemisphere. Mostly widespread around the northern Australian coast, less common in the south, with few inland records (Chatto 2003).</p> <p>Records: There are no records from the NT close to the construction ROW. In Qld, there are six recent and records around Mount Isa – all from Lake Moondarra. Another three undated or old (1968) records are from west of Mount Isa approximately 10 km from the construction ROW.</p>	<p>LOW (NT & Qld)</p> <ul style="list-style-type: none"> There is no suitable habitat within the Project footprint. The Mount Isa end of the Project footprint is within the <i>expert distribution (likely)</i>. The records near Mount Isa are associated with Lake Moondarra – which presents the most suitable habitat within the region but is outside the construction ROW.
MAMMALS				
Greater Bilby <i>Macrotis lagotis</i>	VU	VU	<p>Habitat: In the NT, hummock grasslands on sandy soils with a preference for palaeo-drainage lines (Southgate 1990). Has large foraging area and will move home range in search for food (Johnson 2008). In Qld, it occurs on clay plains dominated by Mitchell Grass.</p> <p>Distribution: Historically widespread in arid Australia. Currently in the NT stronghold is the Tanami Desert (Pavey 2006). There are also small populations in far south-western Qld.</p> <p>Records: In the NT, there are 25 records within 50 km of the Project footprint – 12 of which have occurred between 1990 and 2004. It is unknown whether these records are burrows or sightings. There are no recent records within the vicinity of the Qld Project footprint, as currently known populations have retracted to the south-west of Qld (approximately 350 km from the Project footprint).</p>	<p>MEDIUM (NT) / NONE (Qld)</p> <ul style="list-style-type: none"> A large area of the Project footprint in the NT contains suitable habitat. None of the Qld Project footprint contains suitable habitat. The entire Project footprint is within the <i>expert distribution (likely)</i>. The range of this species has contracted considerably since the last proximate records, such that it is suspected the Wakaya Desert population is now extinct.

THREATENED SPECIES LIKELIHOOD ANALYSIS				
Species	TPWC Act	EPBC Act	Species details	Likelihood of occurrence
Southern Marsupial Mole <i>Notoryctes typhlops</i>	EN	-	<p>Habitat: Sandy deserts mostly associated with dunes, sandy plains and river flats (Pavey 2006b).</p> <p>Distribution: Central WA, northern SA and southern NT. Seems to be confined to the southern and western sections of the NT (Benshemesh & Schultz 2008) where it has been found as far north as Barrow Creek (Pavey 2006b).</p> <p>Records: There are no database records of the species to the east of the Stuart Hwy (i.e. in the Wakaya Desert). The nearest records are more than 100 km to the west and to the south of the easternmost end of the Project footprint.</p>	<p>NONE</p> <ul style="list-style-type: none"> Not federally-listed, therefore likelihood of occurrence in Qld has not been considered. There is no suitable habitat within the Project footprint. The species is known to occur within sand plains; however, they are generally found close to dune habitat, which does not occur within the Project footprint. The nearest records are more than 100 km to the west and to the south of the easternmost end of the Project footprint. About half of the Project footprint in the NT is within the <i>expert distribution (likely)</i>, and further quarter within the <i>expert distribution (maybe)</i>.
Black-footed Rock-wallaby <i>Petrogale lateralis</i> <i>(MacDonnell Ranges race)</i>	VU	VU	<p>Habitat: Upland rocky areas with associated steep slopes (Pavey 2006c).</p> <p>Distribution: In the NT, this species is mostly found in the MacDonnell Ranges, but also occurs throughout the arid southern end of the NT (Pavey 2006c) and may be found in the Davenport and Murchison Ranges. There are no Qld records for this species.</p> <p>Records: There are two records from 1987 approximately 50 km south of the Project footprint.</p>	<p>LOW (NT) / NONE (Qld)</p> <ul style="list-style-type: none"> There is no suitable habitat within the Project footprint. The Project footprint is outside the <i>expert distribution (likely)</i>, but within the <i>expert distribution (maybe)</i>. The nearest records are approximately 50 km to the south of the Project footprint, and in habitat that does not occur within the Project footprint.
Carpentarian Antechinus <i>Pseudantechinus mimulus</i>	VU	VU	<p>Habitat: A range of vegetation types that are consistently associated with a high cover of rocks and boulders (Johnson et al. 2008). Within Qld, the records come from rocky habitat with open woodland dominated by <i>Eucalyptus leucophloia</i>, <i>E. normantonensis</i> and <i>Corymbia terminalis</i> with a grass layer dominated by <i>Triodia</i> spp. and <i>Enneapogon</i> spp.</p> <p>Distribution: Only known from Sir Edward Pellew group of islands in the NT (Kitchener 1991; Johnson & Kerle 1991; Taylor et al. 2004) and from a few records north and east of Mount Isa (Woinarski 2004, Woinarski & Ward 2012).</p> <p>Records: The closest records are from Qld (at three locations) and are all approximately 38 km from the ROW.</p>	<p>NONE (NT) / HIGH (Qld)</p> <ul style="list-style-type: none"> There is suitable habitat within the sandstone hills and boulders to the west of the Mount Isa end of the Project footprint. The Mount Isa end of the Project footprint is within the <i>expert distribution (likely)</i>. There are no records proximate to the Project footprint; however, this is a poorly surveyed species.

THREATENED SPECIES LIKELIHOOD ANALYSIS				
Species	TPWC Act	EPBC Act	Species details	Likelihood of occurrence
Golden Bandicoot <i>Isodon auratus</i>	EN	VU	<p>Habitat: Mainly in heathland and shrubland on sandstone sheets, avoiding vegetation with greater tree cover (Palmer et al. 2012; Southgate et al. 1996)</p> <p>Distribution: Formerly across most of northern, central and western Australia (across a broad range of habitats), but now only recorded population on mainland Australia is within the Kimberley (Palmer et al. 2012). In the NT the species is confined to the offshore islands of Arnhem Land.</p> <p>Records: The only records from mainland NT are from the north-east corner of Arnhem Land between 1950 and 1980.</p>	<p>NONE</p> <ul style="list-style-type: none"> This species is likely regionally extinct.
Brush-tailed Mulgara <i>Dasyercus blythi</i>	VU	-	<p>Habitat: A range of vegetation types, but prefer mature hummock grasslands of spinifex, especially <i>Triodia basedowii</i> and <i>T. pungens</i> (Pavey & Woinarski 2006; Masters et. al. 2003). Digs burrows between sand dunes (Woolley 2008).</p> <p>Distribution: Because most previous records did not distinguish between the two species of mulgara now recognised, there is ambiguity about the distribution of both species. This species is known from at least the Western and Simpson Deserts, with confirmed records in the NT from Haast Bluff, Uluru, Papunya, Tanami Desert, Illamurta, Charlotte Waters and Crown Point (Pavey & Woinarski 2006).</p> <p>Records: One record 25 km to the south of the ROW from 1993. Two records for Tennant Creek from 1901 & 1904.</p>	<p>MEDIUM (NT) / Not assessed (Qld)</p> <ul style="list-style-type: none"> Not federally-listed, therefore likelihood of occurrence in Qld has not been considered. A large area of the Project footprint in the NT contains suitable habitat. There is a recent record proximate to the construction ROW.
Common Brushtail Possum (Southern NT) <i>Trichosurus vulpecula vulpecula</i>	EN	-	<p>Habitat: In Central Australia, riverine habitat that is close to rocky outcrops and moist gullies within the ranges or rocky slopes (Kerle et al. 1992). Habitat occurs on various geological substrates but is characterised by a diverse association of fire-sensitive plant species (Pavey and Ward 2012).</p> <p>Distribution: Occurs in isolated populations in the southern NT. Most common in the southern NT within the MacDonald Ranges (Pavey and Ward 2012). Formerly had a much more extensive distribution in the NT.</p> <p>Records: Two records for Tennant Creek from 1968 are the nearest to the Project footprint.</p>	<p>NONE (NT) /Not assessed QLD</p> <ul style="list-style-type: none"> Not federally-listed, therefore likelihood of occurrence in Qld has not been considered. There is no suitable habitat within the Project footprint. There is no expert distribution mapping available. Apart from the records mentioned below, all other records are from a significant distance to the south and west of the Project footprint. The records from the rocky hills around Tennant Creek are historic records and range contraction indicates that the species is unlikely to still occur in these areas.

THREATENED SPECIES LIKELIHOOD ANALYSIS				
Species	TPWC Act	EPBC Act	Species details	Likelihood of occurrence
REPTILES				
Plains Death Adder <i>Acanthophis hawkei</i>	VU	VU	<p>Habitat: Floodplains and cracking soil plains (Webb et al. 2002).</p> <p>Distribution: Habitat mapping suggests the potential geographic range extends from western Qld, across the north of the NT to north-eastern Western Australia. Fragmented populations occur in the Mitchell Grass Downs of western Qld, the Barkly Tablelands on the NT/Qld border and east of Darwin in the NT (TSSC 2012).</p> <p>Records: Only one record from 1978 south of the Barkly Highway and north of the Project footprint. There are, however, many records in similar habitat to the north of the Barkly Highway.</p>	<p>HIGH (NT & Qld)</p> <ul style="list-style-type: none"> There is suitable habitat within the Project footprint. The Project footprint is within the <i>expert distribution (likely)</i> for the eastern half of the pipeline. There is a record for this species proximate to, and in similar habitat to that within, the Project footprint.
Great Desert Skink <i>Liopholis kintorei</i>	VU	VU	<p>Habitat: Generally tall open shubland and hummock grasslands on red sandplains and sand ridges (Cogger et al. 1993; Pavey 2006d). However, in some locations (e.g. the Gibson Desert) found on sandplains with fine gravel.</p> <p>Distribution: Originally within a broad range extending from the desert parts of south-western NT, eastern interior of WA and north-western South Australia (Cogger et al. 1993). Currently known from seven populations (McAlpin 2001), three of which occur in the NT –the Tanami Desert, Uluru-Kata Tjuta National Park and the Yulara lease lands.</p> <p>Records: Two records near Tennant Creek from 1906 are the nearest to the Project footprint.</p>	<p>NONE</p> <ul style="list-style-type: none"> The current distribution of the species is confined to the western and southern NT. The only records near the construction ROW are from 1906. The Project footprint is within the <i>expert distribution (maybe)</i> at the Tennant Creek end of the pipeline.
Gulf Snapping Turtle <i>Elseya lavarackorum</i>	-	EN	<p>Habitat: Large rivers and their associated overflow lagoons and oxbow lakes (Cogger 2000; Woinarski 2006). Found in deeper permanent pools most often with muddy, sandy or rocky bottoms. Also found in the middle reaches of rivers, upstream of saline regions and downstream of escarpments, including plunge pools. Steep rocky gorges, and river reaches with intact river banks seem to be preferred habitats (Thomson et al. 1997).</p> <p>Distribution: From the Calvert River to the Nicholson River systems, including the Roper, Limmen Bight, Robinson and Nicholson Rivers all of which discharge into the Gulf of Carpentaria (Georges & Adams 1996; Thomson et al. 1997; Woinarski 2006).</p>	<p>NONE</p> <ul style="list-style-type: none"> The Project footprint primarily lies in drainages flowing south away from the majority of river systems that this species uses. There is no suitable habitat within the Project footprint. The only area where the Project footprint overlaps with potential habitat is the Leichardt River near Mount Isa. However, these upper reaches are upstream of where the river is dammed to form Lake Moondarra, and so have no connectivity with the Leichardt River downstream of the lake. The Leichardt River section of the

THREATENED SPECIES LIKELIHOOD ANALYSIS				
Species	TPWC Act	EPBC Act	Species details	Likelihood of occurrence
			Records: None in the region.	Project footprint is within the <i>expert distribution</i> at the Mount Isa end, which is unusual because there are no records of the species within the Leichardt River. The closest records are from the Lawn Hill area approximately 200 km from the Project footprint.
SNAILS				
Spencer's Land Snail <i>Bothriembryon spenceri</i>	VU	-	Habitat: In leaf litter under fig trees and/or rocky areas. During unfavourable periods, buries in the soil (Wilson et al. 2006). Distribution: Restricted to the Krichauff and Chewings Ranges west of Alice Springs, notably occurring in Palm Valley (Solem 1988). Records: None proximate to the Project footprint.	NONE <ul style="list-style-type: none"> This species should not have come up in the NT Infonet search. This species has a very restricted range west of Alice Springs that is hundreds of kilometres to the south of the Project footprint.
PLANTS				
Tobernmorey Melon <i>Austrobryonia argillicola</i>	VU	-	Habitat: Along creeks and poorly drained areas. Recorded from Bluebush swamps, Gidgee shrubland and <i>Eucalyptus camaldulensis</i> dominated riparian woodlands (Nano et al. 2012). Distribution: Endemic to central western Queensland extending to the adjoining Barkly Tablelands in the NT (Schaefer et al. 2008). Currently known from five locations within the NT (Nano et al. 2012). Records: Three records (one location) from 2001 approximately 15 km north of the Project footprint. The remaining records are at least 200 km south of the construction ROW.	HIGH (NT) / Not assessed (Qld) <ul style="list-style-type: none"> No longer federally-listed, therefore likelihood of occurrence in Qld has not been considered. There is suitable habitat within the Project footprint for this species, especially in the eastern area near the Qld border where there are numerous small ephemeral creeks and cracking clay soils, with some intermittent lakes. There is a record for this species proximate to the Project footprint and in similar habitat to that within the Project footprint.
Latz's Grass <i>Sporobolus latzii</i>	VU	-	Habitat: Only known to occur on clay soil at the edge of a seasonal swamp surrounded by <i>Eucalyptus coolabah</i> (Albrecht et al. 2012). Distribution: Endemic to the NT and currently only known from one site (Albrecht et al. 2012). Records: The only record ever of this species is approximately 4 km south of the Project footprint in the Wakaya Desert	HIGH (NT) / Not assessed (Qld) <ul style="list-style-type: none"> Not federally-listed, therefore likelihood of occurrence in Qld has not been considered. There is the potential for there to be suitable habitat within the Project footprint. There is a record for this species proximate to the Project footprint.

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Appendix F

...@umg; fUgg\ abitat descriptions oZsurvey sites

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Latz's Grass (*Sporobolus latzii*) site descriptions, May 2016

Site name: SL2



This photograph shows fire sensitive fringing vegetation

Site information

Landform: Depression; also other minor (indistinct when observed on ground) depressions in area not selected as part of survey site.

Survey type: Aerial and ground checked.

Area: 0.57 ha

Project footprint: 191 m north of ROW (KP 223)

Swamp edge vegetation: *Ventilago viminalis*, *Eragrostis* sp., *Aristida* sp., *Gossypium* sp., *Eremophila longifolia*.

Fire history: Last burnt in 2011 (NAFI); evidence of fire-sensitive flora species suggests low fire impact.

Surface water: Not present.

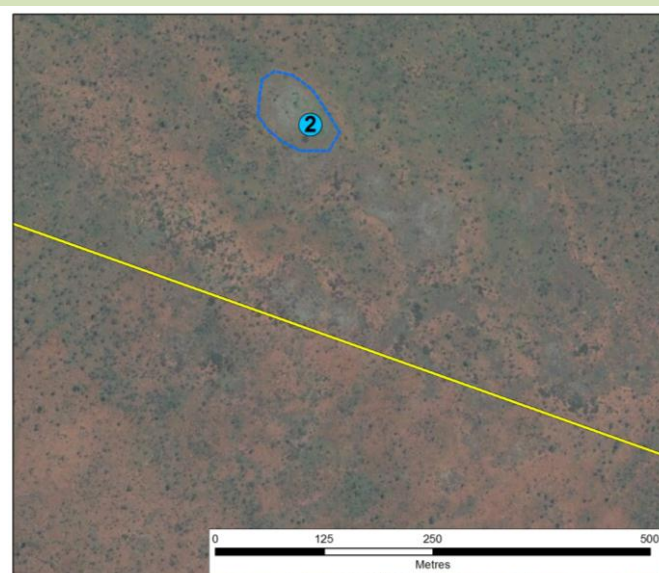
Cattle impact: None

Evidence of weeds / other impacts: Not observed

Surrounding landform (s): Minor depressions; desert sandplains dominated by hummock grasslands and *Acacia* shrubs (Turpentine)

Suitability assessment: None observed; low altitude fly over did not observe any patches of *Sporobolus* sp. grass; low habitat suitability due to lack of clay loam soils; no Coolabah trees observed.

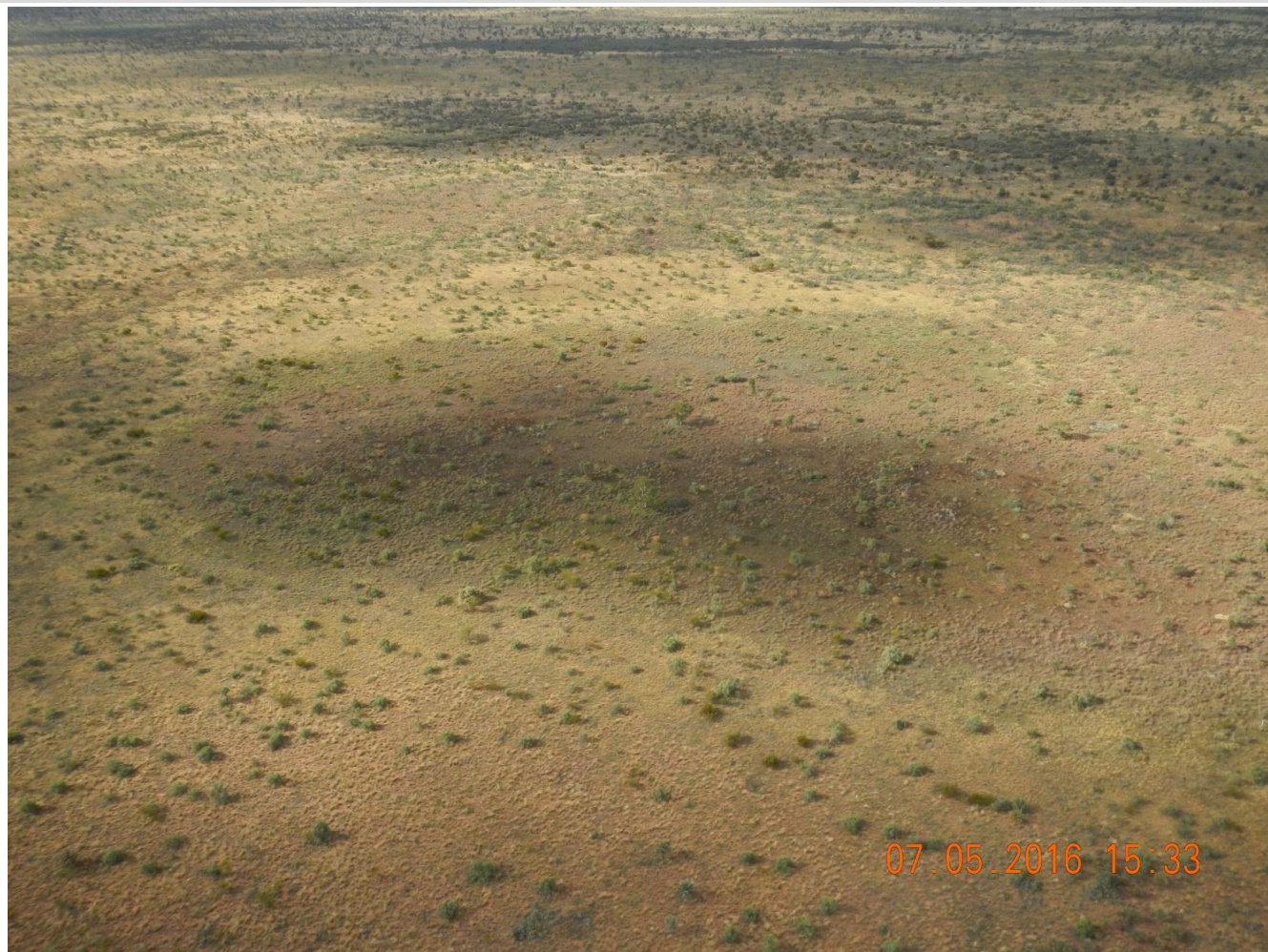
Reference map (refer to site map for location)



Map key: Yellow line = ROW; Blue circle = survey site; Blue line = depression boundary

Latz's Grass (*Sporobolus latzii*) site descriptions, May 2016

Site name: SL3



Site information

Landform: Claypan / seasonal swamp

Survey type: Aerial survey

Area: 3.9 ha (claypan looks larger in aerial image when observed during survey)

Project footprint: 581 m south of ROW (KP 238)

Swamp edge vegetation: *Eucalyptus coolabah* (uncommon), *Eucalyptus pachyphylla*, *Acacia* shrubs, *Melaleuca glomerata*, *Aristida* sp., *Eragrostis* sp., sedges observed within swamp

Fire history: Last burnt in 2011 (NAFI); fire impacted Coolabah present (malleed trees).

Surface water: Not present; clay soils appear wet.

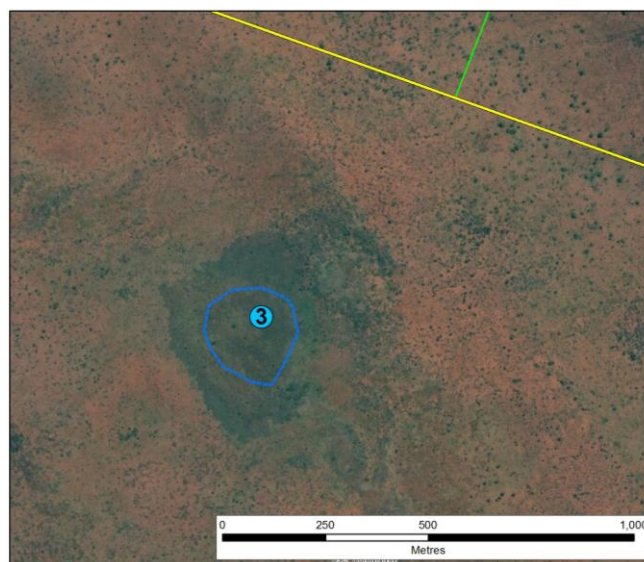
Cattle impact: None

Evidence of weeds / other impacts: Not observed

Surrounding landform (s): Desert sandplains dominated by hummock grasslands and *Acacia* shrubs (Turpentine)

Suitability assessment: No ground search; low altitude fly over did not observe any patches of *Sporobolus* sp. grass; marginal habitat due to presence of fire impacted Coolabah; no chance of impact if present due to considerable distance from Project footprint.

Reference map (refer to site map for location)



Map key: Yellow line = ROW; Blue circle = survey site; Blue line = depression boundary; Green line = proposed access track

Latz's Grass (*Sporobolus latzii*) site descriptions, May 2016

Site name: SL4



Site information

Landform: Claypan / seasonal swamp

Survey type: Aerial survey

Area: 3.7 ha

Project footprint: 1 200 m north of ROW (KP 237); 1 250 m west of proposed access road.

Swamp edge vegetation: *Eucalyptus coolabah*, *Eucalyptus pachyphylla*, *Acacia* shrubs, *Aristida* sp., *Eragrostis* sp., sedges observed within swamp

Fire history: Last burnt in 2011 (NAFI); some fire impacted Coolabah present (malleed trees) and some non-fire impact Coolabah (single trunk) in centre of swamp.

Surface water: Not present. Swamp contained water in March 2016 when observed during recon survey.

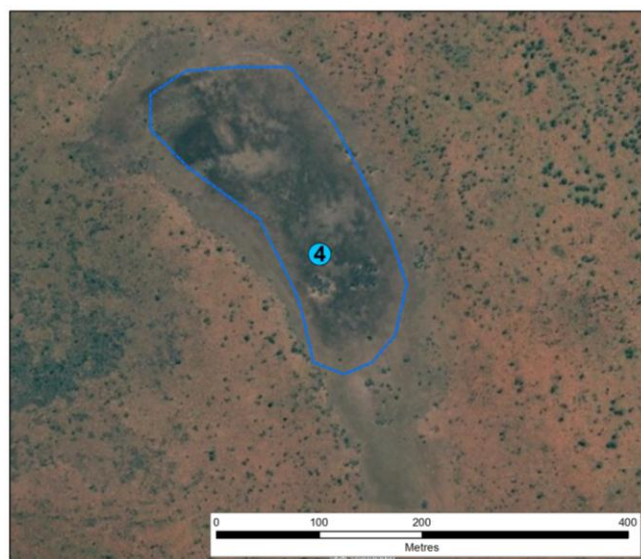
Cattle impact: None

Evidence of weeds / other impacts: Not observed; Buffel Grass in local area.

Surrounding landform (s): Desert sandplains dominated by hummock grasslands and *Acacia* shrubs

Suitability assessment: No ground search; low altitude fly over did not observe any patches of *Sporobolus* sp. grass; moderate habitat suitability due to presence of fire impacted and non-fire impacted Coolabah; low chance of impact if present due to distance from Project footprint.

Reference map (refer to site map for location)



Map key: Yellow line = ROW; Blue circle = survey site; Blue line = depression boundary; Green line = proposed access track

Latz's Grass (*Sporobolus latzii*) site descriptions, May 2016

Site name: SL5



Site information

Landform: Claypan / seasonal swamp; surrounded by depression

Survey type: Aerial and ground survey

Area: 5.2 ha

Project footprint: 400 m south of ROW (KP 242); however, swamp edge habitat is extensive and pass within 100 m of ROW.

Swamp edge vegetation: *Eucalyptus coolabah* (all malleed), *Melaleuca glomerata*, *Eucalyptus pachyphylla*, *Acacia* shrubs, *Eulalia aurea*, *Triodia* sp., *Fimbristylis* sp., *Aristida* sp., *Eragrostis* sp., sedges dominant in swamp

Fire history: Last burnt in 2011 (NAFI); fire impacted vegetation present (i.e. malleed Coolabah trees)

Surface water: Present; small pool (10 x 10 m).

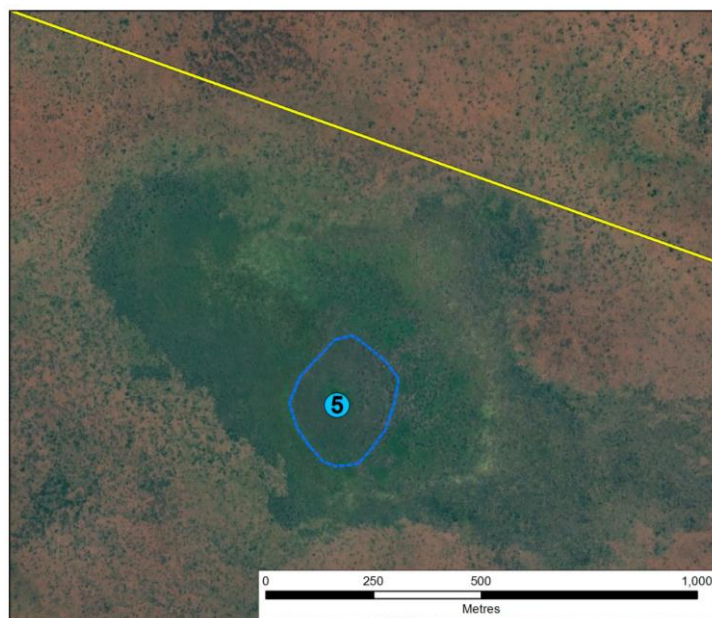
Cattle impact: None

Evidence of weeds / other impacts: Not observed; Buffel Grass in local area.

Surrounding landform (s): Desert sandplains dominated by hummock grasslands and *Acacia* shrubs

Suitability assessment: None observed during ground searches; low habitat suitability due to presence of fire impacted vegetation.

Reference map (refer to site map for location)



Map key: Yellow line = ROW; Blue circle = survey site; Blue line = depression boundary (note: ROW has since been moved north to avoid temporary swamp).

Latz's Grass (*Sporobolus latzii*) site descriptions, May 2016

Site name: SL6



Site information

Landform: Sinkhole

Survey type: Aerial and ground survey

Area: 0.11 ha

Project footprint: 15 m north of ROW (KP 257)

Swamp edge vegetation: Not applicable

Fire history: Area last burnt in 2011 (NAFI); sinkhole vegetation has low fire frequency.

Surface water: Not present.

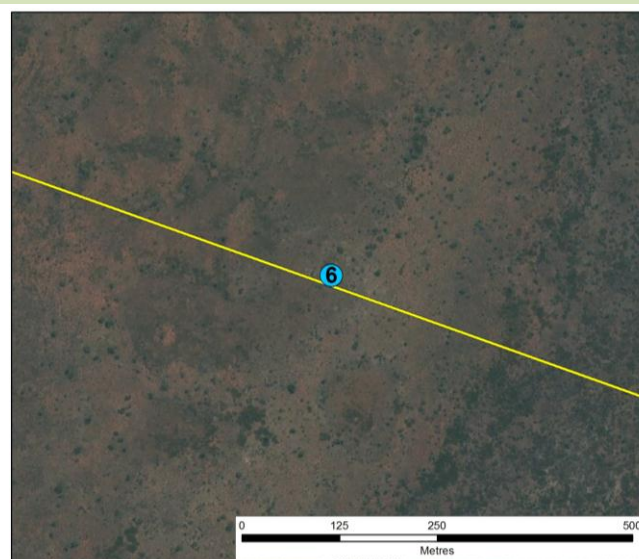
Cattle impact: None

Evidence of weeds / other impacts: Not observed

Surrounding landform (s): Desert sandplains dominated by hummock grasslands and Acacia shrubs

Suitability assessment: None observed during ground searches; not suitable habitat.

Reference map (refer to site map for location)



Map key: Yellow line = ROW; Blue circle = survey site; Blue line = depression boundary; Green line = proposed access track

Latz's Grass (*Sporobolus latzii*) site descriptions, May 2016

Site name: SL7



Site information

Landform: Depression (no clay soils present)

Survey type: Aerial and ground survey

Area: 0.26 ha

Project footprint: 15 m north of ROW (KP 269)

Swamp edge vegetation: *Melaleuca glomerata*, *Hakea* sp., *Eucalyptus pachyphylla*, *Aristida* sp., *Gossypium* sp., *Acacia* shrubs, tussock grasses, *Triodia* sp. (*Spinifex*) relatively uncommon.

Fire history: Area last burnt in 2011 (NAFI); previous burn in 2007.

Surface water: Not present

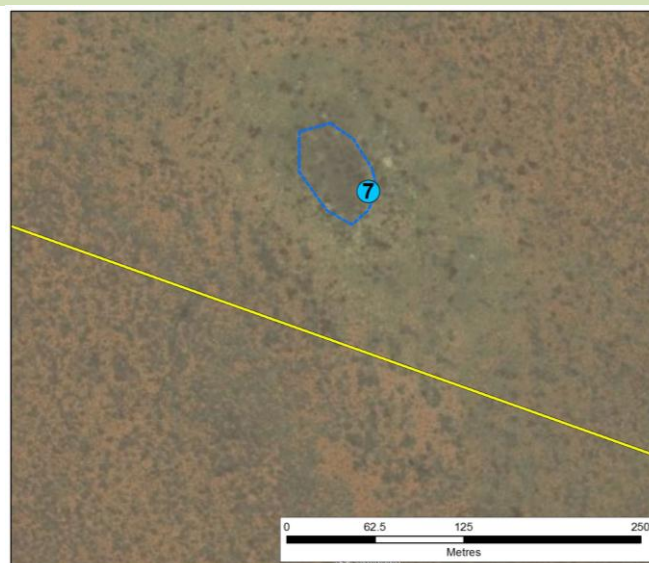
Cattle impact: None

Evidence of weeds / other impacts: Not observed

Surrounding landform (s): Desert sandplains dominated by hummock grasslands and *Acacia* shrubs

Suitability assessment: None observed during ground searches; not suitable habitat.

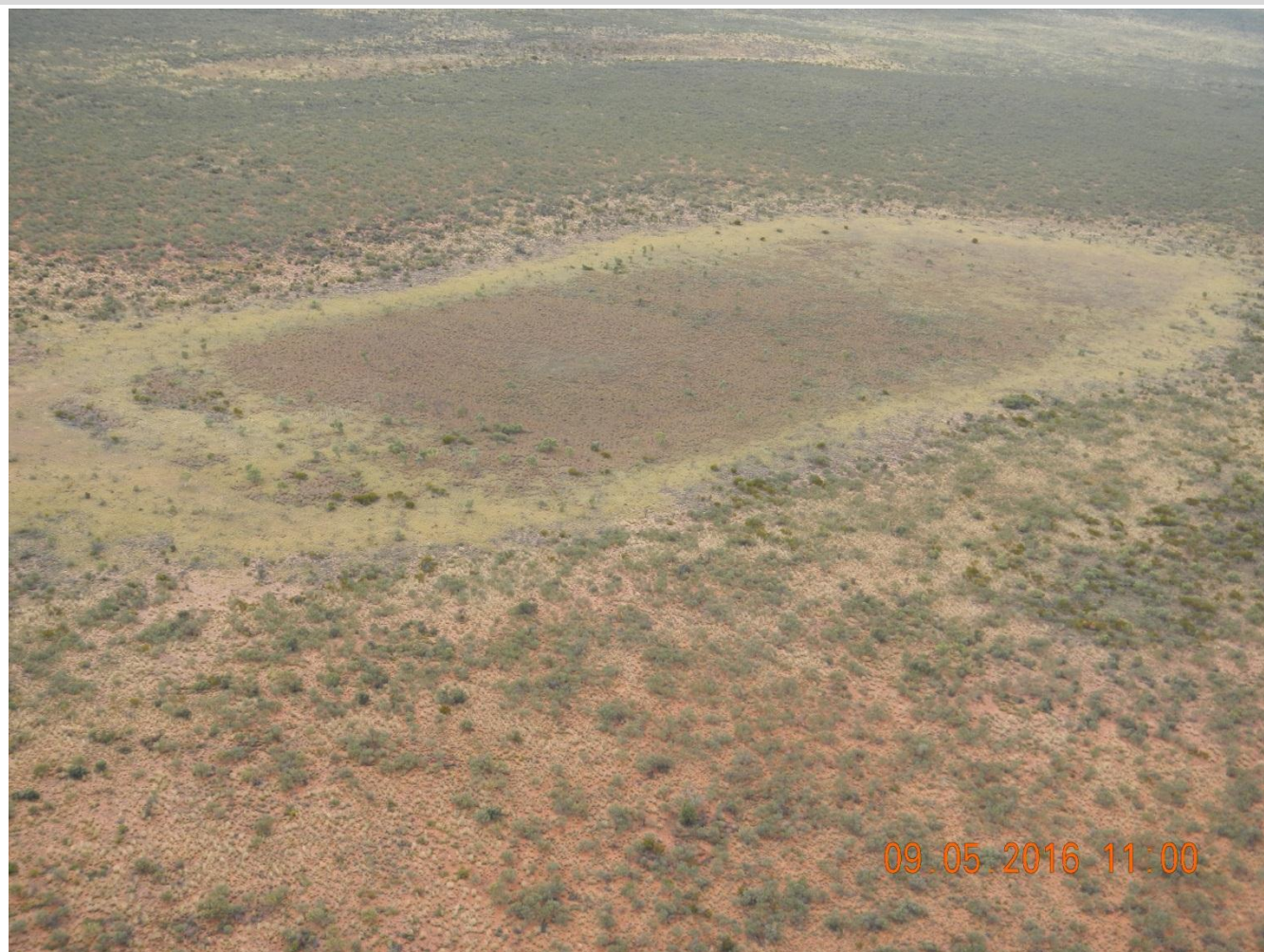
Reference map (refer to site map for location)



Map key: Yellow line = ROW; Blue circle = survey site; Blue line = depression boundary; Green line = proposed access track

Latz's Grass (*Sporobolus latzii*) site descriptions, May 2016

Site name: SL8



Site information

Landform: Claypan / seasonal swamp

Survey type: Aerial survey

Area: 8.26 ha

Project footprint: 798 m north of ROW (KP 268)

Swamp edge vegetation: *Eucalyptus coolabah*, *Melaleuca glomerata*, *Eucalyptus pachyphylla*, *Eulalia aurea*, *Aristida* sp. *Acacia* shrubs, tussock grasses, *Triodia* sp. (*Spinifex*) relatively uncommon.

Fire history: Area last burnt in 2011 (NAFI); presence of large Coolabah and malleed Coolabah indicates moderate long term fire impact on edge of swamp.

Surface water: Not present

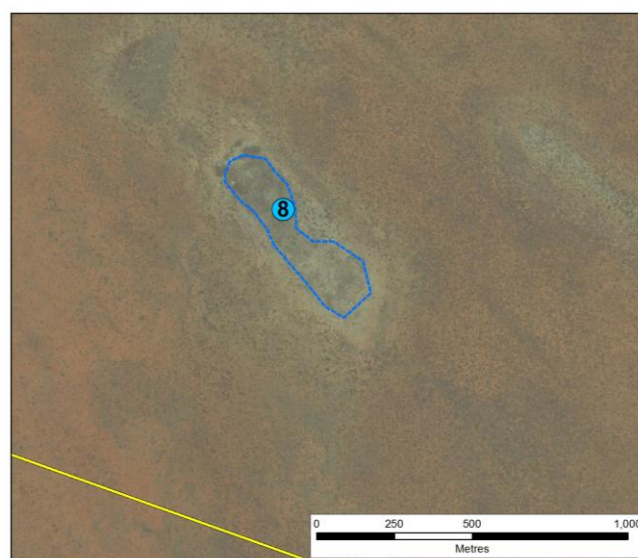
Cattle impact: None

Evidence of weeds / other impacts: Not observed

Surrounding landform (s): Desert sandplains dominated by hummock grasslands and *Acacia* shrubs

Suitability assessment: No ground search; low altitude fly over did not observe any patches of *Sporobolus* sp. grass; moderate habitat suitability due to presence of fire impacted and non-fire impacted Coolabah; low chance of impact if present due to distance from Project footprint.

Reference map (refer to site map for location)



Map key: Yellow line = ROW; Blue circle = survey site; Blue line = depression boundary

Latz's Grass (*Sporobolus latzii*) site descriptions, May 2016

Site name: SL9



Site information

Landform: Minor swamp / depression (considered as transition due to the presence of Coolabah trees)

Survey type: Aerial survey

Area: 2.2 ha

Project footprint: 1 052 m north of ROW (KP 270)

Swamp edge vegetation: *Eucalyptus coolabah*, *Aristida* sp. *Acacia* shrubs, *Eulalia aurea*, tussock grasses

Fire history: Area last burnt in 2011 (NAFI).

Surface water: Not present

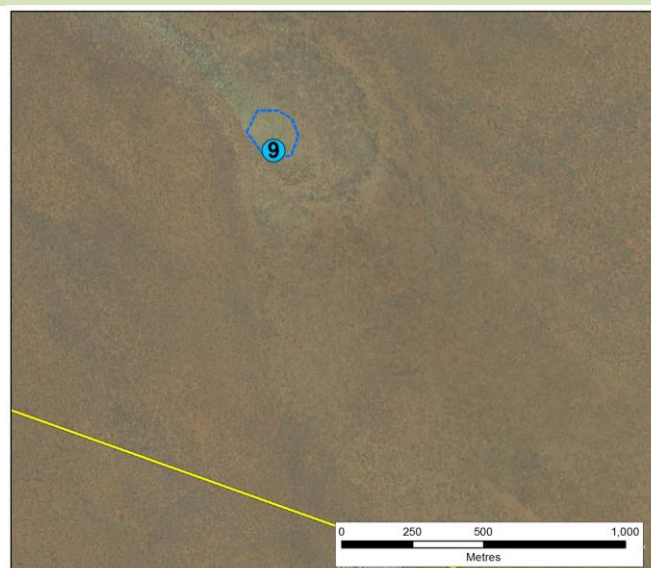
Cattle impact: None

Evidence of weeds / other impacts: Not observed

Surrounding landform (s): Desert sandplains dominated by hummock grasslands and *Acacia* shrubs

Suitability assessment: No ground search; low altitude fly over did not observe any patches of *Sporobolus* sp. grass; low chance of impact if present due to distance from Project footprint.

Reference map (refer to site map for location)



Map key: Yellow line = ROW; Blue circle = survey site; Blue line = depression boundary

Appendix G

.....HcVYfa cfYmiAYcb`habitat descriptions of ROW survey sites

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Tobermorey Melon (*Austrobryonia argillicola*) ROW survey sites, May 2016

Site: AA01



Site description details

Survey: Aerial and ground

Landform: Minor drainage

Vegetation: *Astrebla* sp. (likely *pectinata*) grassland

Soil: Gravel survey over heavy clay

Surface water present: No

***Austrobryonia argillicola* assessment:** None observed; marginal habitat.

Notes: Cattle disturbance; no existing tracks / fences

Site: AA02 (Ranken River)



Site description details

Survey: Aerial and ground

Landform: River (Ranken River)

Vegetation: Coolabah (*Eucalyptus microtheca*) line the creek banks (low open woodland), Noogoora Burr (*Xanthium strumarium*), *Astrebla pectinata*, *Enteropogon acicularis*, numerous herbs and forbs.

Soil: Heavy clay

Surface water present: Yes, large pool

***Austrobryonia argillicola* assessment:** Present in low numbers; 2 small plants identified on upper bank of river (vouchered); foliage present but dry; fruit present and conspicuous; suitable habitat.

Notes: Declared weed present in high densities – Noogoora Burr (*Xanthium strumarium*); Cattle impact (erosion, trampling); no existing tracks / fences

Tobermorey Melon (*Austrobryonia argillicola*) ROW survey sites, May 2016

Site: AA03



Site description details

Survey: Aerial and ground

Landform: Floodout; relic channel; depression

Vegetation: Coolabah (*Eucalyptus microtheca*) and Gidyea (*Acacia georginae*) low open woodland, *Astrebla* sp., *Aristida* sp., numerous herbs and forbs.

Soil: Heavy clay

Surface water present: No

***Austrobryonia argillicola* assessment:** Present in low numbers; 1 small plant identified on upper bank of river (not vouchered); occur on clay soils; suitable habitat.

Notes: Cattle disturbance; no existing tracks / fences

Site: AA04



Site description details

Survey: Aerial and ground

Landform: Drainage

Vegetation: Mimosa Bush (*Vachellia farnesiana*) open shrubland, *Eulalia aurea*, *Dichanthium fecundum*, *Astrebla pectinata*, plus other annual grasses, herbs and forbs

Soil: Heavy clay loam

Surface water present: No

***Austrobryonia argillicola* assessment:** None observed; suitable habitat.

Notes: Cattle disturbance; no existing tracks / fences

Tobermorey Melon (*Austrobryonia argillicola*) ROW survey sites, May 2016

Site: AA05



Site description details

Survey: Aerial and ground

Landform: Minor drainage

Vegetation: Grassland of *Eulalia aurea*, *Dichanthium fecundum*, *Astrebla pectinata*, plus other annual grasses, herbs and forbs with sparse Mimosa Bush (*Vachellia farnesiana*) shrubs

Soil: Clay

Surface water present: No

***Austrobryonia argillicola* assessment:** None observed; suitable habitat.

Notes: Cattle disturbance; no existing tracks / fences

Site: AA06



Site description details

Survey: Aerial

Landform: Drainage

Vegetation: Grassland of *Eulalia aurea*, *Dichanthium fecundum*, *Astrebla pectinata*, plus other annual grasses, herbs and forbs

Soil: Clay

Surface water present: No

***Austrobryonia argillicola* assessment:** None observed; suitable habitat.

Notes: Cattle disturbance; no existing tracks / fences

Tobermorey Melon (*Austrobryonia argillicola*) ROW survey sites, May 2016

Site: AA07



Site description details

Survey: Aerial

Landform: Minor drainage

Vegetation: Grassland of *Eulalia aurea*, *Astrebla pectinata*

Soil: Heavy clay

Surface water present: No

***Austrobryonia argillicola* assessment:** None observed; suitable habitat.

Notes: Cattle disturbance; no existing tracks / fences

Site: AA08



Site description details

Survey: Aerial and ground

Landform: Depression

Vegetation: Coolabah (*Eucalyptus microtheca*) low open to sparse woodland, plus *Excoecaria parvifolia*, *Muehlenbeckia florulenta*, *Astrebla* sp., numerous herbs and forbs.

Soil: Heavy clay; cracking; surface rock / gravel.

Surface water present: No

***Austrobryonia argillicola* assessment:** Present in low numbers; 2 small plants identified on open clay soils (vouchered); foliage dry; fruit present and conspicuous; suitable habitat.

Notes: Cattle impact (erosion, trampling); no existing tracks / fences

Tobermorey Melon (*Austrobryonia argillicola*) ROW survey sites, May 2016

Site: AA09



Site description details

Survey: Aerial and ground

Landform: River

Vegetation: Coolabah (*Eucalyptus microtheca*) and low open woodland, *Astrebla* sp., numerous herbs and forbs.

Soil: Heavy clay

Surface water present: Yes, large pool

***Austrobryonia argillicola* assessment:** None observed; suitable habitat.

Notes: Cattle disturbance; heavily grazed; no existing tracks / fences

Site: AA10



Site description details

Survey: Aerial and ground

Landform: Drainage

Vegetation: Small Coolabah (*Eucalyptus microtheca*) low sparse woodland, *Astrebla* sp., numerous herbs and forbs.

Soil: Heavy clay

Surface water present: No

***Austrobryonia argillicola* assessment:** Present in low numbers; 3 small plants identified on clay soils; foliage dry; fruit present and conspicuous; suitable habitat.

Notes: Cattle disturbance; heavily grazed; no existing tracks / fences

Tobermorey Melon (*Austrobryonia argillicola*) ROW survey sites, May 2016

Site: AA11



Site description details

Survey: Aerial and ground

Landform: Drainage

Vegetation: Sparse shrubland (species not identified) over *Astrebla pectinata* grassland, annual grasses

Soil: Heavy clay loam

Surface water present: No

***Austrobryonia argillicola* assessment:** None observed; suitable habitat.

Notes: Cattle disturbance; heavily grazed; no existing tracks / fences

Site: AA12



Site description details

Survey: Aerial

Landform: Drainage

Vegetation: Sparse shrubland (species not identified) over *Astrebla pectinata* grassland, annual grasses

Soil: Heavy clay

Surface water present: No

***Austrobryonia argillicola* assessment:** None observed; suitable habitat.

Notes: Cattle disturbance; heavily grazed; existing tracks present near crossing site

Tobermorey Melon (*Austrobryonia argillicola*) ROW survey sites, May 2016

Site: AA13



Site description details

Survey: Aerial and ground

Landform: Drainage

Vegetation: Mimosa Bush (*Vachellia farnesiana*) open shrubland over *Astrebla pectinata* grassland, annual grasses

Soil: Heavy clay

Surface water present: No

***Austrobryonia argillicola* assessment:** Present in low numbers on clay soils (not vouchered); foliage absent; fruit present and observed hanging in the base of shrubs; suitable habitat.

Notes: Cattle disturbance; no existing tracks / fences

Site: AA14



Site description details

Survey: Aerial

Landform: Depression

Vegetation: Bluebush (*Chenopodium auricomum*) low open shrubland, with *Astrebla pectinata*, *Dichanthium fecundum*, *Eulalia aurea*.

Soil: Heavy clay

Surface water present: No

***Austrobryonia argillicola* assessment:** Suitable habitat

Notes: Cattle disturbance; no existing tracks / fences

Tobermorey Melon (*Austrobryonia argillicola*) ROW survey sites, May 2016

Site: AA15



Site description details

Survey: Aerial and ground

Landform: River

Vegetation: Coolabah (*Eucalyptus microtheca*) low open woodland, *Astrebla* sp., numerous herbs and forbs.

Soil: Heavy clay; calcrete outcrop on floodout area

Surface water present: Yes

***Austrobryonia argillicola* assessment:** None observed; upper banks and floodout areas where checked; suitable habitat.

Notes: Cattle disturbance; heavily grazed; existing tracks present near crossing site

Site: AA16



Site description details

Survey: Aerial and ground

Landform: Drainage

Vegetation: Lignum (*Muehlenbeckia florulenta*) low open shrubland, with *Astrebla pectinata*, *Dichanthium fecundum*, *Eulalia aurea*, annual herbs and forbs.

Soil: Heavy clay

Surface water present: No

***Austrobryonia argillicola* assessment:** Present in low numbers on clay soils; 2 x relatively large specimens observed (vouchered); green foliage present; fruit present and conspicuous; suitable habitat.

Notes: Cattle disturbance; no existing tracks / fences

Tobermorey Melon (*Austrobryonia argillicola*) ROW survey sites, May 2016

Site: AA17



Site description details

Survey: Aerial and ground

Landform: Floodout; relic channel; depression

Vegetation: Coolabah (*Eucalyptus microtheca*) low open woodland, Lignum (*Muehlenbeckia florulenta*), Bluebush (*Chenopodium auricomum*), *Sporobolus* sp., *Astrebula pectinata*, numerous herbs and forbs.

Soil: Heavy clay

Surface water present: Yes; upstream ~100 m

***Austrobryonia argillicola* assessment:** Present in low numbers on open clay soils; 1 x specimens observed (not vouchered); green foliage present; fruit present and conspicuous; suitable habitat.

Notes: Cattle disturbance; no existing tracks / fences

Site: AA18



Site description details

Survey: Aerial

Landform: Floodout; relic channel; depression

Vegetation: Coolabah (*Eucalyptus microtheca*) low open woodland, *Astrebula* sp., numerous herbs and forbs.

Soil: Heavy clay; calcrete outcrop / surface rocks

Surface water present: No

***Austrobryonia argillicola* assessment:** None observed; upper banks and floodout areas where checked; suitable habitat.

Notes: Cattle disturbance; heavily grazed; no existing tracks / fence lines

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Appendix H

**.....HcVYfa cfYmAYcb'habitat descriptions of access track
survey sites**

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Tobermorey Melon (*Austrobryonia argillicola*) access track survey site descriptions, May 2016

Site: AA19 (western access track)



Landform: Depression
***A. argillicola* habitat assessment:** Suitable

Site: AA20 (western access track)



Landform: Claypan
***A. argillicola* habitat assessment:** Suitable

Site: AA21 (western access track)



Landform: Drainage
***A. argillicola* habitat assessment:** Suitable

Site: AA22 (western access track)



Landform: Small drainage
***A. argillicola* habitat assessment:** Suitable

Site: AA23 (western access track)



Landform: Drainage
***A. argillicola* habitat assessment:** Suitable

Site: AA24 (western access track)



Landform: Small drainage
***A. argillicola* habitat assessment:** Suitable

Tobermorey Melon (*Austrobryonia argillicola*) access track survey site descriptions, May 2016

Site: AA25 (western access track)



Landform: Edge of soak / depression
***A. argillicola* habitat assessment:** Suitable

Site: AA26 (western access track)



Landform: Small drainage
***A. argillicola* habitat assessment:** Suitable

Site: AA27 (western access track)



Landform: Claypan
***A. argillicola* habitat assessment:** Marginal

Site: AA28 (western access track)



Landform: Creek
***A. argillicola* habitat assessment:** Suitable

Site: AA29 (western access track)



Landform: Creek
***A. argillicola* habitat assessment:** Suitable (banks)

Site: AA30 (central access track)



Landform: Depression
***A. argillicola* habitat assessment:** Suitable

Tobermorey Melon (*Austrobryonia argillicola*) access track survey site descriptions, May 2016

Site: AA31 (central access track)



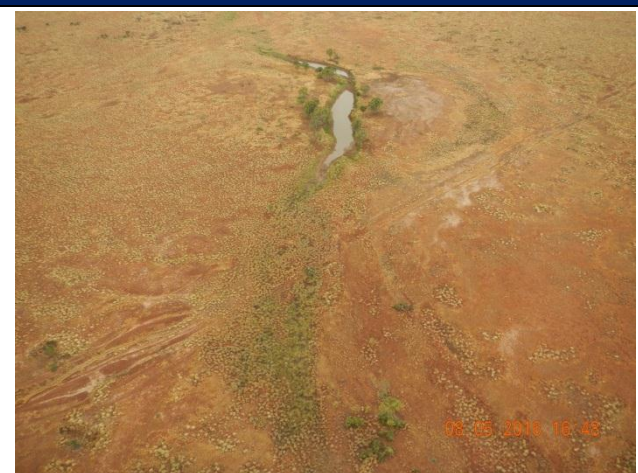
Landform: Small drainage
***A. argillicola* habitat assessment:** Suitable

Site: AA32 (central access track)



Landform: Small drainage
***A. argillicola* habitat assessment:** Suitable

Site: AA33 (central access track)



Landform: Drainage
***A. argillicola* habitat assessment:** Suitable

Site: AA34 (central access track)



Landform: Depression
***A. argillicola* habitat assessment:** Suitable

Site: AA35 (central access track)



Landform: Drainage
***A. argillicola* habitat assessment:** Suitable

Site: AA36 (central access track)



Landform: Small drainage
***A. argillicola* habitat assessment:** Suitable

Tobermorey Melon (*Austrobryonia argillicola*) access track survey site descriptions, May 2016

Site: AA37 (central access track)



Landform: Small drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA38 (central access track)



Landform: Depression

***A. argillicola* habitat assessment:** Suitable

Site: AA39 (central access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA40 (central access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

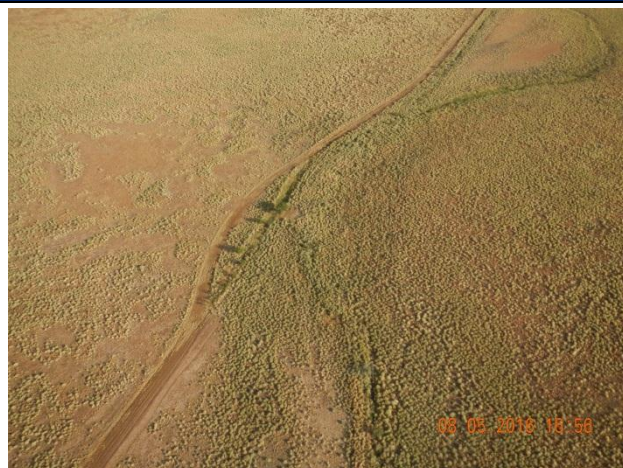
Site: AA41 (central access track)



Landform: Creek

***A. argillicola* habitat assessment:** Suitable

Site: AA42 (central access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Tobermorey Melon (*Austrobryonia argillicola*) access track survey site descriptions, May 2016

Site: AA43 (central access track)



Landform: Small drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA44 (central access track)



Landform: Depression

***A. argillicola* habitat assessment:** Suitable

Site: AA45 (central access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA46 (central access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA47 (central access track)



Landform: Creek

***A. argillicola* habitat assessment:** Suitable

Site: AA48 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Tobermorey Melon (*Austrobryonia argillicola*) access track survey site descriptions, May 2016

Site: AA49 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA50 (eastern access track)



Landform: Small drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA51 (eastern access track)



Landform: Small drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA52 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA53 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA54 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Tobermorey Melon (*Austrobryonia argillicola*) access track survey site descriptions, May 2016

Site: AA55 (eastern access track)



Landform: Depression

***A. argillicola* habitat assessment:** Suitable

Site: AA56 (eastern access track)



Landform: Creek

***A. argillicola* habitat assessment:** Suitable

Site: AA57 (eastern access track)



Landform: Depression

***A. argillicola* habitat assessment:** Suitable

Site: AA58 (eastern access track)



Landform: Depression

***A. argillicola* habitat assessment:** Suitable

Site: AA59 (eastern access track)



Landform: Creek

***A. argillicola* habitat assessment:** Suitable

Site: AA60 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Tobermorey Melon (*Austrobryonia argillicola*) access track survey site descriptions, May 2016

Site: AA61 (eastern access track)



Landform: Claypan

***A. argillicola* habitat assessment:** Suitable

Site: AA62 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA63 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA64 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Site: AA65 (eastern access track)



Landform: Depression

***A. argillicola* habitat assessment:** Suitable

Site: AA66 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

Tobermorey Melon (*Austrobryonia argillicola*) access track survey site descriptions, May 2016

Site: AA67 (eastern access track)

Site: AA68 (eastern access track)



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable



Landform: Drainage

***A. argillicola* habitat assessment:** Suitable

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Appendix I




Carpentarian Antechinus habitat descriptions of survey sites

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Carpentarian Antechinus (*Pseudantechinus mimulus*) survey site descriptions, May 2016

 <p>Site 1 – facing north</p>	<p>Site name: CA 1</p> <p>Land form: Rocky ridge line</p> <p>Vegetation: Low open woodland with hummock grass understory (RE1.11.2a/1.11.2d). Dominant species – <i>Eucalyptus leucophloia</i> over <i>Triodia</i> spp. Patchy shrub layer present with <i>Acacia monticola</i> and <i>Jacksonia vernicosa</i>. Well vegetated drainage line with large <i>E. camaldulensis</i> at base of slope.</p> <p>Fire history: Appeared burnt recently. Mostly immature <i>Triodia</i> hummocks present throughout.</p> <p>Landform description: West facing slope and ridgeline within rocky range running in north-south direction. Two trapping transects located on midslope and upper slope/ridgeline. Loose scree (cobble sized) throughout with scattered protruding rock formations along ridge, siltstone and metamorphic rocks present, little evidence of crevice formation, immature spinifex cover (> 30 %) throughout with some bare areas in steep sections.</p> <p>Trapping results: Carpentarian Antechinus (<i>Pseudantechinus mimulus</i>) and Common Rock Rat (<i>Zyzomys argurus</i>).</p> <p>Fauna habitat observations: Relatively diverse avian fauna present due to downslope presence of drainage line. Evidently suitable habitat for small ground mammal fauna despite lack of ground cover.</p>
 <p>Site 2 - facing east side of valley</p>	<p>Site name: CA 2</p> <p>Land form: Rocky valley</p> <p>Vegetation: Low open woodland with hummock grass understory (RE1.11.2a). Dominant species – sparse <i>Eucalyptus leucophloia</i> over <i>Triodia</i> spp. Very sparse shrub layer on slopes. Well vegetated minor drainage line at base of valley.</p> <p>Fire history: Appeared burnt recently (< 1 year). Only very immature <i>Triodia</i> hummocks present throughout.</p> <p>Landform description: Valley within rocky range running in north-south direction. Two trapping transects located midslope on either side (east and west) of valley. Loose scree (cobble sized) throughout with scattered protruding rock formations particularly on west slope where some evidence of minor crevice formation, siltstone and metamorphic rocks present, immature spinifex cover (> 20 %) throughout.</p> <p>Trapping results: Carpentarian Antechinus (<i>Pseudantechinus mimulus</i>) and Desert Mouse (<i>Pseudomys desertor</i>).</p> <p>Fauna habitat observations: Few birds present at any stage although grasswrens observed on two occasions. Evidently suitable habitat for small ground mammal fauna and reptiles (Ring-tailed Dragon <i>Ctenophorus caudicinctus</i> observed) despite lack of ground cover.</p>
 <p>Site 3 - facing west</p>	<p>Site name: CA 3</p> <p>Land form: Boulder pile on low ridge line</p> <p>Vegetation: Low open woodland with hummock grass understory (RE1.12.1). Dominant species – sparse <i>Eucalyptus leucophloia</i> over <i>Triodia</i> spp.</p> <p>Fire history: Appeared burnt relatively recently (between 1-2 years). Mostly immature <i>Triodia</i> hummocks present. Sparse low shrub layer regenerating away from trapping area (boulder pile).</p> <p>Landform description: East facing slope and ridgeline within low rocky undulating hill country. Two trapping transects located on lower slope and midslope. Large boulders throughout (igneous rocks present). Extensive crevice and small cave formation, immature spinifex cover – approx. 40 % off slope and less coverage on boulder pile sections.</p> <p>Trapping results: No animals captured.</p> <p>Fauna habitat observations: Limited fauna observations available at this site with few birds present at any stage. Appeared abundant suitable shelter habitat for a range of fauna including microbats, rock-wallaby, and small mammals/reptiles. However only Wallaroo <i>Macropus robustus</i> and Ring-tailed Dragon observed.</p>

Carpentarian Antechinus (*Pseudantechinus mimulus*) survey site descriptions, May 2016

 <p>Site 4 - facing south-west along transect</p>	<table border="1"> <tr> <td>Site name: CA 4</td><td>Land form: Boulder piles on ridge line</td></tr> </table> <p>Vegetation: Open woodland with hummock/tussock grass understory (RE1.11.3). Dominant species – <i>Eucalyptus leucophylla</i> and <i>Corymbia terminalis</i> over <i>Triodia spp</i> and exotic Annual Mission Grass <i>Pennisetum pedicellatum</i>. Adjacent to drainage line lined by <i>Melaleuca bracteata</i> and small <i>E. camaldulensis</i>.</p> <p>Fire history: > 2 years, some mature <i>Triodia</i> hummocks present in scattered areas around boulder piles.</p> <p>Landform description: Twin boulder piles within low rocky undulating hill country uphill from sandy drainage line. Two trapping transects located on twin boulder piles. Large boulders throughout (igneous rocks present). Extensive crevice formation and small cave formation. Mixture of spinifex, native tussock grasses and exotic Annual Mission Grass provide extensive cover although impacted by cattle (approx. 50-60% coverage).</p> <p>Trapping results: Sandy Inland Mouse <i>Pseudomys hermannsburgensis</i> and Common Rock Rat.</p> <p>Fauna habitat observations: Relatively diverse avian assemblage, due to presence of creekline habitat. Suitable shelter habitat for a range of fauna including microbats, small mammals/reptiles and Purple-necked Rock-wallaby <i>Petrogale purpureicollis</i> observed nearby. Wallaroo, Ring-tailed Dragon and Spiny-tailed Monitor <i>Varanus acanthurus</i> observed.</p>	Site name: CA 4	Land form: Boulder piles on ridge line
Site name: CA 4	Land form: Boulder piles on ridge line		
 <p>Site 5 - facing west to ridgeline</p>	<table border="1"> <tr> <td>Site name: CA 5</td><td>Land form: Rocky ridge line</td></tr> </table> <p>Vegetation: Low open woodland with hummock grass understory (RE1.11.2a). Dominant species – sparse <i>Eucalyptus leucophloia</i> over <i>Triodia spp</i>. Very sparse shrub layer.</p> <p>Fire history: > 2 years, appears long unburnt on upper slope where mature <i>Triodia</i> hummocks present.</p> <p>Landform description: Single trapping transect located on upper slope (near ridgeline), slope east facing, loose metamorphic rocks (cobble sized) on mid and lower slope type, more extensive rock formations on upper slope with limited evidence of crevice/cave formation, mature spinifex cover (> 50 %) particularly on upper slope.</p> <p>Trapping results: No animals captured.</p> <p>Fauna habitat observations: Site located uphill from Diamantina Development Road. Limited fauna observations available at this site with few birds present at any stage. Suitable habitat for small ground mammal fauna and reptiles.</p>	Site name: CA 5	Land form: Rocky ridge line
Site name: CA 5	Land form: Rocky ridge line		
 <p>Site 6 - facing south</p>	<table border="1"> <tr> <td>Site name: CA 6</td><td>Land form: Rocky ridge line</td></tr> </table> <p>Vegetation: Low open woodland with hummock grass understory (RE1.11.2a). Dominant species – sparse <i>Eucalyptus leucophloia</i> and <i>Corymbia terminalis</i> over <i>Triodia spp</i>. Patchy shrub layer on lower slopes. Located uphill from well vegetated alluvial flat area.</p> <p>Fire history: Appeared burnt relatively recently (between 1-2 years). Mostly immature <i>Triodia</i> hummocks present.</p> <p>Landform description: Northern end of ridgeline within isolated low rocky range running in north-south direction. Camera trapping only located on upper slope. Loose metamorphic rocks (cobble sized) on mid and lower slope type, more extensive rock formations on upper slope and ridgeline. Limited crevice and cave formations present, largely immature spinifex cover (approx. 40 %) throughout.</p> <p>Trapping results:</p> <p>Fauna habitat observations: Limited fauna observations carried out at site. Avian fauna likely to be bolstered by more vegetated adjacent alluvial flats. Suitable habitat for small ground mammal fauna, microbats and reptiles.</p>	Site name: CA 6	Land form: Rocky ridge line
Site name: CA 6	Land form: Rocky ridge line		

Appendix J

.....Greater Bilby habitat descriptions of track-plot sites

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Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016



Site name: TP 01

Land form: Loamy sand plain

Site class: Habitat

Vegetation: Low open woodland with tussock grass understorey (grazed). Dominant species – *Acacia aneura* (5%), *Eucalyptus brevifolia* (1%), *Hakea arborescens* (1%), *Aristida* sp. (10 – 15%).

Fire history: > 3 years

Habitat notes: Above ground termite mounds suggest a high water table - lowers suitability for Greater Bilby burrow; no food indicator plants present.

Tracking conditions: Average to poor; overnight light rain; slight shadow; 20% of track-plot contained soils suitable for tracking; high level of cattle trampling and grazing; heavy loam soils and recent rain reduce chance of tracking smaller animals.

Fauna signs:

- Large goanna – diggings, tracks; common; recent
- Small lizard – burrows; common; recent
- Australian Bustard – feather; uncommon; recent
- Cow – tracks, scats; abundant; recent



Site name: TP02

Land form: Loamy sand plain

Site class: Putative Greater Bilby

Vegetation: Low open woodland with hummock grass understorey. Dominant species – *Eucalyptus pachyphylla* (2%), *Eucalyptus brevifolia* (1%), *Acacia lysiphloia* (5%), *Triodia pungens* (45%).

Fire history: > 3 years

Habitat notes: Food indicator plant present (*A. lysiphloia*) in relatively high density (40 % cover).

Tracking conditions: Average; overnight light rain; slight shadow; 50% of track-plot contained soils suitable for tracking; high level of cattle trampling and grazing; loam soils and recent rain reduce chance of detecting smaller animal tracks; diggings burrows still obvious.

Fauna signs:

- Large goanna – burrow, digs, scat; common; recent
- Small lizard – burrows, sighted; *Ctenotus pantherinus*, *Ctenophorus nuchalis*; common; recent
- Large rodent – sighted; *Rattus villosissimus* (likely); uncommon; recent
- Red Kangaroo – track, scat; uncommon; old
- Cow – tracks, scats; abundant; recent



Site name: TP 03

Land form: Low rocky rise

Site class: Putative Greater Bilby

Vegetation: Low open woodland with hummock grass understorey. Dominant species – *Eucalyptus brevifolia* (5%), *Acacia hilliana* (40%); *Triodia* sp. (60%).

Fire history: > 3 years




Habitat notes: Food indicator plant present in high densities (*A. hilliana*); suitable substrate for burrow.

Tracking conditions: Poor; overnight light rain; no shadow; 20% of track-plot contained soils suitable for tracking; rocky soils and recent rain reduce chance of tracking smaller animals; burrows and diggings obvious.




Fauna signs:

- Large goanna – burrow; common; recent; *V. gouldii*
- Small goanna – burrow; uncommon; old.
- Small lizard – burrows, sighted; common; recent
- Little Button-quail – sighted (flushed); common; recent




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 04 Land form: Loamy sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low open woodland with hummock grass understorey (grazed). Dominant species – <i>Acacia aneura</i> (5%), <i>Triodia sp.</i> (25%), annual grasses (10%). <i>Yakirra australiensis</i> was observed in low densities.</p> <p>Fire history: > 3 years, long unburnt</p> <p>Habitat notes: Above ground termite mounds suggest a high water table - lowers suitability for Greater Bilby burrow; <i>Yakirra australiensis</i> was observed.</p> <p>Tracking conditions: Average to poor; overnight light rain; no shadow; 30% of track-plot contained soils suitable for tracking; high level of cattle trampling and grazing; heavy loam soils and recent rain reduce chance of tracking smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow with large spoil; uncommon; relatively recent; <i>V. gouldii</i> • Cow – tracks, scats; abundant; recent
	<p>Site name: TP 05 Land form: Sand plain</p> <p>Site class: Habitat</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Acacia coriacea</i> (<5%), <i>Acacia lysiphloia</i> (30%), <i>Acacia adsurgens</i> (5%), <i>Triodia pungens</i> (60%)</p> <p>Fire history: > 3 years, long unburnt</p> <p>Habitat notes: Food indicator plant present (<i>A. lysiphloia</i>) in relatively high density (30 % cover).</p> <p>Tracking conditions: Good; overnight light rain; distinct shadow; 60% of track-plot contained soils suitable for tracking; low level of cattle trampling and grazing; some cryptogam crust present; sandy soils improves chance of detecting smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small lizard – burrows; common; recent • Red Kangaroo – scat; uncommon; relatively recent • Cow – tracks, scats; abundant; recent
	<p>Site name: TP 06 Land form: Sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Eucalyptus brevifolia</i>, <i>Acacia lysiphloia</i>, <i>Triodia pungens</i>,</p> <p>Fire history: < 1 year</p> <p>Habitat notes: Food indicator plant present (<i>Senna notabilis</i>) (5 % cover, in burnt and disturbed area only).</p> <p>Tracking conditions: Average; overnight light rain; slight shadow; 50% of track-plot contained soils suitable for tracking; sandy soils improves chance of detecting smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – tracks, burrow with large spoil; uncommon; recent; <i>V. gouldii</i>




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 07 Land form: Loamy sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Eucalyptus gamophylla</i> (2%), <i>Triodia pungens</i> (50 – 60%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Nil</p> <p>Tracking conditions: Average; overnight light rain; slight shadow; 50% of track-plot contained soils suitable for tracking; loamy clay soils and recent rain reduce chance of detecting smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small lizard – diggings; common; recent • Red Kangaroo – scat; uncommon; relatively recent • Northern Nailtail Wallaby – scat; relatively common; relatively recent. • Cat – tracks; abundant; recent
	<p>Site name: TP 08 Land form: Low rocky rise</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Low open woodland with hummock grass understorey (grazed). Dominant species – <i>Eucalyptus brevifolia</i> (2%), <i>Acacia ancistrocarpa</i> (5%), <i>Acacia hilliana</i> (10%), <i>Triodia sp.</i> (70%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator plant present (<i>Acacia hilliana</i>)</p> <p>Tracking conditions: Poor; overnight light rain; no shadow; 20% of track-plot contained soils suitable for tracking; high rock cover; loam soils with cryptogam curst present; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – diggings, uncommon; relatively recent; <i>V. gouldii</i> (likely). • Red Kangaroo – scat; uncommon; relatively recent
	<p>Site name: TP 10 Land form: Sand plain</p> <p>Site class: Habitat</p> <p>Vegetation: Low open woodland with hummock grass understorey (grazed). Dominant species – <i>Eucalyptus sp.</i> (2%), <i>Acacia hilliana</i> (20%), <i>Triodia sp.</i> (40%) – patchy due to recent burn.</p> <p>Fire history: < 1 year</p> <p>Habitat notes: Food indicator plant present (<i>Acacia hilliana</i>); recently burnt but no germination of <i>Yakirra australiensis</i> (post-fire ephemeral grass often targeted by Greater Bilby).</p> <p>Tracking conditions: Good; overnight light rain; slight shadow; 70% of track-plot contained soils suitable for tracking; moderate level of cattle trampling and grazing; sandy soils improves chance of detecting smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Red Kangaroo – scat; common; recent • Small lizard – burrows; common; recent • Cow – tracks, scats; abundant; recent




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 11 Land form: Loamy sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low sparse woodland with hummock grass understorey (grazed). Dominant species (% cover) – <i>Eucalyptus microtheca</i> (1%), <i>Acacia tenuissima</i> (3%), <i>Triodia pungens</i> (55%)</p> <p>Fire history: 2 years,</p> <p>Habitat notes: No food indicator plants recorded.</p> <p>Tracking conditions: Good; overnight light rain; slight shadow; 60% of track-plot contained soils suitable for tracking; high level of cattle; heavy loam soils and recent rain reduce chance of tracking smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow; uncommon; relatively recent; <i>V. gouldii</i> (likely). • Small goanna – burrow, diggings; relatively recent • Red Kangaroo – scat; common; recent • Small lizard – burrows; common; recent • Cow – tracks, scats; abundant; recent • Camel – tracks, scats; uncommon; old • Red-chested Button-quail – seen; uncommon; recent
	<p>Site name: TP 12 Land form: Loamy sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Eucalyptus gamophylla</i>, <i>Triodia pungens</i> (60%), <i>Senna</i> sp. (2%), <i>Carissa lanceolata</i> (2%)</p> <p>Fire history: 2 years</p> <p>Habitat notes: No food indicator plants recorded.</p> <p>Tracking conditions: Average; overnight light rain; no shadow; 50% of track-plot contained soils suitable for tracking; high level of cattle; heavy loam soils and recent rain reduce chance of tracking smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow; uncommon; relatively recent; <i>V. gouldii</i> (likely). • <i>Ctenophorus isolepis</i> (Military Dragon) – sighted, burrows; common; recent. • Cow – tracks, scats; abundant; recent
	<p>Site name: TP 13 Land form: Low rocky rise</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Low shrubland with hummock grass understorey. Dominant species – <i>Grevillea wickhamii</i> (1%), <i>Acacia hilliana</i> (40%), <i>Acacia lysiphloia</i> (5%), <i>Triodia</i> sp. (50%).</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator plants present (<i>Acacia hilliana</i> and <i>A. lysiphloia</i>); substrate suitable for bilby burrows.</p> <p>Tracking conditions: Poor; overnight light rain; no shadow; 20% of track-plot contained soils suitable for tracking; rocky soils reduce chance of tracking smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow; uncommon; relatively recent; <i>V. gouldii</i> (likely). • Small lizard – burrows; common; recent • Dingo - scat; uncommon; old • Cow – tracks, scats; common; relatively recent




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

 <p>03.05.2016 11:35</p>	<p>Site name: TP 14 Land form: Loamy sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Shrubland (burnt) with hummock grass understorey. Dominant species – unknown shrubs (5%), <i>Triodia</i> sp (30%).</p> <p>Fire history: < 1 year</p> <p>Habitat notes: Food indicator plant present (<i>Acacia lysiphloia</i>); substrate suitable for bilby burrows; freshly burnt with green pick available although mostly spinifex.</p> <p>Tracking conditions: Good; overnight light rain; no shadow; 40% of track-plot contained soils suitable for tracking; cattle trampling present; heavy loam soils reduce chance of tracking smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow; uncommon; relatively recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small goanna – burrows; common; recent • Small lizard – burrows; common; recent • Cow – tracks, scats; common; recent • Cat – sighted (flushed), uncommon; recent • Camel – tracks; uncommon; relatively recent
 <p>03.05.2016 12:17</p>	<p>Site name: TP 15 Land form: Loamy sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Eucalyptus</i> sp (3%), <i>Hakea</i> sp. (3%), <i>Acacia adsurgens</i> (10%), <i>Acacia lysiphloia</i> (25%), <i>Triodia pungens</i> (40%).</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator plant present (<i>Acacia lysiphloia</i>); substrate suitable for bilby burrows</p> <p>Tracking conditions: Good; overnight light rain; distinct shadow; 60% of track-plot contained soils suitable for tracking; loamy soils reduce chance of tracking smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow; uncommon; relatively recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small lizard – <i>Ctenotus pantherinus</i>; sighted; common; recent • Spectacled Hare-wallaby – scats; common. recent
 <p>03.05.2016 14:53</p>	<p>Site name: TP 16 Land form: Sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Eucalyptus aspera</i>, <i>Acacia ancistrocarpa</i> (5%), <i>Senna notabilis</i> (3%), <i>Triodia pungens</i> (50%), <i>Aristida</i> sp. (2%).</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator plant present (<i>Senna notabilis</i>); substrate suitable for bilby burrows.</p> <p>Tracking conditions: Good; slight shadow; 80% of track-plot contained soils suitable for tracking; sandy soils improves chance of detecting smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small goanna – diggings; uncommon; recent • Small lizard – burrows; common; recent • Large snake – sighted (Black-headed Python) • Camel – tracks; uncommon; relatively recent • Cow – tracks, scats; abundant; recent




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

 <p>03.05.2016 15:53</p>	<p>Site name: TP 17 Land form: Sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low sparse woodland with hummock grass understorey (grazed). Dominant species – <i>Eucalyptus aspera</i> (1%), <i>Eucalyptus microtheca</i> (1%), <i>Petalostylis cassioides</i> (3%), <i>Senna notabilis</i> (2%), <i>Triodia pungens/schinzii</i> (25% - patchy due to burn), <i>Aristida</i> sp., <i>Yakirra australiensis</i> (<1%).</p> <p>Fire history: < 1 year</p> <p>Habitat notes: Food indicator plant present (<i>Senna notabilis</i>); <i>Yakirra australiensis</i> was observed; substrate suitable for bilby burrows.</p> <p>Tracking conditions: Good; slight shadow; 80% of track-plot contained soils suitable for tracking; sandy soils improves chance of detecting smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, tracks, scats; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small rodent – track, scat; relatively recent; fresh • Hopping Mouse – burrow; uncommon; recent • Red Kangaroo – tracks, scat; uncommon; recent • Northern Nailtail – tracks, scats; common; recent • Cat – tracks; uncommon; recent • Camel – scats; uncommon; old • Cow – tracks, scats; common; recent
 <p>03.05.2016 16:10</p>	<p>Site name: TP 18 Land form: Sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low sparse woodland with hummock grass understorey. Dominant species – <i>Corymbia opaca</i> (2%), <i>Acacia lysiphloia</i> (20%), <i>Senna notabilis</i> (5%), <i>Triodia schinzii</i> (60%).</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator plant present (<i>Senna notabilis</i>); substrate suitable for bilby burrows.</p> <p>Tracking conditions: Good; slight shadow; 70% of track-plot contained soils sandy soils improves chance of detecting smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, tracks, scats; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Cow – tracks, scats; abundant; recent
 <p>03.05.2016 16:48</p>	<p>Site name: TP 19 Land form: Alluvial plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Low woodland with tussock grass understorey (heavily grazed). Dominant species – <i>Eucalyptus microtheca</i> (15%), <i>Hakea</i> sp (10%), <i>Corymbia aparrerinja</i> (5%), grazed tussock grasses</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Alluvial area impacted by cattle; no food indicator plants.</p> <p>Tracking conditions: Poor; slight shadow; 30 % of track-plot contained soils suitable for tracking; high level of cattle trampling and grazing; heavy loam/clay soils and recent rain reduce chance of tracking smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, scats; common; recent; possibly <i>Varanus panoptes</i> (Yellow Spotted Goanna). • Small lizard – burrows; common; recent; sighted. • Cow – tracks, scats; abundant; recent




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

 <p>03.05.2016 17:12</p>	<p>Site name: TP 20 Land form: Sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low sparse woodland with hummock grass understorey. Dominant species – <i>Eucalyptus aspera</i> (1%), <i>Hakea</i> sp. (1%), <i>Senna notabilis</i> (5%), <i>Triodia</i> sp. (20%).</p> <p>Fire history: < 1 year</p> <p>Habitat notes: Food indicator plant present (<i>Senna notabilis</i>); substrate suitable for bilby burrows.</p> <p>Tracking conditions: Good; slight shadow; 80% of track-plot contained soils sandy soils improve chance of detecting smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, tracks; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Little Button-quail – tracks, sighting; common; recent • Cow – tracks, scats; uncommon; old
 <p>04.05.2016 08:53</p>	<p>Site name: TP 21 Land form: Loamy sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Eucalyptus gamophylla</i> (5%), <i>Triodia pungens</i> (70%); <i>Yakirra australiensis</i> (<1%), sedges and small ground ferns present.</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Seasonally inundated; clay loam soils; <i>Yakirra australiensis</i> was observed in very low densities.</p> <p>Tracking conditions: Average to poor; slight shadow; 20% of track-plot contained soils suitable for tracking; heavy loam soils and high cryptogam crust cover reduce chance of tracking smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, tracks; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small lizard – burrows; common; recent • Small lizard – sighting (<i>Liasis burtonis</i>) • Small rodent – burrows; uncommon; fresh; likely <i>Leggadina forrestii</i>.
 <p>04.05.2016 09:27</p>	<p>Site name: TP 22 Land form: Loamy sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Eucalyptus microtheca</i> (2%), <i>Eucalyptus gamophylla</i> (2%), <i>Hakea</i> sp. (1%), <i>Triodia pungens</i> (65%).</p> <p>Fire history: 2 years</p> <p>Habitat notes: No food indicator plants present</p> <p>Tracking conditions: Average; distinct shadow; 40% of track-plot contained soils suitable for tracking; heavy loam soils and high cryptogam crust cover reduce chance of tracking smaller animals; burrows and diggings obvious.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, diggings; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small lizard – burrows; common; recent • Cow – tracks, scats; uncommon; old

Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 23 Land form: Sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Acacia shrubland with hummock grass understorey (burnt). Dominant species – <i>Eucalyptus setosa</i> (1%), <i>Hakea lorea</i> (2%), <i>Senna notabilis</i> (2%), <i>Corchorus sidoides</i> (3%), <i>Aristida sp.</i> (10%), <i>Triodia sp.</i> (10%), various other emergent annual grasses and herbs.</p> <p>Fire history: < 1 year</p> <p>Habitat notes: Very recent fire;</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, diggings; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Hopping mouse – burrow; uncommon; recent • Small lizard – burrows; common; recent • Small lizard – sighting (<i>Strophurus ciliaris</i>)
	<p>Site name: TP 24 Land form: Sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Open shrubland, understorey (burnt). Dominant species – <i>Hakea sp.</i> (1%), <i>Petalostylis cassioides</i> (3%), emergent post-fire tussocks grasses and herbs (10%).</p> <p>Fire history: < 1 year</p> <p>Habitat notes: <i>Yakirra australiensis</i> was observed in low densities</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, diggings; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small lizard – tracks; common; recent
	<p>Site name: TP 25 Land form: Sand plain</p> <p>Site class: Habitat</p> <p>Vegetation: Low shrubland with hummock grass understorey. Dominant species – <i>Eucalyptus pachyphylla</i> (5%), <i>Acacia coriacea</i> (5%), <i>Triodia</i> (40%).</p> <p>Fire history: > 3 years</p> <p>Habitat notes: No food indicator plants present.</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small lizard – burrows; common; fresh • Large snake – tracks; common; fresh • Small snake – tracks; uncommon; fresh • Central Blue Tongue – sighting • Hopping mouse – tracks; uncommon; fresh • Australian Bustard - tracks; uncommon; recent • Cat – tracks; uncommon; fresh • Insects – tracks; common; fresh

Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 26 Land form: Sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Shrubland with hummock grass understorey. Dominant species – <i>Eucalyptus aspera</i> (1%), <i>Grevillea wickhamii</i> (2%), <i>Triodia pungens</i> (80% in unburnt areas), numerous emergent annual grasses, forbs and herbs in burnt area (30%).</p> <p>Fire history: < 1 year; small scale burn.</p> <p>Habitat notes: No food indicator plants present; burn was small compared to other large scale burns in region.</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – diggings; common; fresh • Small lizard – burrows, tracks; common; fresh • Small lizard – sightings (<i>Ctenophorus isolepis</i> & <i>Ctenotus pantherinus</i>). • Central Blue Tongue – track; uncommon; fresh • Hopping mouse – tracks; uncommon; fresh • Small rodent - tracks; uncommon; recent • Cat – tracks; uncommon; fresh • Dingo – tracks, sighting; uncommon; recent • Insect – tracks; common; fresh
	<p>Site name: TP 27 Land form: Sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Sparse woodland with hummock grass understorey (burnt). <i>Eucalyptus aspera</i> (1%), numerous emergent annual grasses, forbs and herbs in burnt area (30%).</p> <p>Fire history: < 1 year</p> <p>Habitat notes: <i>Yakirra australiensis</i> was observed in low densities</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, diggings; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small lizard – tracks; common; recent • Large snake – track; uncommon; recent • Small rodent – tracks; common; fresh • Australian Bustard – tracks; uncommon; fresh • Little Button-quail – tracks, day roosts; common; fresh
	<p>Site name: TP 28 Land form: Sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Shrubland with hummock grass understorey. Dominant species – <i>Hakea coriacea</i> (1%), <i>Corymbia opaca</i> (2%), <i>Acacia lysiphloia</i> (3%), <i>Acacia</i> sp. (35%), <i>Triodia</i> sp. (70%).</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator plant is present (<i>Acacia lysiphloia</i>).</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking smaller animals; high vegetation cover reduced tracking shadow.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, diggings; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Hopping mouse – burrow; uncommon; old

Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016



Site name: TP 30

Land form: Sand plain

Site class: Habitat

Vegetation: Shrubland with hummock grass understorey. Dominant species – *Corymbia opaca* (1%), *Hakea coriacea* (1%), *Acacia lysiphloia* (15%), *Triodia sp.* (50%)

Fire history: > 3 years, long unburnt

Habitat notes: Food indicator plant is present (mature - *Acacia lysiphloia*).

Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking smaller animals.

Fauna signs:

- Small goanna – diggings; common; recent
- Red Kangaroo – track; uncommon; recent
- Small lizard – diggings, burrows; common; recent
- Button-quail – tracks, day roost; common; fresh
- Cow – tracks; uncommon; old



Site name: TP 31

Land form: Sand plain

Site class: Putative Greater Bilby

Vegetation: Shrubland with hummock grass understorey. Dominant species – *Atalaya hemiglaucula* (1%), *Hakea coriacea* (1%), *Hakea lorea* (1%), *Acacia lysiphloia* (15%), *Carissa lanceolata* (5%), *Triodia sp.* (50%), *Aristida sp.* (15%)

Fire history: > 3 years

Habitat notes: Food indicator plant is present (mature - *Acacia lysiphloia*).

Tracking conditions: Average; distinct shadow; 50% of track-plot contained soils suitable for tracking smaller animals; cryptogam crust.

Fauna signs:

- Large goanna – burrow, diggings; common; recent; likely *Varanus gouldii* (Sand Goanna).
- Small lizard – diggings, burrows; common; recent



Site name: TP 32

Land form: Sand plain

Site class: Putative Greater Bilby

Vegetation: Low sparse woodland with hummock grass understorey. Dominant species – *Eucalyptus aspera* (2%), *Acacia sp.* (15%), *Triodia sp.* (65%)

Fire history: > 3 years




Habitat notes: No food indicator species present.

Tracking conditions: Good; distinct shadow; 70% of track-plot contained soils suitable for tracking smaller animals




Fauna signs:

- Large goanna – burrow, diggings; common; recent; likely *Varanus gouldii* (Sand Goanna).
- Small lizard – burrows; sighting; common; recent
- Cat – tracks; common; fresh
- Small rodent – tracks; common; recent
- Small rodent – sighting (likely *Pseudomys desertor*)
- Hopping mouse – tracks; uncommon; fresh
- Australian Bustard – tracks; common; fresh
- Fox – track; uncommon; relatively recent
- Small snake – track; uncommon; recent
- Button-quail – tracks; common; fresh




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 33 Land form: Sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Low sparse woodland with hummock grass understorey. Dominant species – <i>Eucalyptus aspera</i> (1%), <i>Corymbia opaca</i> (1%), <i>Hakea</i> sp. (1%), <i>Petalostylis cassioides</i> (3%), <i>Triodia</i> sp. (25%)</p> <p>Fire history: < 1 year</p> <p>Habitat notes: <i>Yakirra australiensis</i> was observed in very low densities</p> <p>Tracking conditions: Good; distinct shadow; 80% of track-plot contained soils suitable for tracking smaller animals</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, diggings; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small goanna – burrow, digs; common; recent • Small lizards – burrows; sighting (<i>Ctenophorus isolepis</i>, <i>Lerista</i> sp.); common; recent • Dasyurid – tracks; uncommon; recent • Small rodent – tracks; common; recent • Hopping mouse – tracks, pop-holes; uncommon; fresh • Button-quail – tracks; common; fresh
	<p>Site name: TP 34 Land form: Sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Shrubland with hummock grass understorey. Dominant species – <i>Eucalyptus aspera</i> (<1%), <i>Corymbia opaca</i> (<1%), <i>Triodia</i> sp. (25% - in unburnt areas), emergent post fire grass, herbs, and forbs in burnt area.</p> <p>Fire history: < 1 year</p> <p>Habitat notes: <i>Yakirra australiensis</i> was observed in low densities</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, diggings; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small goanna – burrow, digs; common; recent • Small lizards – burrows; tracks; common; recent • Dasyurid – tracks; uncommon; recent • Small rodent – tracks; common; recent • Australian Bustard – tracks; uncommon; recent • Hopping mouse – tracks; uncommon; fresh • Hopping birds – tracks; common; recent
	<p>Site name: TP 35 Land form: Sand plain</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low sparse woodland with tussock grass understorey (grazed). Dominant species – <i>Acacia aneura</i>, <i>Eucalyptus brevifolia</i>, <i>Hakea arborescens</i>, <i>Aristida</i> sp.</p> <p>Fire history: < 1 year</p> <p>Habitat notes: <i>Yakirra australiensis</i> was observed in low densities</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – burrow, digs; common; recent • Small rodent – tracks; uncommon; recent • Hopping mouse – tracks; common; fresh • Hopping birds – tracks; common; recent • Button-quail – tracks; common; fresh • Cat – tracks; common; fresh




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 40 Land form: Sand plain</p> <p>Site class: Habitat</p> <p>Vegetation: Acacia shrubland with hummock grass understorey. Dominant species – <i>Corymbia opaca</i> (1%), <i>Hakea lorea</i> (1%), <i>Eucalyptus pachyphylla</i> (1%), <i>Acacia</i> sp. (10%), <i>Triodia</i> sp. (40%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: No food indicator species present.</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, diggings; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small goanna – burrow, digs; common; recent • Small lizards – burrows; tracks; common; recent • Small snake – track; uncommon; fresh • Small rodent – tracks; common; recent • Cat – tracks; relatively common; recent • Australian Bustard – tracks; uncommon; recent • Hopping birds – tracks; common; recent • Button-quail – tracks; common; fresh • Invertebrates – tracks; common; fresh
	<p>Site name: TP 41 Land form: Sand plain</p> <p>Site class: Habitat</p> <p>Vegetation: Acacia shrubland with hummock grass understorey. Dominant species – <i>Corymbia opaca</i> (2%), <i>Hakea lorea</i> (1%), <i>Eucalyptus aspera</i> (1%), <i>Acacia adsurgens</i> (10%), <i>Acacia</i> sp. (15%), <i>Triodia</i> sp. (40%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: No food indicator species present.</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – burrow, digs; common; recent • Small lizard – burrow, sighting; track; common; recent • Small snake – track; uncommon; fresh • Small rodent – tracks; uncommon; recent • Cat – tracks; relatively common; recent • Hopping birds – tracks; common; recent • Button-quail – tracks; common; fresh • Invertebrates – tracks; common; fresh
	<p>Site name: TP 42 Land form: Depression</p> <p>Site class: Habitat</p> <p>Vegetation: Low sparse woodland with tussock and hummock grass understorey. Dominant species – <i>Hakea coriacea</i> (2%), <i>Melaleuca</i> sp. (2%), <i>Triodia</i> sp. (10%), <i>Aristida</i> sp. (40%).</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Large ground termite mounds suggest palaeo drainage features however no typical food indicator plants found.</p> <p>Tracking conditions: Good; distinct shadow; 90% of track-plot contained soils suitable for tracking smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – burrow, digs; common; recent • Small goanna – sighted in termite mound (identification of species not confirmed) • Small lizard – burrows; common; recent • Small rodent – tracks, scats; common; relatively recent.




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 43 Land form: Low rocky rise</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Acacia shrubland with hummock grass understorey. Dominant species – <i>Grevillea wickhamii</i> (2%), <i>Grevillea</i> sp. (1%), <i>Eucalyptus</i> sp. (1%), <i>Acacia hilliana</i> (25%), <i>Triodia</i> sp. (35%).</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator plant present (<i>Acacia hilliana</i>); low rocky rise constitutes suitable habitat.</p> <p>Tracking conditions: Average; distinct shadow; 40% of track-plot contained soils suitable for tracking.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – diggings, tracks; common; recent • Small lizard – burrows; common; recent • Australian Bustard - feather; uncommon; recent • Hopping birds – tracks; common; recent
	<p>Site name: TP 44 Land form: Low rocky rise</p> <p>Site class: Habitat</p> <p>Vegetation: Acacia shrubland with hummock grass understorey. Dominant species – <i>Hakea lorea</i> (1%), <i>Eucalyptus</i> sp. (1%), <i>Acacia ancistrocarpa</i> (3%), <i>Acacia hilliana</i> (25%), <i>Triodia</i> sp. (35%).</p> <p>Fire history: 1 to 3 years</p> <p>Habitat notes: Food indicator plant present (<i>Acacia hilliana</i>); low rocky rise constitutes suitable habitat.</p> <p>Tracking conditions: Poor; distinct shadow; 20% of track-plot contained soils suitable for tracking (mostly rocky substrate)</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small lizard – burrows; common; recent • Red Kangaroo – tracks; uncommon; old • Australian Bustard - feather; uncommon; recent • Hopping birds – tracks; common; recent • Button-quail – tracks; common; fresh
	<p>Site name: TP 45 Land form: Low rocky rise</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Acacia shrubland with hummock grass understorey. Dominant species – <i>Eucalyptus aspera</i> (1%), <i>Acacia</i> sp. (3%), <i>Acacia hilliana</i> (2%), <i>Triodia</i> sp. (40%).</p> <p>Fire history: 1 to 3 years</p> <p>Habitat notes: Food indicator plant present (<i>Acacia hilliana</i>); low rocky rise constitutes suitable habitat.</p> <p>Tracking conditions: Poor; distinct shadow; 25% of track-plot contained soils suitable for tracking (mostly rocky substrate)</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – diggings, tracks; common; recent • Small lizard – burrows; sightings; common; recent • Small snake – track; uncommon; recent • Hopping mouse – track; uncommon; recent • Cat – tracks; uncommon; recent • Hopping birds – tracks; common; recent




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

 <p>06.05.2016 15:32</p>	<p>Site name: TP 46 Land form: Loamy sand plain</p> <p>Site class: Habitat</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Eucalyptus gamophylla</i> (5%), <i>Hakea arborescens</i> (2%), <i>Acacia ancistrocarpa</i> (5%), <i>Triodia sp.</i> (35%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: No food indicator plants present.</p> <p>Tracking conditions: Average; distinct shadow; 50% of track-plot contained soils suitable for tracking; heavy loam soils reduce chance of tracking smaller animals.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – diggings, tracks; common; recent • Australian Bustard - feather; uncommon; recent • Hopping bird – tracks; common; recent
 <p>06.05.2016 15:56</p>	<p>Site name: TP 47 Land form: Low rocky rise</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Acacia shrubland with hummock grass understorey. Dominant species – <i>Acacia aneura</i>, <i>Eucalyptus brevifolia</i>, <i>Hakea arborescens</i>, <i>Aristida sp.</i></p> <p>Fire history: 1 to 3 years</p> <p>Habitat notes: Food indicator plant present (<i>Acacia hilliana</i>); low rocky rise constitutes suitable habitat.</p> <p>Tracking conditions: Poor; slight shadow; 25% of track-plot contained soils suitable for tracking (mostly rocky substrate).</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – diggings, tracks; common; recent • Small lizard – tracks; uncommon; recent • Small rodent – tracks; uncommon; recent • Hopping bird – tracks; common; recent
 <p>07.05.2016 06:45</p>	<p>Site name: TP 48 Land form: Sand plain</p> <p>Site class: Habitat</p> <p>Vegetation: Low open woodland with hummock grass understorey. Dominant species – <i>Corymbia opaca</i> (1%), <i>Hakea lorea</i> (1%), <i>Hakea arborescens</i> (1%), <i>Acacia ancistrocarpa</i> (2%), <i>Acacia lysiphloia</i> (5%), <i>Acacia sp.</i> (3%), <i>Triodia sp.</i> (50%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator species present (<i>Acacia lysiphloia</i> – mature).</p> <p>Tracking conditions: Good; distinct shadow; 50% of track-plot contained soils suitable for tracking; high cryptogam crust on remaining bare soils (reduces ability to detect fauna tracks).</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – burrow, digs; uncommon; recent • Small lizards – burrows; tracks; common; recent • Small rodent – tracks; common; recent • Hopping mouse – tracks; uncommon; recent • Cat – tracks; relatively common; recent • Australian Bustard – tracks; uncommon; recent • Button-quail – tracks; common; fresh • Invertebrates – tracks; common; fresh




Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

 <p>07.05.2016 09:51</p>	<p>Site name: TP 49 Land form: Sand plain</p> <p>Site class: Habitat</p> <p>Vegetation: Shrubland with tussock grass understorey. Dominant species – <i>Atalaya hemiglauc</i> (2%), <i>Acacia lysiphloia</i> (5%), <i>Carissa lanceolata</i> (5%), <i>Aristida</i> sp. (10%), <i>Eragrostis</i> sp. (10%), <i>Triodia</i> sp. (5%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator species present (<i>Acacia lysiphloia</i> – mature).</p> <p>Tracking conditions: Good; distinct shadow; 80% of track-plot contained soils suitable for tracking.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – burrow, digs; uncommon; recent • Small lizards – burrows; tracks; common; recent • Central Blue Tongue – track; uncommon; recent • Dasyurid – tracks; uncommon; recent • Small rodent – tracks; common; recent • Hopping mouse – tracks; uncommon; recent • Button-quail – tracks; common; fresh • Invertebrates – tracks; common; fresh
 <p>07.05.2016 10:20</p>	<p>Site name: TP 50 Land form: Sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Shrubland with hummock grass understorey. Dominant species – <i>Ventilago viminalis</i> (2%), <i>Acacia coriacea</i> (1%), <i>Acacia lysiphloia</i> (5%), <i>Triodia</i> sp. (5%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator species present (<i>Acacia lysiphloia</i> – mature).</p> <p>Tracking conditions: Good; distinct shadow; 80% of track-plot contained soils suitable for tracking.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, diggings; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small goanna – burrow, digs; uncommon; recent • Small lizards – burrows; tracks; common; recent • Large snake – sighting (Mulga Snake) • Small rodent – tracks; common; recent • Hopping mouse – tracks; uncommon; recent • Button-quail – tracks; common; fresh • Hopping bird – tracks; uncommon; fresh
 <p>07.05.2016 11:00</p>	<p>Site name: TP 51 Land form: Low rocky rise</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Low Acacia Shrubland with hummock grass understorey. Dominant species – <i>Acacia hilliana</i> (40%), <i>Triodia</i> sp. (40%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator species present (<i>Acacia hilliana</i>).</p> <p>Tracking conditions: Good; distinct shadow; 80% of track-plot contained soils suitable for tracking; remaining areas were rocky substrate.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small lizards – tracks; common; recent • Button-quail – tracks; common; fresh • Invertebrates – tracks, diggings; uncommon; fresh

Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 52 Land form: Low rocky rise</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Low sparse woodland with tussock grass understorey (grazed). Dominant species – <i>Corymbia opaca</i> (1%), <i>Ventilago viminalis</i> (1%), <i>Eucalyptus gamophylla</i> (1%), <i>Acacia hilliana</i> (5%), <i>Triodia sp.</i> (35%)</p> <p>Fire history: 1 to 2 years ago</p> <p>Habitat notes: Food indicator species present (<i>Acacia hilliana</i>).</p> <p>Tracking conditions: Good; distinct shadow; 60% of track-plot contained soils suitable for tracking; remaining areas were rocky substrate.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – burrow, digs; uncommon; recent • Small lizards – sighted; tracks; common; recent • Small rodent – tracks; common; recent • Hopping mouse – tracks; uncommon; recent • Australian Bustard – tracks; uncommon; fresh • Button-quail – tracks; common; fresh • Hopping bird – tracks; uncommon; fresh • Invertebrates – tracks, burrows; uncommon; recent
	<p>Site name: TP 53 Land form: Low rocky rise</p> <p>Site class: Habitat</p> <p>Vegetation: Low Acacia Shrubland with hummock grass understorey. Dominant species – <i>Acacia hilliana</i> (40%), <i>Triodia sp.</i> (40%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: Food indicator species present (<i>Acacia hilliana</i>).</p> <p>Tracking conditions: Average; distinct shadow; 45% of track-plot contained soils suitable for tracking; remaining areas were rocky substrate.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – burrow, digs; uncommon; recent • Small lizards – sighted; tracks; common; recent • Small rodent – tracks, scats; common; recent • Hopping mouse – tracks; uncommon; recent • Bush Stone-curlew – tracks; uncommon; fresh • Button-quail – tracks; common; fresh • Cat – tracks; uncommon; old • Cow – tracks; uncommon; old • Invertebrates – tracks, burrows; uncommon; recent
	<p>Site name: TP 54 Land form: Depression</p> <p>Site class: Habitat</p> <p>Vegetation: Low open woodland with tussock grass understorey (grazed). Dominant species – <i>Acacia aneura</i>, <i>Eucalyptus brevifolia</i>, <i>Hakea arborescens</i>, <i>Aristida sp.</i></p> <p>Fire history: > 3 years, long unburnt</p> <p>Habitat notes: Palaeo drainage characteristics.</p> <p>Tracking conditions: Average to poor; distinct shadow; 20% of track-plot contained soils suitable for tracking; heavy loam soils and recent rain reduce chance of tracking smaller animals</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Small goanna – sighted (on termite mound); common; recent • Small lizard – sighted (<i>Morethia ruficauda</i>, <i>Carlia sp.</i>)

Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016

	<p>Site name: TP 55 Land form: Sand plain</p> <p>Site class: Habitat / Goanna</p> <p>Vegetation: Acacia Shrubland with hummock grass understorey. Dominant species – <i>Corymbia opaca</i> (1%), <i>Hakea</i> sp. (1%), <i>Carissa lanceolata</i> (2%), <i>Acacia</i> sp. (20%), <i>Triodia</i> sp. (45%), <i>Aristida</i> sp. (5%).</p> <p>Fire history: > 3 years</p> <p>Habitat notes: No food indicator plants present.</p> <p>Tracking conditions: Good; distinct shadow; 80% of track-plot contained soils suitable for tracking.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow; common; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small rodent – tracks; uncommon; recent • Small lizard – burrows; common; recent • Button-quail – tracks, scats; common; recent
	<p>Site name: TP 56 Land form: Sinkhole</p> <p>Site class: Habitat</p> <p>Vegetation: Vine-thicket (in sinkhole – fire protected)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: No food indicator species present.</p> <p>Tracking conditions: Poor; slight shadow; 20% of track-plot contained soils suitable for tracking.</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Dingo – scat; uncommon; recent • Small lizard – sighted; common; recent
	<p>Site name: TP 60 Land form: Depression</p> <p>Site class: Putative Greater Bilby</p> <p>Vegetation: Low open woodland with tussock grass understorey (grazed). Dominant species – <i>Carissa lanceolata</i> (5%), <i>Melaleuca glomerata</i> (5%)</p> <p>Fire history: > 3 years</p> <p>Habitat notes: No food indicator plants present.</p> <p>Tracking conditions: Good; distinct shadow; 80% of track-plot contained soils suitable for tracking; high level of cattle trampling and grazing</p> <p>Fauna signs:</p> <ul style="list-style-type: none"> • Large goanna – burrow, tracks; abundant; recent; likely <i>Varanus gouldii</i> (Sand Goanna). • Small lizard – burrows; common; recent • Cow – tracks, scats; abundant; recent

Greater Bilby (*Macrotis lagotis*) track-plot site descriptions, May 2016



Site name: TP 61

Land form: Playa

Site class: Habitat

Vegetation: Sedges.

Fire history: > 3 years, long unburnt

Habitat notes: Small muddy patch; no surface water; no food indicator species present.

Tracking conditions: Poor; slight shadow; 5% of track-plot contained soils suitable for tracking.

Fauna signs:

- Small lizard – burrows; uncommon; recent



Site name: TP 62

Land form: Playa

Site class: Habitat

Vegetation: Low open woodland with hummock grass understorey. Dominant species – *Melaleuca glomerata* (5%), *Eucalyptus microtheca* (5%), *Triodia pungens* (60%)

Fire history: > 3 years

Habitat notes: No food indicator plants present.

Tracking conditions: Average; slight shadow; 65% of track-plot contained soils suitable for tracking

Fauna signs:

- Australian Bustard - feather; uncommon; recent
- Small lizard – burrows; common; recent

Appendix K

.....**Greater Bilby track-plot survey photographs**

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Greater Bilby (*Macrotis lagotis*) survey photographs, May 2016

Examples of goanna diggings and burrows that were recorded as Putative Greater Bilby sign during the aerial transects. Note GPS is 15 cm (including antenna).



Greater Bilby (*Macrotis lagotis*) survey photographs, May 2016

Photographs of sign or sightings from other species recorded within the 2 ha track-plot sites



Small rodent burrow



Small rodent burrow



Small rodent burrow



Small rodent runway of tracks



Fresh tracks from large rodent / dasyurid (suspected to belong to Long-haired Rat *Rattus villosissimus* due to multiple sighting of the species, but could not discount possibility of Brush-tailed Mulgara *Dasycercus blythi*) (note book is 12 cm long)



Potential Central Pebble Mound Mouse (*Pseudomys johnsoni*)

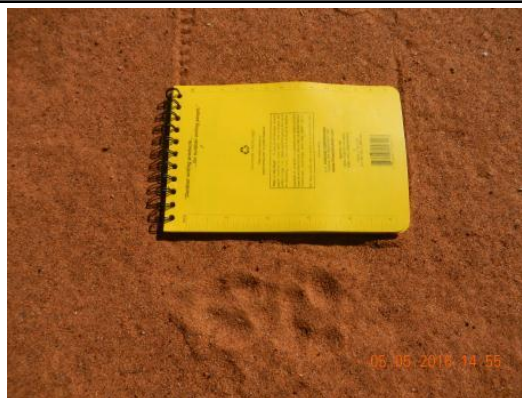


Potential Central Pebble Mound Mouse (*Pseudomys johnsoni*)

Greater Bilby (*Macrotis lagotis*) survey photographs, May 2016



Suspected Red Fox (*Vulpes vulpes*) track



Suspected Red Fox (*Vulpes vulpes*) track



Black-headed Python (*Aspedites melanocephalus*)



Spiny-tailed Gecko (*Strophurus ciliaris*)



Fresh small snake track



Tracks from *Lerista* sp. (likely *L. bipes*)



Fresh tracks from Australian Bustard (*Ardeotis australis*)



Centralian Blue Tongue Lizard (*Tiliqua multifaciata*)

Greater Bilby (*Macrotis lagotis*) survey photographs, May 2016



Button-quail day roost (likely Little Button-quail *Turnix velox*)



Button-quail tracks (likely Little Button-quail *Turnix velox*)



Tracks from bird species with a bipedal hop (referred to as 'hopping birds' throughout this report)



Fresh lizard track



Fresh Mole-cricket mound



Scats from Spectacled Hare-wallaby (*Lagorchestes conspicillatus*)

Appendix L

.....Gouldian Finch site descriptions of breeding sites

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Gouldian Finch (*Erythrura gouldiae*) breeding survey site descriptions, May 2016



Site name: B1S1

Land form: Rocky plain

Site class: Breeding survey site

Vegetation: Low open woodland with hummock grass understory. Dominant species – *Eucalyptus leucophloia*, *Triodia* spp., *Acacia chisolmii*.

Fire history: > 2 years.

Habitat notes: Rocky plain along drainage line below low slope. *E. leucophloia* generally had thin, re-sprouted trunk stems due previous fires. *Triodia* sp. had formed established hummocks and was the only grass species observed.

Hollow assessment: 52 trees were inspected along the transect – 14 had hollows, with a total of 31 hollows within the site. Only 3 hollows were in living tissue. Hollow entrance diameters were between 2 and 10 cm (median 6 cm) and hollows were between 1.8 and 6 metres above the ground (median 3 m).

Gouldian surveys: No Gouldian Finches (*Erythrura gouldiae*) were detected during the survey nor were any other finch species detected.



Site name: B1S2

Land form: Low rocky rise

Site class: Breeding survey site

Vegetation: Sparse woodland with hummock grass understory. Dominant species – *Eucalyptus leucophloia*, *E. leucophylla*, *Corymbia aparrerinja*, *Triodia* spp., *Acacia chisolmii*.

Fire history: Burnt last year

Habitat notes: Rocky site on lower slope with northerly aspect. *Eucalyptus* spp. (apart from *C. aparrerinja*) were short with multiple thin stems. *Triodia* sp. were small – forming open hummock grassland.

Hollow assessment: There were only 21 trees along the transect of which only 4 had a single hollow each. These hollows were all in *E. leucophloia*, between 2 and 4 m from the ground and between 4 and 10 cm in diameter at the entrance. The hollows were all > 60° with 3 in dead tissue.

Gouldian surveys: No Gouldian Finches were detected through the survey, 5 Zebra Finches were seen.



Site name: B1S3

Land form: Low rocky ridge

Site class: Breeding survey site

Vegetation: Open woodland with hummock grass understory. Dominant species – *Eucalyptus leucophloia*, *E. leucophylla*, *Corymbia terminalis*, *Triodia* spp., *Acacia chisolmii*.

Fire history: 1-2 years unburnt


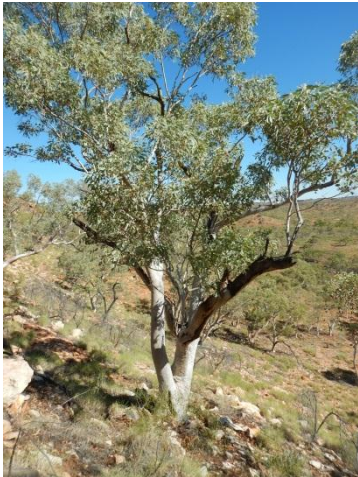

Habitat notes: Rocky site with westerly aspect on a low rocky rise running north-south. Some larger *E. leucophloia* especially towards the top of the ridgeline where trees were in higher density. *Triodia* spp. formed some complex hummocks – increasing up ridgeline. *Acacia chisolmii* provided sparse shrub mid-story.

Hollow assessment: There were 60 trees along the transect, of which 18 had hollows – most hollow containing trees had multiple hollows (33 hollows total). Hollows were 0.6 and 4 m above the ground and between 3 and 15 cm in diameter at the entrance (median 5 cm). The hollows were all in dead tissue though a occurred at mix of angles.

One hollow contained nesting material though nest was elongated and larger than a simple cup shaped Gouldian Finch nest. Nest was in a large (15 cm diameter) burnt spout, 1.5 m above ground.

Gouldian surveys: No Gouldian Finches were detected through the survey, 5 Zebra Finches were seen.

Gouldian Finch (*Erythrura gouldiae*) breeding survey site descriptions, May 2016

	<table border="1"> <tr> <td>Site name: B2S1</td><td>Land form: Rocky ridgeline</td></tr> </table> <p>Site class: Breeding survey site</p> <p>Vegetation: Sparse woodland with hummock grass understory. Dominant species – <i>Eucalyptus leucophloia</i>, <i>E. leucophylla</i>, <i>Corymbia terminalis</i>, <i>Triodia</i> spp.</p> <p>Fire history: 1 year unburnt</p> <p>Habitat notes: Rocky site over a rocky ridgeline running north-south. Larger <i>E. leucophloia</i> on top of the ridgeline where trees were in higher density. <i>Triodia</i> spp. was generally simple and small due to recent fire.</p> <p>Hollow assessment: There were 63 trees along the transect, of which 15 had hollows – 5 of these trees had multiple hollows (22 hollows total). Hollows were between 1.5 and 2.5 m above the ground and between 3 and 15 cm in diameter at the entrance (median 5 cm).</p> <p>There was no evidence of breeding.</p> <p>Gouldian surveys: No Gouldian Finches were detected through the survey, 2 Zebra Finches were seen.</p>	Site name: B2S1	Land form: Rocky ridgeline
Site name: B2S1	Land form: Rocky ridgeline		
	<table border="1"> <tr> <td>Site name: B3S1</td><td>Land form: Rocky hills</td></tr> </table> <p>Site class: Breeding survey site</p> <p>Vegetation: Open woodland with hummock grass understory. Dominant species – <i>Eucalyptus leucophloia</i>, <i>Triodia</i> spp., <i>Acacia chisolmii</i>.</p> <p>Fire history: 1-2 years unburnt</p> <p>Habitat notes: Rocky site with westerly aspect on steep rocky hill toward a distinct saddle. A small drainage line supported some larger <i>E. leucophloia</i>. <i>Triodia</i> spp. formed some complex hummocks though was generally small due to fire. Isolated <i>Acacia chisolmii</i> provided sparse shrub mid-story.</p> <p>Hollow assessment: There were 73 trees along the transect, of which 11 had hollows (22 hollows total). Hollows were between 1 and 4 m above the ground and between 3 and 12 cm in diameter at the entrance (median 4 cm). The hollows were all in dead tissue and mostly at > 45°.</p> <p>There was no evidence of breeding observed.</p> <p>Gouldian surveys: No finches were detected during the survey.</p>	Site name: B3S1	Land form: Rocky hills
Site name: B3S1	Land form: Rocky hills		
	<table border="1"> <tr> <td>Site name: B4S1</td><td>Land form: Rocky hills</td></tr> </table> <p>Site class: Breeding survey site</p> <p>Vegetation: Open woodland with hummock grass understory. Dominant species – <i>Eucalyptus leucophloia</i>, <i>Triodia</i> spp.</p> <p>Fire history: 2 years unburnt</p> <p>Habitat notes: Rocky site with an easterly aspect running parallel to a rocky ridgeline. <i>E. leucophloia</i> were generally, small and multi-stemmed. <i>Triodia</i> sp. formed some complex hummocks in open hummock grassland.</p> <p>Hollow assessment: There were 53 trees along the transect, of which only 3 had hollows (3 hollows total). Hollows were between 2.2 and 3.5 m above the ground and between 3 and 5 cm in diameter at the entrance.</p> <p>Gouldian surveys: No Gouldian Finches were detected through the survey, 1 Painted Finch was seen.</p>	Site name: B4S1	Land form: Rocky hills
Site name: B4S1	Land form: Rocky hills		

Appendix M

.....Gouldian Finch site descriptions of feeding sites

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Gouldian Finch (*Erythrura gouldiae*) feeding survey site descriptions, May 2016



Site name: GFF1

Land form: Drainage line

Site description: Approximately 5-6 m wide band along either side of creek line which passes near rocky outcrop. Red, sandy soil extending from surrounding rocky plains through creek bed. Moderate level of cattle caused erosion along creek bank.

Vegetation: Tussock grasses – predominately Buffel Grass (*Cenchrus ciliaris*) along the creek line. Buffel grass shows signs of heavy grazing pressure from cattle. Recently burnt Spinifex Grass behind in open hummock grassland. *E. leucophylla* along creek banks with *Melaleuca bracteata* forming dense stands within drainage line.

Fire history: 2 years unburnt.

Habitat assessment: Heavy grazing pressure from cattle would indicate a lack of seeding grasses to be present. The dominance of Buffel grass through the site shows a lack of grass diversity which is needed to providing seeding at different times.



Site name: GFF2

Land form: Drainage line

Site description: Multiple linear strips along drainage lines and creek beds. Outcropping of rocks in rocky plains, with red sandy soils with patches of grey sandy soils close to drainage lines. Permanent water source from bore fed trough at site. Severe cattle caused erosion along banks.

Vegetation: Tussock grasses – predominately Buffel Grass (*Cenchrus ciliaris*) along the creek line. Buffel grass shows signs of heavy grazing pressure from cattle. Recently burnt Spinifex Grass behind in open hummock grassland. *E. leucophylla* with *Melaleuca bracteata* forming patches within drainage line.

Fire history: 1 year unburnt.

Habitat assessment: No native grasses were identified at the site needed for Gouldian Finch feeding. The mono-species patches of heavily grazed Buffel grass does not constitute suitable wet season breeding habitat.



Site name: GFF3

Land form: Drainage line

Site description: Low lying area along drainage line between higher rocky plains, with red soils (patches of grey soil close to drainage line) and high rock content. Severe cattle caused erosion along banks.

Vegetation: Wide stretch of tussock grass – predominately Buffel Grass (*Cenchrus ciliaris*) along the creek line with large bare areas and common weeds (especially Kapook bush - *Aerva javanica*). Buffel grass shows signs of heavy grazing pressure from cattle. Recently burnt Spinifex Grass behind in open hummock grassland. *E. camaldulensis* and *E. leucophylla* with *Melaleuca bracteata* forming patches within drainage line.

Fire history: 1 year unburnt.

Habitat assessment: No native grasses were identified at the site needed for Gouldian Finch feeding. The mono-species patches of heavily grazed Buffel grass does not constitute suitable wet season breeding habitat. Heavy erosion and grazing pressure from cattle further reduce the suitability of feeding habitat.

Gouldian Finch (*Erythrura gouldiae*) feeding survey site descriptions, May 2016



Site name: GFF4

Land form: Creek line

Site description: Narrow band along either side of creek line. Red, sandy soil extending from surrounding rocky plains through creek bed. Moderate level of cattle caused erosion along creek bank.

Vegetation: Narrow band (< 2 m wide) of tussock grasses – predominately Buffel Grass (*Cenchrus ciliaris*) along the creek line. Recently burnt Spinifex Grass behind in open hummock grassland. Sparse *E. camaldulensis* along creek bank intermixed with *E. leucophylla*.

Fire history: 1 year unburnt.

Habitat assessment: Narrow band of mono species tussock grass (*C. ciliaris*) along creek line is unlikely to provide suitable wet season foraging habitat for the Gouldian Finch.



Site name: GFF5

Land form: Drainage line

Site description: Margin of drainage line surrounded by rocky plains with rock outcrops. Red sandy plains lead to grey sandy soil along drainage line. Site shows signs of moderate to severe cattle erosion and grazing on introduced pasture grasses.

Vegetation: Wide stretch of tussock grass – predominately Buffel Grass (*Cenchrus ciliaris*) along the creek line - with native species present along edge of bank (*Themeda triandra*, *Heteropogon contortus*) and *Aristida* sp. scattered throughout. Buffel grass shows signs of heavy grazing pressure. *E. camaldulensis*, *E. leucophylla* and *Corymbia terminalis* with sparse *A. chisholmii* over *Triodia pungens* back from drainage line.

Fire history: 1 year unburnt.

Habitat assessment: The presence of native grass species indicates that there may be seeding grasses at differing times of the year – a requirement for Gouldian Finch feeding. However, the area of native grass species is small and, combined with the heavy impact of cattle and fire present marginal feeding habitat at best.



Site name: GFF6

Land form: Creek line

Site description: Margin of watercourse with running water. Red sandy soils, showing signs of moderate, cattle caused erosion and grazing pressure.

Vegetation: Wide stretch of tussock grass – predominately Buffel Grass (*Cenchrus ciliaris*) along the creek line - with native species present along edge of bank (*Themeda triandra*, *Heteropogon contortus*). Buffel grass shows signs of heavy grazing pressure. *E. camaldulensis*, *E. leucophylla* and *Corymbia terminalis* with sparse *A. chisholmii* over *Triodia pungens* back from drainage line.

Fire history: 1 year unburnt.

Habitat assessment: The presence of native grass species indicates that there may be seeding grasses at differing times of the year – a requirement for Gouldian Finch feeding. However, the area of native grass species is small and, combined with the heavy impact of cattle and fire present marginal feeding habitat at best.

Gouldian Finch (*Erythrura gouldiae*) feeding survey site descriptions, May 2016



Site name: GFF7

Land form: River line

Site description: Margin of Mica Creek and surrounding flats. Site had deep, sandy, brown soil. Long term water was present at the crossing with Diamantina Developmental Road, approximately 50 m from site. There was signs of cattle caused erosion along stream banks, although little grazing pressure.

Vegetation: Wide stretches of tussock grass – predominately Buffel Grass (*Cenchrus ciliaris*) and Annual Mission Grass (*Pennisetum pedicellatum*) along the creek line - with isolated native species (*Themeda triandra*, *Heteropogon contortus*) at very edge of watercourse. Upper story of *E. camaldulensis*, *E. leucophylla*, *E. leucophloia* and *Corymbia terminalis* with *Triodia pungens* back from drainage line.

Fire history: > 2 years unburnt.

Habitat assessment: Although the site was the longest unburnt site and didn't show signs of over-grazing, there was only isolated native grasses – the area being dominated by Buffel grass and Annual Mission Grass.



Site name: GFF8

Land form: Drainage line

Site description: Narrow margin along drainage line with dark reddish brown sandy soils to a shallow depth surrounded by rocky plains.

Vegetation: Small patches of Buffel Grass (*Cenchrus ciliaris*) with Spinifex (*Triodia pungens*) extending to the drainage line in a number of locations. Upper story of dominated by *E. leucophylla* with isolated *Corymbia terminalis*. Dense but isolated patches of *Melaleuca bracteata* within the drainage line. Abundant occurrence of Kapok Bush (*Aerva javanica*) throughout the site.

Fire history: 1-2 years

Habitat assessment: Site does not provide extensive areas of suitable tussock grasses for Gouldian Finch feeding in the wet season. Area is primarily Spinifex Grass with small patches of Buffel grass showing signs of over grazing.



Site name: GFF9

Land form: Drainage line

Site description: Narrow margin along both banks of rocky drainage line surrounded by rocky plains. Red sandy soils throughout with high rock content and outcropping. Moderate level of cattle caused erosion along bank.

Vegetation: Patches of Buffel Grass (*Cenchrus ciliaris*) along drainage line which are heavily grazed by cattle. Isolated native species (*Themeda triandra*, *Heteropogon contortus*) at very edge of watercourse. *E. leucophylla* dominated upper story with isolated *Corymbia terminalis*. Common *A. chisholmii* throughout and *Triodia pungens* approximately 1-2 m from drainage. Abundant occurrence of Kapok Bush (*Aerva javanica*) throughout the site.

Fire history: Burnt last year

Habitat assessment: Only isolated native grasses and generally small area of tussock grasses combined with recent (and likely frequent) fire indicates the site would not provide good wet season feeding habitat.

Gouldian Finch (*Erythrura gouldiae*) feeding survey site descriptions, May 2016



Site name: GFF10

Land form: Drainage line

Site description: Narrow margin along both banks of rocky drainage line surrounded by rocky plains. Red brown shallow sandy soils throughout with high rock content and outcropping. Moderate level of cattle caused erosion along bank.

Vegetation: Patches of Buffel Grass (*Cenchrus ciliaris*) along drainage line which are heavily grazed by cattle. *E. leucophylla* dominated upper story with sparse *A. chisholmii* throughout and *Triodia pungens* approximately 1-2 m from drainage. Abundant occurrence of Kapok Bush (*Aerva javanica*) throughout the site.

Fire history: Burnt last year

Habitat assessment: Lack of native grasses and the impact of fire and grazing indicate that the site would not provide suitable feeding habitat. The site is also small and weed infested.

Appendix N

.....Painted Honeyeater habitat descriptions of survey sites

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Painted Honeyeater (*Grantiella picta*) survey site descriptions, May 2016



View west along creekline

Site name: Bird count 1

Land form: Creekline and adjacent alluvial flats

Vegetation: Open forest dominated by River Red Gum *Eucalyptus camaldulensis* along creekline (RE1.3.7) over native grasses mixed with exotic Annual Mission Grass *Pennisetum pedicellatum*. Within adjacent Gidgee *Acacia cambagei* woodland (RE1.3.4) over *Triodia* sp. Patchy shrub layer of *Acacia* sp. along creek.

Habitat values: Water present at creekline site fed by upstream spring at time of survey. Relatively diverse shrub layer along creek. Moderate mistletoe presence in River Red Gums and sparse presence in adjacent Gidgee woodland. Abundant tree hollows along creekline.

Disturbance evidence: Heavy cattle impact along creekline with obvious impacts on grass layer (foraging and sheltering) and bank erosion. Little evidence of recent fire. Annual Mission Grass (exotic species) dominant along creek edge.

Bird observations: Diverse site with 22 bird species recorded. Likely due to local relative resource diversity within landscape. Gilbert's Dragon *Lophognathus gilberti* also observed along creekline.



View west across creekline

Site name: Bird count 2

Land form: Creekline and adjacent woodland

Vegetation: Open forest dominated by River Red Gum along creekline (RE1.3.7) over native grasses mixed with exotic Annual Mission Grass. Adjacent woodland dominated by *Eucalyptus leucophylla* (RE1.11.2) over *Triodia* sp.

Habitat values: No water present at creekline. Patchy dense shrub layer of *Acacia* spp. in adjacent woodland. Sparse mistletoe presence in River Red Gums. Abundant tree hollows along creekline.

Disturbance evidence: Light cattle impact along creekline with impacts on grass layer (foraging) and some bank erosion but generally restricted to track/crossing point. Some evidence of past localised mineral extraction activity in woodland area. Little evidence of recent fire. Annual Mission Grass (exotic species) dominant along creek edge.

Bird observations: Only four species recorded at time of survey although timing sub-optimal (midday).



View north along drainage line

Site name: Bird count 3

Land form: flat area between drainage lines

Vegetation: Mixture of Snappy Gum *eucalyptus lucophloia* open woodland (RE1.11.2a) and *E. leucophylla/Corymbia terminalis* woodland (RE1.11.3) over *Triodia* sp.

Habitat values: Large creek and minor drainage line border survey area. Patchy but dense shrub layer present. River Red Gum present on large creek and Black Teatree *Melaleuca bracteata* present on creeklines. Sparse mistletoe presence in River Red Gums. Patchy small rockpiles on minor creekline and through survey area with some crevice formation. Native grasses present along edge of drainage areas.

Disturbance evidence: No evidence of recent fire although *Triodia* hummocks generally small/immature. Evidence of cattle grazing along major creekline where Annual Mission Grass present.

Bird observations: 13 bird species recorded.

Painted Honeyeater (*Grantiella picta*) survey site descriptions, May 2016



View northeast along drainage line between hills

Site name: Bird count 4

Land form: undulating low hills

Vegetation: Mixture of very sparse Snappy Gum open woodland over *Triodia* sp. with *E. leucophylla/Corymbia terminalis* woodland (RE1.11.3) dominating on/close to gully line.

Habitat values: Very open woodland away from gully lines where Black Teatree also present. No mistletoe observed. Patchy small rockpiles throughout survey area although little crevice formation observed.

Disturbance evidence: No evidence of recent fire although *Triodia* hummocks generally small/immature. Little evidence of cattle presence.

Bird observations: Only 6 bird species recorded.



View west along Mica Creek

Site name: Bird count 5

Land form: Mica Creek

Vegetation: Open forest dominated by River Red Gum and *Lophostemon grandiflorus* along creekline (RE1.3.7), with patchy lower tree/shrub layer over dense weedy ground layer.

Habitat values: Braided creek habitat area at survey point (approx. 150 m wide). Pooled water present downstream of site at crossing area. Patchy but dense lower tree/shrub layer present providing good shelter/foraging resource for small birds. Moderate mistletoe presence in River Red Gums. Abundant tree hollows present.

Disturbance evidence: Light cattle impact along creekline with some impact on grass layer (foraging). No evidence of recent fire. Dense patchy ground layer (on raised areas) dominated by exotic Annual Mission Grass and Noogoora Burr *Xanthium strumarium*.

Bird observations: Diverse site with 21 bird species recorded, some in high abundance. Likely due to local relative resource diversity within landscape. Gilbert's Dragon also observed.



View south over survey site

Site name: Bird count 6

Land form: Drainage flats between hills/ridgelines

Vegetation: Mixture of Snappy Gum open woodland (RE1.11.2a) and *E. leucophylla/Corymbia terminalis* woodland (RE1.11.3) over *Triodia* sp.

Habitat values: Minor (dry) drainage area crosses through survey area. Dense shrub layer around drainage area dominated by *Acacia monticola*. Very sparse mistletoe presence in *C. terminalis*. *Triodia* ground layer well developed with mature hummocks present.

Disturbance evidence: No evidence of recent fire in area and little attraction for cattle grazing. Tracks, some evidence of previous earthworks and human/vehicle debris present around area.

Bird observations: 15 bird species recorded. Relatively high abundance and diversity of honeyeaters present due to flowering gums in area.

Painted Honeyeater (*Grantiella picta*) survey site descriptions, May 2016



Site name: Bird count 6

Land form: Creekline

Vegetation: Open forest dominated by River Red Gum along creekline (RE1.3.7) over native grasses mixed with exotic Annual Mission Grass. Adjacent woodland dominated by *Eucalyptus leucophylla* (RE1.11.2) over *Triodia* sp.

Habitat values: No water present at creekline. Patchy dense shrub layer of *Acacia* spp. in adjacent woodland. Sparse mistletoe presence in River Red Gums.

Disturbance evidence: Light cattle impact along creekline with impacts on grass layer (foraging) and some bank erosion but generally restricted to track/crossing point. Particularly large *C. aparrerinja* back from creekline. Annual Mission Grass (exotic species) dominant along creek edge.

Bird observations: 12 species recorded at time of survey despite timing being sub-optimal (midday).

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Appendix O

Bird list (surveys and incidental)

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Bird records within the Project footprint during surveys in May and June 2016 (includes site surveys and incidental records)

Family	Common name	Scientific name	Threatened status			Bioregion		
			N.T.	Qld	National	Davenport & Murchison Ranges / Tanami	Mitchell Grass Downs	Mount Isa Inlier
Acanthizidae	Inland Thornbill	<i>Acanthiza apicalis</i>	LC	LC	-	✓		
	Weebill	<i>Smicrornis brevirostris</i>	LC	LC	-	✓		✓
Accipitridae	Black Kite	<i>Milvus migrans</i>	LC	LC	-	✓	✓	✓
	Black-shouldered Kite	<i>Elanus axillaris</i>	LC	LC	-	✓		
	Brown Goshawk	<i>Accipiter fasciatus</i>	LC	LC	-		✓	✓
	Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>	LC	LC	-		✓	
	Spotted harrier	<i>Circus assimilis</i>	LC	LC	-	✓	✓	
	Swamp Harrier	<i>Circus approximans</i>	LC	LC	-	✓	✓	
	Wedge-tailed Eagle	<i>Aquila audax</i>	LC	LC	-	✓		✓
	Whistling Kite	<i>Haliastur sphenurus</i>	LC	LC	-	✓	✓	✓
Aegothelidae	Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	LC	LC	-		✓	✓
Anseranatidae	Magpie Goose	<i>Anseranas semipalmata</i>	LC	LC	-		✓	✓
Ardeidae	White-necked Heron (Pacific Heron)	<i>Ardea pacifica</i>	LC	LC	-		✓	✓
Artamidae	Australian Magpie	<i>Gymnorhina tibicen</i>	LC	LC	-			✓
	Black-faced Woodswallow	<i>Artamus cinereus</i>	LC	LC	-	✓		✓
	Little Woodswallow	<i>Artamus minor</i>	LC	LC	-	✓		✓
	Masked Woodswallow	<i>Artamus personatus</i>	LC	LC	-	✓	✓	✓
	Pied Butcherbird	<i>Cracticus nigrogularis</i>	LC	LC	-	✓		✓
	White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	LC	LC	-	✓	✓	
Burhinidae	Bush Stone-Curlew	<i>Burhinus grallarius</i>	LC	LC	-	✓		
Cacatuidae	Cockatiel	<i>Nymphicus hollandicus</i>	LC	LC	-			
	Galah	<i>Eolophus roseicapilla</i>	LC	LC	-	✓	✓	✓
	Little Corella	<i>Cacatua sanguinea</i>	LC	LC	-	✓		
	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	LC	LC	-			✓
Campephagidae	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	LC	LC	-	✓	✓	✓
	White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>	LC	LC	-			✓
	White-winged Triller	<i>Lalage sueurii</i>	LC	LC	-	✓		✓

Bird records within the Project footprint during surveys in May and June 2016 (includes site surveys and incidental records)

Family	Common name	Scientific name	Threatened status			Bioregion		
			N.T.	Qld	National	Davenport & Murchison Ranges / Tanami	Mitchell Grass Downs	Mount Isa Inlier
Cinclosomatidae	Chiming Wedgebill	<i>Psophodes occidentalis</i>	LC	LC	-	✓		
Cisticolidae	Golden-headed Cisticola	<i>Cisticola exilis</i>	LC	LC	-	✓		
Climacteridae	Black-tailed Treecreeper	<i>Climacteris melanura</i>	LC	LC	-			✓
Columbidae	Common Bronzewing	<i>Phaps chalcoptera</i>	LC	LC	-			
	Crested Pigeon	<i>Ocyphaps lophotes</i>	LC	LC	-	✓	✓	
	Diamond Dove	<i>Geopelia cuneata</i>	LC	LC	-	✓	✓	
	Flock Bronzewing	<i>Phaps histrionica</i>	NT	LC	-	✓		
	Peaceful Dove	<i>Geopelia placida</i>	LC	LC	-			✓
	Spinifex Pigeon	<i>Geophaps plumifera</i>	LC	LC	-			✓
Corvidae	Australian Raven	<i>Corvus coronoides</i>	LC	LC	-			✓
Cuculidae	Horsefield's Bronze Cuckoo	<i>Chrysococcyx basalis</i>	LC	LC	-	✓		✓
	Pallid Cuckoo	<i>Cacomantis pallidus</i>	LC	LC	-	✓		✓
	Pheasant Coucal	<i>Centropus phasianinus</i>	LC	LC	-	✓		
Estrildidae	Painted Finch	<i>Emblema pictum</i>	LC	LC	-			✓
	Zebra Finch	<i>Taeniopygia guttata</i>	LC	LC	-	✓	✓	✓
Eurostopdidae	Spotted Nightjar	<i>Eurostopodus argus</i>	LC	LC	-	✓		✓
Falconidae	Nankeen Kestrel	<i>Falco cenchroides</i>	LC	LC	-	✓	✓	✓
	Brown Falcon	<i>Falco berigora</i>	LC	LC	-	✓	✓	✓
	Grey Falcon	<i>Falco hypoleucos</i>	VU	VU	-	✓	✓	
Gruidae	Brolga	<i>Grus rubicunda</i>	LC	LC	-		✓	
Halcyonidae	Red-backed Kingfisher	<i>Todiramphus pyrrhopygius</i>	LC	LC	-	✓		✓
	Sacred Kingfisher	<i>Todiramphus sanctus</i>	LC	LC	-	✓		
Maluridae	Kalkadoon Grasswren	<i>Amytornis ballarae</i>	-	LC	-			✓
	Variegated Fairy-wren	<i>Malurus lamberti</i>	LC	LC	-	✓		
Meliphagidae	Banded Honeyeater	<i>Cissomela pectoralis</i>	LC	LC	-	✓	✓	
	Black Honeyeater	<i>Sugomel niger</i>	LC	LC	-	✓		
	Black-chinned Honeyeater	<i>Melithreptus gularis</i>	LC	LC	-	✓		

Bird records within the Project footprint during surveys in May and June 2016 (includes site surveys and incidental records)

Family	Common name	Scientific name	Threatened status			Bioregion		
			N.T.	Qld	National	Davenport & Murchison Ranges / Tanami	Mitchell Grass Downs	Mount Isa Inlier
Meliphagidae	Brown Honeyeater	<i>Lichmera indistincta</i>	LC	LC	-	✓		✓
	Crimson Chat	<i>Epthianura tricolor</i>	LC	LC	-	✓		
	Grey-fronted Honeyeater	<i>Ptilotula plumula</i>	LC	LC	-	✓		✓
	Grey-headed Honeyeater	<i>Ptilotula keartlandi</i>	LC	LC	-	✓		✓
	Little Friarbird	<i>Philemon citreogularis</i>	LC	LC	-			✓
	Pied Honeyeater	<i>Certhionyx variegatus</i>	LC	LC	-		✓	
	Rufous-throated Honeyeater	<i>Conopophila rufogularis</i>	LC	LC	-	✓		
	Silver-crowned Friarbird	<i>Philemon argenticeps</i>	LC	LC	-			✓
	Singing Honeyeater	<i>Gavicalis virescens</i>	LC	LC	-	✓		✓
	Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>	LC	LC	-			✓
	White-plumed Honeyeater	<i>Ptilotula penicillata</i>	LC	LC	-		✓	✓
	Yellow-throated Miner	<i>Manorina flavigula</i>	LC	LC	-	✓	✓	✓
	Yellow-tinted Honeyeater	<i>Ptilotula flavescens</i>	-	LC	-			✓
Meropidae	Rainbow Bee-eater	<i>Merops ornatus</i>	LC	LC	-			✓
Monarchidae	Magpie-Lark	<i>Grallina cyanoleuca</i>	LC	LC	-			✓
Nectariniidae	Mistletoebird	<i>Dicaeum hirundinaceum</i>	LC	LC	-			✓
Otididae	Australian Bustard	<i>Ardeotis australis</i>	NT	LC	-	✓	✓	
Pachycephalidae	Crested Bellbird	<i>Oreoica gutturalis</i>	LC	LC	-	✓		✓
	Grey Shrike-thrush	<i>Colluricincla harmonica</i>	LC	LC	-	✓		✓
	Rufous Whistler	<i>Pachycephala rufiventris</i>	LC	LC	-	✓		✓
Pardalotidae	Red-browed Pardalote	<i>Pardalotus rubricatus</i>	LC	LC	-	✓		✓
	Striated Pardalote	<i>Pardalotus striatus</i>	LC	LC	-			✓
Petroicidae	Hooded Robin	<i>Melanodryas cucullata</i>	LC	LC	-	✓		✓
	Jacky Winter	<i>Microeca fascinans</i>	LC	LC	-			✓
Phasianidae	Brown Quail	<i>Coturnix ypsilophora</i>	LC	LC	-	✓		
	Stubble Quail	<i>Coturnix pectoralis</i>	LC	LC	-	✓		
Pomatostomidae	Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	LC	LC	-			✓

Bird records within the Project footprint during surveys in May and June 2016 (includes site surveys and incidental records)

Family	Common name	Scientific name	Threatened status			Bioregion		
			N.T.	Qld	National	Davenport & Murchison Ranges / Tanami	Mitchell Grass Downs	Mount Isa Inlier
Psittacidae	Australian (Cloncurry) Ringneck	<i>Barnardius zonarius macgillivrayi</i>	LC	LC	-			✓
	Budgerigar	<i>Melopsittacus undulatus</i>	LC	LC	-	✓		✓
	Red-winged Parrot	<i>Aprosmictus erythropterus</i>	LC	LC	-	✓		
Ptilonorhynchidae	Great Bowerbird	<i>Chlamydera nuchalis</i>	LC	LC	-			✓
Rhipiduridae	Willie Wagtail	<i>Rhipidura leucophrys</i>	LC	LC	-	✓	✓	✓
Turnicidae	Little Button-quail	<i>Turnix velox</i>	LC	LC	-	✓	✓	
	Red-chested Button-quail	<i>Turnix pyrrhothorax</i>	LC	LC	-	✓		

Key: Northern Territory (N.T.); Queensland (Qld); Vulnerable (VU); Near Threatened (NT); Least Concern (LC); no listing (-); Species was recorded (✓)

Appendix P

Migratory species likelihood of occurrence assessment

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Migratory species likelihood analysis

This likelihood of occurrence assessment identifies which federally-listed migratory species have potential to occur within the Project footprint. The following procedure was used to determine the likelihood of occurrence of migratory species:

- 1) A search for MNES along the proposed pipeline route and within a 50 km buffer was undertaken using the Protected Matters Search Tool on 9 May 2016 (see Appendix C).
- 2) The ecology, distribution and survey records of each of the species recorded in Step 1 were examined along with habitat types within the Project footprint.
- 3) Using that information, species are allocated one of the following categories:
 - HIGH – there are recent records of the species within the Project footprint.
 - MEDIUM – core habitat for the species occurs within the Project footprint but there are no records.
 - LOW – there is no core habitat for the species within the Project footprint; however, the species may be present on occasion.
 - NONE – there is strong evidence that this species will not occur within the Project footprint.

It should be noted that resultant likelihood rankings may differ from those assigned in the EPBC Protected Matters Search Report because criteria in this assessment considers habitat present within refined project area, whereas the EPBC Report utilises coarser-scale filters.

Although migratory, the Curlew Sandpiper is considered in the threatened species section as the species is listed as Critically Endangered under the *EPBC Act*.

Note: For many threatened species, the Atlas of Living Australia provides ‘likely’ and ‘possible’ modelled expert distributions. These distributions are referred to throughout this document and mostly come from the Species of National Environmental Significance Database maintained by the federal Department of the Environment.

The location of some threatened species records from the Atlas of Living Australia has been generalised to 0.1 degree (introducing a location variance of up to 11 km) due to concerns that revealing the actual location may lead to poaching. Spatially-generalised records have been considered in this assessment; however, use of these records has been noted where relevant.

MIGRATORY SPECIES LIKELIHOOD ANALYSIS		
Species	Details	Likelihood of occurrence within the Project footprint
Fork-tailed Swift <i>Apus pacificus</i>	<p>Habitat: Almost exclusively aerial. Mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh (Higgins 1999).</p> <p>Distribution: Non-breeding visitor to all states and territories of Australia. Breeds in Siberia and migrates southward during the northern winter (Higgins 1999). Within Queensland, there are scattered records in the Gulf Country, and a few records on Cape York Peninsula. In the north-east region there are many records east of the Great Divide from near Cooktown and south to Townsville (Higgins 1999).</p> <p>Records: 14 records within 50 km of the pipeline route.</p>	<p>HIGH</p> <ul style="list-style-type: none"> • There are recent records of the species within the 50 km buffer. • <i>Expert distribution (likely)</i> (Commonwealth of Australia 2016) incorporates the entire Project footprint. • Given the broad distribution and wide ranging nature of this species, it is likely to forage in the air space over the Project footprint on occasion.
Barn Swallow <i>Hirundo rustica</i>	<p>Habitat: Prefers open coastal lowlands, often near water and populated areas where it perches on artificial substrate. Also found in or over freshwater wetlands, Melaleuca woodland, mesophyll shrub thickets and tussock grassland.</p> <p>Distribution: Occurs patchily across the north coast of mainland Australia from the Pilbara region of WA to Fraser Island in Qld (DOE 2016a).</p> <p>Records: A single record from 1989 near Lake Moondarra.</p>	<p>LOW</p> <ul style="list-style-type: none"> • The species distribution does not extend over the Project footprint. • Derived <i>expert distribution</i> (BirdLife International 2016) is not intersected by the Project footprint. • The patchy distribution along coastal areas is not consistent with the habitat within or location of the Project footprint. • There are no records from within the Project footprint.
Rainbow Bee-eater <i>Merops ornatus</i>	<p>Habitat: Occurs mainly in open forests and woodlands, farmland and areas of human habitation (Higgins 1999).</p> <p>Distribution: Widely distributed throughout Australia, eastern Indonesia, Papua New Guinea, the Bismarck Archipelago and, rarely, the Solomon Islands. Majority of the global population breeds in Australia (Higgins 1999).</p> <p>Records: 697 records within 50 km of the pipeline route.</p>	<p>HIGH</p> <ul style="list-style-type: none"> • There are multiple records from across the Project footprint. • Core habitat exists within the Project footprint for the species.
Grey Wagtail <i>Motacilla cinerea</i>	<p>Habitat: Has a strong association with water and has been detected on margins of wetlands, watercourses, lakes and marshes (DOE 2015).</p> <p>Distribution: A rare vagrant to Australia (Morcombe 2003) between October and March. Occurrences in Australia have been in Cape York and the NT Top End, with two records around Alice Springs and isolated records along the southern Australia coast (DOE 2015).</p> <p>Records: None</p>	<p>LOW</p> <ul style="list-style-type: none"> • No records of the species within the Project footprint. Records of the species are predominately from coastal regions. • Distribution of the species is well outside the Project footprint. • Core habitat is not present within the Project footprint.

MIGRATORY SPECIES LIKELIHOOD ANALYSIS		
Species	Details	Likelihood of occurrence within the Project footprint
Yellow Wagtail <i>Motacilla flava</i>	<p>Habitat: Habitat requirements vary but typically include a proximity to water. Typically favours open areas such as grasslands and wetland edges but also man-made open areas such as sports grounds, sewage ponds and farmlands (DOE 2015).</p> <p>Distribution: Rare summer migrant to Australia (Morecombe 2003), typically found around coastal regions across northern Australia from the Pilbarra to southern Qld but has occurred in coastal Victoria.</p> <p>Records: One record from Lake Moondarra.</p>	<p>LOW</p> <ul style="list-style-type: none"> • A single record from Lake Moondarra (outside the Project footprint). • Distribution is largely confined to coastal areas. • There are few records in Australia. • No core habitat is located within the Project footprint; however, suitable open wet areas could be present during the wet summer season.
Great Egret <i>Ardea alba</i>	<p>Habitat: Occurs on a variety of habitat types including wetlands, flooded pastures, dams, estuaries, mangroves and reefs (Morecombe 2003).</p> <p>Distribution: Broadly distributed across Australia.</p> <p>Records: 435 records within 50 km of the pipeline route.</p>	<p>HIGH</p> <ul style="list-style-type: none"> • There are multiple records from across the Project footprint.
Cattle Egret <i>Ardea ibis</i>	<p>Habitat: Occurs on a variety of habitat types including flooded pastures, dam edges, mudflats and open wetlands (Morecombe 2003).</p> <p>Distribution: Broadly distributed across Australia.</p> <p>Records: 113 records within 50 km of the pipeline route.</p>	<p>HIGH</p> <ul style="list-style-type: none"> • There are multiple records from across the Project footprint.
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	<p>Habitat: Prefers muddy edges of shallow wetlands, with inundated low vegetation (DOE 2016b).</p> <p>Distribution: In Qld, widely distributed along the coast but are sparsely distributed inland. One particular inland location is Lake Moondarra area near Mt Isa.</p> <p>Records: 110 records within 50 km of the pipeline route.</p>	<p>NONE</p> <ul style="list-style-type: none"> • There are 72 associated with Lake Moondarra or the Mount Isa Mines tailings dam and are outside of the Project footprint. • There are two records from the western end of the Project footprint that are likely associated with small dams which will not be intersected by the Project footprint. • Preferred habitat is not typical of the Project footprint; only marginal habitat is likely to be present in wet seasons.
Red-necked Stint <i>Calidris ruficollis</i>	<p>Habitat: Found mostly in coastal areas. Sometimes occur inland at water bodies and water treatment facilities. Mostly forage on bare wet mud on intertidal mudflats or sandflats, or in very shallow water and roosts on sheltered beaches (DOE 2016c).</p> <p>Distribution: Recorded in all coastal regions, and found inland in all states when conditions are suitable.</p> <p>Records: 22 records within 50 km of the pipeline route.</p>	<p>NONE</p> <ul style="list-style-type: none"> • Most records are associated with Lake Moondarra or the Mount Isa Mines tailings dam. • The record from near Tennant Creek is from the Sewage Ponds. • The record from Barkly Station is from a swamp which will not be intersected by the Project footprint. • There is no suitable habitat within the Project footprint.

MIGRATORY SPECIES LIKELIHOOD ANALYSIS		
Species	Details	Likelihood of occurrence within the Project footprint
Lesser Sand Plover <i>Charadrius mongolus</i>	<p>Habitat: Feeds mostly on extensive, freshly-exposed areas of intertidal sandflats and mudflats in estuaries or beaches, or in shallow ponds in saltworks (DOE 2016d).</p> <p>Distribution: Widespread in coastal regions. Relative to the project location, mainly occurs in south-eastern parts of the Gulf of Carpentaria though occasionally also inland.</p> <p>Records: 3 records within 50 km of the pipeline route.</p>	<p>NONE</p> <ul style="list-style-type: none"> • The only three records are close to Mt Isa and Lake Moondarra. • Given that this is a predominately coastal species, these records are likely incidental. • There is no suitable habitat within the Project footprint.
Oriental Plover <i>Charadrius veredus</i>	<p>Habitat: After moving from coastal environments, usually inhabit flat, open, grasslands, where short grass is interspersed with hard, bare ground (Boekel 1980; Carruthers 1966; Pedler 1982)</p> <p>Distribution: Non-breeding visitor to Australia, where the species occurs in both coastal and inland areas, mostly in northern Australia. Found on black soil plains in the Northern Territory and Queensland.</p> <p>Records: 29 records within 50 km of the pipeline route.</p>	<p>HIGH</p> <ul style="list-style-type: none"> • There are records from approximately 3 km north of the construction ROW. • The distribution extends across much of the Project footprint. • The hummock grasslands and open woodlands of the Project footprint contain sufficient open areas and bare ground to support inhabitation by this species.
Oriental Pratincole <i>Glareola maldivarum</i>	<p>Habitat: Non-breeding in Australia, usually inhabits open plains, floodplains or short grassland, often with extensive bare areas (DOE 2016e). Often occurs near inland water.</p> <p>Distribution: Most of the migratory population is thought to spend the non-breeding season in Australia (Higgins & Davies 1996).</p> <p>Records: 28 records within 50 km of the pipeline route.</p>	<p>HIGH</p> <ul style="list-style-type: none"> • There are numerous records of near the Project footprint, although mostly associated with Lake Moondarra. • There is suitable open plains habitat through to the Project footprint.
Black-tailed Godwit <i>Limosa limosa</i>	<p>Habitat: Strongly favours coastal habitat. Few inland records around waterbodies. Also uses lagoons in sewage farms and saltworks (Higgins & Davies 1996).</p> <p>Distribution: Found in all states and territories of Australia, prefers coastal regions and the largest populations are found on the north coast between Darwin and Weipa. Generally found in small numbers elsewhere including inland sites (Watkins 1993).</p> <p>Records: 19 records within 50 km of the pipeline route.</p>	<p>NONE</p> <ul style="list-style-type: none"> • The records are from the Mt Isa region and are associated with Lake Moondarra or the Mount Isa Mines tailings dam (outside Project footprint). • There is no suitable habitat within the Project footprint.
Little Curlew <i>Numenius minutus</i>	<p>Habitat: Most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated (DOE 2016f).</p> <p>Distribution: Generally spend the non-breeding season in northern Australia from Port Hedland in WA to the Qld coast, with scattered inland records (DOE 2016f).</p> <p>Records: 17 records within 50 km of the pipeline route.</p>	<p>LOW</p> <ul style="list-style-type: none"> • There are no records from the Project footprint. The 10 recent records are from around Lake Moondarra (outside the Project footprint). • Limited, scattered inland records indicate a strong preference for coastal areas. • No core habitat is located within the Project footprint. Some seasonally suitable inundated areas are within the Project footprint the areas are expected to be used infrequently if at all.

MIGRATORY SPECIES LIKELIHOOD ANALYSIS		
Species	Details	Likelihood of occurrence within the Project footprint
Whimbrel <i>Numenius phaeopus</i>	<p>Habitat: Often found on the intertidal mudflats of sheltered coasts. It has been infrequently recorded using brackish lakes near coastal areas (DOE 2016g).</p> <p>Distribution: Regular migrant to Australia and New Zealand, with a primarily coastal distribution. There are also scattered inland records in all regions (Garnett et al 2011).</p> <p>Records: No records within 50 km of the pipeline route.</p>	<p>NONE</p> <ul style="list-style-type: none"> • There are no records within the Project footprint. • There is no suitable habitat within the Project footprint. • The species has a strong association with coastal areas.
Osprey <i>Pandion haliaetus</i>	<p>Habitat: Occur in coastal habitats and terrestrial wetlands. Mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia (Marchant & Higgins 1993; Olsen et al. 1995). Species requires extensive areas of open fresh, brackish or saline water for foraging, where they feed mainly on fish (Marchant and Higgins, 1993).</p> <p>Distribution: Breeding range extends around the northern coast of Australia. Non-breeding range is nearly continuous along the north Australia coast (DOE 2016h).</p> <p>Records: 14 records within 50 km of the pipeline route.</p>	<p>NONE</p> <ul style="list-style-type: none"> • The Moondarra Lake area to the north East of Mt Isa provides open water habitat for <i>Pandion cristatus</i>. • There are recent records from this lake. • However, no suitable habitat exists within the Project footprint.
Pacific Golden Plover <i>Pluvialis fulva</i>	<p>Habitat: Usually inhabits coastal habitats, though it occasionally occurs around inland wetlands especially those with muddy margins (DOE 2016i)</p> <p>Distribution: Widespread in coastal regions, though there are also a number of inland records (in all states), sometimes far inland and usually along major river systems (DOE 2016i).</p> <p>Records: 13 records within 50 km of the pipeline route.</p>	<p>NONE</p> <ul style="list-style-type: none"> • The majority of records are from Lake Moondarra or the Mount Isa Mines tailings dam. • There is an old (1958) record from 10 km south of the Project footprint. • The species has a strong association with coastal habitats. • There is no suitable habitat within the Project footprint.
Wood Sandpiper <i>Tringa glareola</i>	<p>Habitat: Uses well-vegetated, shallow, freshwater wetlands as typical habitat. Forages on mud at the edges of wetlands and roosts by loafing on low, grassy hillocks in flooded meadows or perched low in trees and on fences (Higgins & Davies 1996).</p> <p>Distribution: Largest numbers recorded in north-west Australia, with all areas of national importance located in WA (Watkins 1993). In Qld, sparsely scattered records south of 17°S.</p> <p>Records: 82 records within 50 km of the pipeline route.</p>	<p>NONE</p> <ul style="list-style-type: none"> • The records near Mt Isa are associated with Lake Moondarra or the Mount Isa Mines tailings dam (outside the Project footprint). • The records from Tennant Creek are from the sewerage works (outside the Project footprint). • There is no suitable habitat intersected by the Project footprint.
Common Greenshank <i>Tringa nebularia</i>	<p>Habitat: Found in a wide range of wetland habitats of varying salinity. Inland, utilises permanent and seasonal wetlands including man-made areas but prefers clay substrate to sand (Morecombe 2003)</p> <p>Distribution: Found across much of Australia including inland areas of NT and Qld. Within the NT, the species is scattered including records from the Barkly Tableland and Tanami region. In Queensland there are sporadic</p>	<p>LOW</p> <ul style="list-style-type: none"> • No records from within the Project footprint (one record approximately 10 km south near KP 60). • Numerous records near Lake Moondarra and Mount Isa Mines tailings dam (outside construction ROW).

MIGRATORY SPECIES LIKELIHOOD ANALYSIS		
Species	Details	Likelihood of occurrence within the Project footprint
	inland records including from around Mt Isa. Records: 63 records within 50 km of the pipeline route.	<ul style="list-style-type: none"> Marginally suitable habitat may be present in some wet seasons.
Marsh Sandpiper <i>Tringa stagnatilis</i>	Habitat: Permanent or ephemeral wetlands. In north Australia, prefers intertidal mudflats (Higgins & Davies 1996). Distribution: Found on coastal and inland wetlands throughout Australia and is widespread in coastal Qld. Records: 89 records within 50 km of the pipeline route.	NONE <ul style="list-style-type: none"> The records near Mt Isa are associated with Lake Moondarra or the Mount Isa Mines tailings dam (outside the Project footprint). The records from Tennant Creek are from the sewerage works (outside the Project footprint). There is no suitable habitat within the Project footprint.

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