



SURAT GAS PROJECT

Off-tenement Terrestrial Ecology Survey Report

PREPARED FOR ARROW ENERGY PTY LTD
March 2019



Surat Gas Project

Off-Tenure Terrestrial Ecology Survey Report

March 2019

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- Appendix A: GIS/Data Package
- Appendix B: Fauna Species List
- Appendix C: Species Mapping Rules

1.0 INTRODUCTION

1.1 BACKGROUND AND SCOPE

Arrow Energy (Arrow) has received Federal and State government approval for its Environmental Impact Statement (EIS) for the Surat Gas Project (SGP). To facilitate the SGP, additional linear (pipeline) infrastructure is required in areas that are not covered by the existing SGP *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval. Arrow Energy has submitted a new Referral to the Federal Government to accommodate this additional infrastructure, and now requires further information on the value of vegetation within the development area for the following MNES:

- Murray Cod (*Maccullochella peelii*) - Vulnerable,
- Yakka Skink (*Egernia rugosa*) – Vulnerable,
- Dunmall's Snake (*Furina dunmalli*) – Vulnerable,
- Squatter Pigeon (*Geophaps scripta scripta*) – Vulnerable,
- Koala (*Phascolarctos cinereus*) – Vulnerable, and
- Greater Glider (*Petauroides volans*) – Vulnerable.

Previous assessments have confirmed the presence of Kogan Wax Flower (*Philotheca sporadica*) and Brigalow Threatened Ecological Communities (TEC) within the SGP and local surrounds (3D Environmental). These assessments also considered Painted Honeyeater (*Grantiella picta*) as possibly occurring. Despite not being included in the information request, both species were recorded during this work and habitat mapping has been included.

The particular aims of this work are to:

- Evaluate habitat suitability for the above EPBC Act fauna species, using Regional Ecosystem as the basic unit of assessment and mapping. The mapping procedure will follow SGP EIS (3D Environmental 2013) with the resulting product categorising vegetation units (RE's) for each species as: 'Core Habitat Known' (CHK), 'Core Habitat Possible' (CHP), and 'General Habitat' (GH);
- Where possible, assess how the habitat may be used by the species (e.g., foraging, breeding, dispersal etc),
- For each of the target taxa, gather data and evaluate 'habitat quality' for CHK and CHP which may be used in the EPBC Act Offset calculator,
- Locate individuals or evidence of their activity, and
- Indicate whether any other EPBC Act listed threatened species (i.e. beyond those listed above) was observed within the pipeline assessment area.

In order to achieve the above goals, refined vegetation mapping is required and has been included in this work. Threatened Ecological Communities (TEC's) identified during the

surveys will be documented and mapped, but are not the subject of this report, nor is a detailed description of each encountered RE type.

1.2 SURVEY LOCATION

The current surveys are additional to ones undertaken by Ecosmart Ecology in December 2017 (EcoSmart Ecology 2018). The initial survey report was included in the EPBC Act Referral lodged by Arrow in May 2018. The current, additional field assessments, provide a greater coverage of the off-tenure pipeline easements proposed to support the Surat Gas Project. These pipelines are centred around four geographical areas (listed north to south, see Figure 1.1): Miles, Wieambilla, Kogan and Braemar. These pipelines fall into the following creek catchments: Columboola, Wambo, Braemar, and Wilkie Creek. All flow ultimately into the Condamine River.

The surveys and assessment focused on each nominal pipeline route and a 500 m buffer. The final pipeline alignment is yet to be determined.



Legend

- Pipeline
- Pipeline Buffer (500m)

Figure 1.1. Project Location

Client			
ARROW ENERGY			
Scale	1:468,560	Drawn By	DG
Date	21-Jan-19	A4	

3D Environmental

Vegetation Assessment
& Mapping Specialists

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2.0 SURVEY AND STUDY METHODS

2.1 SURVEY TEAM

The survey team, as detailed in Table 2.1, was led by David Stanton (flora ecologist) and Mark Sanders (fauna ecologist) of 3D Environment and EcoSmart Ecology. The survey leads were supported by three Arrow ecologists and land liaison officers.

Table 2.1. Field survey team and their qualifications/experience

Name	Position	Qualifications	Experience
Mark Sanders	Principal ecologist/fauna	BSc (Hons)	20+ yrs
David Stanton	Principal ecologist/flora	BSc (Hons)	20+ yrs
Paul Finn	Principal ecologist/fauna	BSc (Hons), PhD (ecology)	19 yrs
Peter Hall	Senior ecologist/flora	BSc	20 yrs
Melanie Ashmore	Ecologist/flora	BSc	2 yrs

2.2 PRE-FIELD SURVEY DESKTOP ASSESSMENT

A detailed desktop review of available ecological information was undertaken as part of the SGP Terrestrial Ecology Assessment (EcoSmart Ecology 2017). Much of this data is relevant to the off-tenement areas and was utilised during this assessment as required. Desktop data sources inspected or reviewed during 2007 study included:

- Birdlife atlas database, including geo-referenced data for threatened taxa,
- Wildnet database, including inspecting threatened species profile data to gather geo-referenced locations (where possible),
- The EPBC Act Protected Matters Search Tool,
- Species Profile and Threats (SPRAT) database and relevant Recovery Plans,
- *Vegetation Management Act 1999* (VM Act) – Vegetation management regional ecosystem map - Version 10.1 (DNRME 2018), and
- Queensland Wetland Data Version 4.0 (EHP 2016).

2.3 FIELD SURVEY METHODOLOGY

The survey was completed over of a nine-day period from the 3rd to the 11th December 2018. Survey conditions were suitable for the detection of the target species (see Section 2.5 for conditions and limitations).

2.3.1 Flora Field Survey Techniques

To assist assessing habitat quality for the target fauna species, flora methods were adopted from the *Guide to determining terrestrial habitat quality – Version 1.2* (DEHP 2017) and the *Queensland BioCondition Assessment Manual* (Eyre *et al.* 2015). BioCondition sites were supplemented with quaternary sites (as per Nelder *et al.* 2017) specifically for the purpose of

increasing mapping confidence and allowing extrapolation of BioCondition scores to habitats/Regional Ecosystems (REs) throughout the assessment area.

BioCondition sites consisted of a 100x50 m plot in which the following parameters were measured:

- Large trees assessed against benchmark thresholds (100x50 m plot).
- Canopy cover including sub-canopy and shrub layers (measured along a 100 m plot centreline).
- Native species richness within the following plots:
 - 100x50 m for trees
 - 50x10 m for shrubs, forbs, grasses and other life forms.
- Coarse woody debris in a 50x20 m plot.
- Groundcover composition (grass, forbs shrubs, exotics) assessed in 5x1 m quadrats along the transect centreline.
- Number of tree species recruiting in 100x50 m plot.

Quaternary sites recorded structural formation, dominant floristic composition of the various structural layers, and geological information.

A total of 78 flora survey sites were recorded during the assessment including 47 BioCondition and 31 quaternary sites. Locations of survey sites are shown in Figure 2.1.

2.3.2 Fauna Field Survey Techniques

The fauna survey included bird survey and area searches at 40 locations scattered throughout the off-tenure area (Figure 2.2). In addition to rolling rocks, logs and searching through other debris (e.g., raking dense leaf litter), area searches included assessment for scats, tracks and scratches on the trunks of smooth-barked trees. Specifically, this included searching for Glossy Black Cockatoo feeding remains (orts) and Koala scats under suitable tree species. Area searches were typically conducted for a minimum of 20 minutes (often more) by no less than two ecologists (usually three). The total area search effort during the survey exceeded 40 person hours.

In addition, six hours of spotlighting by three ecologists over two nights (a total of 18 spotlight hours) was also undertaken in an area of habitat deemed highly suitable for Greater Glider and Koala.

Throughout the survey vegetation was visually assessed for its value as habitat for the target EPBC Act species. The habitat assessment was undertaken by an ecologist with more than 20 years expertise and first-hand experience of all targeted EPBC Act species.



Figure 2.1. Biocondition and quaternary assessment site localities

Legend

- Biocondition Site
- ◆ Quaternary Assessment Site
- Pipeline
- Pipeline Buffer (500m)

Client			
ARROW ENERGY			
Scale	1:468,560	Drawn By	DG
Date	29-Jan-19		A4

3D Environmental

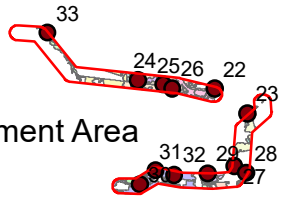
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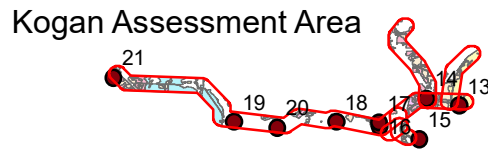




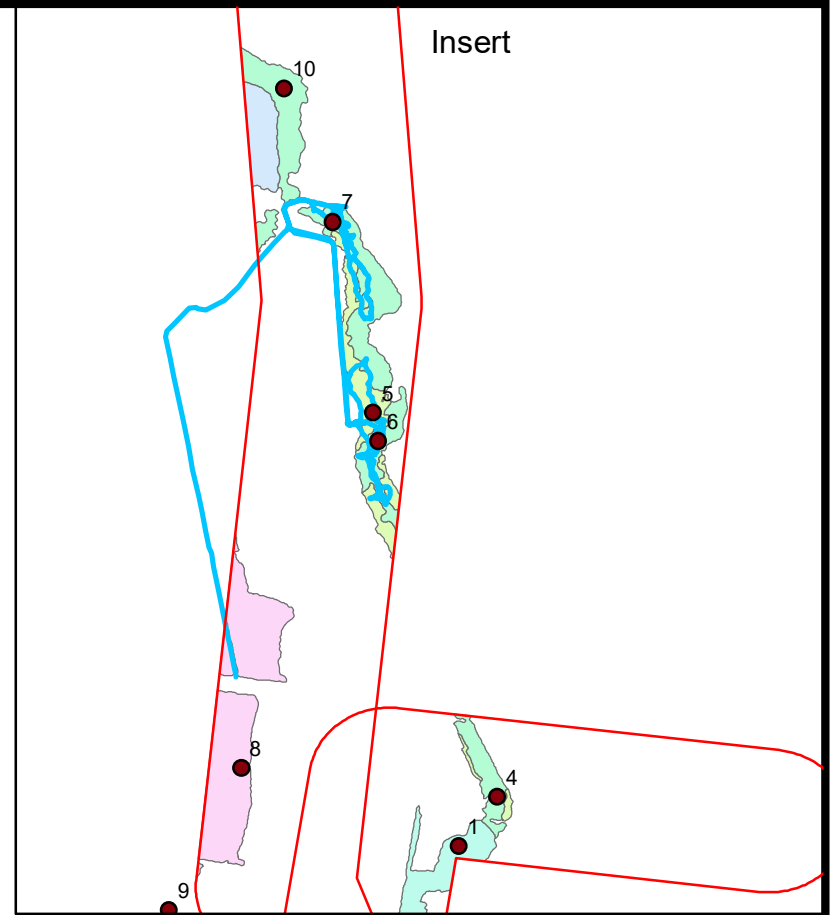
Miles Assessment Area



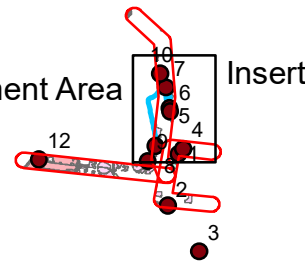
Wieambilla Assessment Area



Kogan Assessment Area



Insert



Braemar Assessment Area

Insert

Legend

- Off-tenure Assessment Area
- Fauna Survey Sites
- Spotlight_route

Figure 2.2
Fauna survey locations and spotlight areas



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Project: Off-tenure Terrestrial Ecological Assessment



2.4 MAPPING AND ANALYSIS

2.4.1 Vegetation Mapping Scale and Attributes

Vegetation linework was established at a scale of 1:25,000 providing an accuracy of hard boundaries of +/-25 m and a minimum polygon size of 0.5 ha. A polygon of 0.5 ha represents the minimum patch size threshold for the Brigalow Ecological Communities, listed as an Endangered TEC under the EPBC Act.

GIS shapefiles of all floristic survey sites within the surveyed area have been provided to Arrow in a separate package to accompany this report (Appendix A), which also includes the locations and habitat scoring for site and context-based attributes.

2.4.2 Threatened Species Habitat Mapping

Habitat mapping was undertaken for each of the MNES fauna species subject to the DoEE further information request, plus Kogan Wax Flower and Painted Honeyeater. These maps used RE's as the basic unit of assessment, with each unit categorised as 'Core Habitat Known' (based around known records), 'Core Habitat Possible' or 'General Habitat' where:

Core Habitat Possible = habitat which is perceived to be highly suitable for the species and, if present, provides suitable resources to support a stable population,

General Habitat = less optimal, or sub-optimal, habitat that has a low likelihood of supporting a population or significantly contributing to its long-term survival, and

Core Habitat Known = habitat surrounding a known record. A species-specific buffer distance is used to generate Core Habitat Known based on each species movement potential.

It should be noted that the above definitions evaluate habitat suitability, they do not attempt to evaluate how likely a species might be. This is achieved in the likelihood assessment. Obviously those species considered 'possible' or 'likely' to occur within or adjacent the SGP are more likely to inhabit areas of better habitat (Core Habitat Possible) than sub-optimal habitat.

During the initial likelihood assessment (3D Environmental 2013), Yakka Skink was rated as 'unlikely' and Squatter Pigeon as 'transient' based on relevant records from the SGP and surrounding area. Despite these ratings, DoEE have requested mapping for both species. While the produced maps show areas of best habitat (Core Habitat Possible), we maintain that the likely occurrence of these species, or the probability of resident populations, remains very low.

The above mapping approach is consistent with the ecology assessment for the SGP Supplementary EIS (3D Environmental 2013) where mapping rules were formulated for the relevant threatened species including the Dunmall's Snake. Subsequent to the 2013 studies, two fauna species were added to the MNES list, the Koala and Greater Glider and mapping rules for these were developed in 2017 (EcoSmart Ecology 2017).

One RE identified during field investigations within the off-tenure areas was not previously included in habitat mapping due to its absence from the SGP area (RE 11.7.2). Existing

habitat mapping rules for the three above-mentioned species were updated to reflect this additional vegetation community.

All previous assessments have considered Yakka Skink unlikely to occur, and Squatter Pigeons as transient individuals which do not represent extant populations (but rather nomadic birds). These later two species have not been previously mapped and require new mapping rules.

In assigning habitat categories the mapping product considered:

- Known records (based on database searches and field investigations),
- Preferred habitat attributed on an RE level, and
- Behaviour/movement potential (e.g., the removal of small isolated patches of suitable habitat for immobile species, or increasing the buffer size of 'Core Habitat Known' for highly mobile species).

2.4.3 Habitat Quality Scoring

For the purpose of providing context to the quality of habitat assessed within the pipelines study area, the method applied in the EPBC Act Offset calculator has been applied. It is recognised that this method does not equate to impact criteria as per the EPBC Significant Impact Guidelines, however it does provide useful information to inform the suitability of habitat within the study area for the various MNES species. The 'Habitat Quality' from the EPBC Act Offset calculator uses three components: Site Context, Site Condition and Species Stocking Rates. These are weighted as 30%/30%/40% and should result in an overall score out of 10 (i.e., 3+3+4). Following advice provided by DoEE (Vaughn Cox *pers. Comm*, 5th Sep 2018) these components will be calculated using the below methodology. No scores have been calculated for the Murray Cod due to the lack of any suitable habitat.

Site Context

Site Context should be calculated using a subset of attributes (Table 2.2) from the Queensland '*Guide to determining terrestrial habitat quality*' (DEHP 2017). Using these attributes, the 'Site context' will score out of a maximum 56 and be converted into a score out of three for inclusion into the calculator. For example, a site context score of 44 would be converted for use in the EPBC Act calculator as 2.36; $(44/56) \times 3$.

Table 2.2. Relevant attributes from DEHP (2017) used to calculate 'Site Context' for inclusion into the EPBC Act offset calculator. Numbers show highest possible score for each attribute.

DEHP Site Context Attributes		DEHP Species Habitat Index Attributes	
1. Size of Patch	10	1. Threats to species	15
2. Connectedness	5	4. Species mobility	10
3. Context	5	5. Role of site location to overall population	5
5. Ecological Corridors	6		

Using the DEHP (2017) methodology, 'context' (attribute 3 in Table 2.2) is an estimation of the extent of remnant habitat within one kilometre of the BioCondition site. Following advice from DoEE, 'context' was modified to include both remnant and regrowth vegetation (when considered suitable for the target species) based on the following buffer distances:

- Dunmall's Snake – 5 km, and
- Greater Glider and Koala – 20 km.

No specific buffer distance has been advised for Murray Cod, Yakka Skink and Squatter Pigeon. A buffer of either 5 km (Yakka Skin) or 20 km (Squatter Pigeon) has been applied for these species. For plants and TECs, a 1km buffer was applied and species mobility is not calculated meaning site context is scored out of a maximum possible score of 46.

Site Condition

Site Condition has been calculated using the attributes from DEHP (2017) detailed in Table 2.3. Each attribute is evaluated by comparing the BioCondition data against published benchmarks for the Brigalow Belt Bioregion (Queensland Herbarium 2016). Where benchmarks are not available, BioCondition site data from the ecology assessment for the Surat Gas Project Supplementary EIS (3D Environmental 2013) was used if suitable benchmark data had been collected. Where no benchmark data was available surrogate REs were utilised, supplemented with site-based observations of vegetation condition and disturbance.

These attributes provide a score out of a possible 100 and have been converted to a score out of three for inclusion in the EPBC Act Calculator. For plants and TECs, data is scored out of a maximum 80 points as factors relating to food and foraging resources are not considered.

Table 2.3. Relevant attributes from DEHP (2017) used to calculate 'Site Condition' for inclusion into the EPBC Act offset calculator. Numbers show highest possible score for each attribute.

DEHP Site Condition Attributes		DEHP Species Habitat Index Attributes	
1. Recruitment of woody perennial species in the EDL	5	2. Quality and availability of food and foraging habitat	10
2. Native species richness - trees	5	3. Quality and availability of shelter	10
3. Native species richness - shrubs	5		
4. Native species richness - grasses	5		
5. Native species richness – forbs	5		
6. Tree canopy height	5		
7. Tree canopy cover	5		
8. Shrub canopy cover	5		
9. Native perennial grass cover	5		
10. Organic litter	5		
11. Large trees	15		
12. Coarse woody debris	5		
13. Non-native plant cover	10		

Species Stocking Rates

'Species Stocking Rates' will be evaluated as a score out of 4 based on the criteria outlined in Table 2.4. In keeping with the above definitions, 'Species Stocking Rates' will be evaluated as a score out of '1' whenever evidence of an MNES is located as this work does not include density studies. However it should be noted that we believe this score to be low for Koala as the Wilkie Creek/Condamine catchment is a stronghold for the species in the southern Brigalow Belt.

Table 2.4. Score definitions for 'Species Stocking Rates'

Score	Description
0	No evidence of the species being present at the site (i.e. historical records are not a consideration)
1	Evidence of species at the site during surveys conducted for the purpose of the EPBC environmental assessment (note species density will be required to demonstrate attainment of score = 2)
2	There is a statistically significant increase in species density relative to the species density determined for a score of 1 or species density is equal to or greater than the species density at a reference site (not required to be an important population)
3	Equivalent to the species density at a reference site associated with an important population
4	Equivalent to the maximum species density measured at a DoEE agreed number of reference sites associated with important populations

2.5 SURVEY TIMING, CONDITIONS AND LIMITATIONS

2.5.1 Survey Timing and Conditions

The survey was completed over of a nine-day period from the 3rd to the 11th December 2018. The surveys commenced in the south (Braemar) and moved progressively north to Miles. Spotlighting was undertaken on the nights of the 9th and 10th December. Minimum and maximum temperatures at the towns of Dalby and Miles during the survey are provided in Table 2.5. Spotlighting, which was completed shortly before or around midnight, was undertaken when ambient air temperatures were above 18°C.

Table 2.5. Daily minimum and maximum temperatures during the survey

	03/12	04/12	05/12	06/12	07/12	08/12	09/12	10/12	11/12
DALBY									
Minimum	21.9	14.2	16.6	15.3	16.2	17	15	15.6	14.8
Maximum	36.4	30.6	31.7	29.2	28.9	27.9	28.8	32.5	33.4
MILES									
Minimum	23.1	16.1	16.7	17.4	17.1	16.8	17.6	16.4	19.3
Maximum	35.6	30.5	32.8	31.9	31.3	31.6	29.6	33.6	35.4

Source: BOM

Rainfall in the weeks preceding the survey was below average in all months except October (Figure 2.3). No rain fell during the survey. Smaller pools were present in deeper waterholes and dams throughout the assessment area, though in general surface water was scattered.

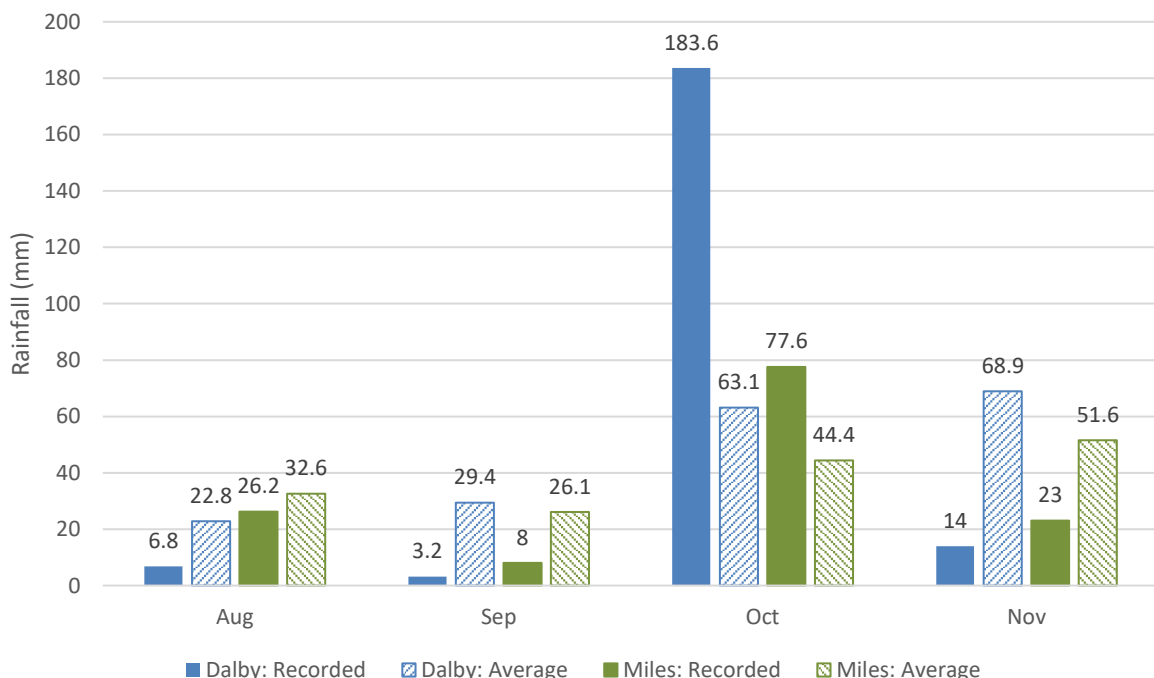


Figure 2.3. Rainfall at Miles and Dalby in the months preceding the survey

2.5.2 Survey and Assessment Limitations

The following limitations of this work are noted:

- Some areas of vegetation/habitat (~25% of the total assessment area) along the pipeline easements were not assessed due to landholder constraints (Figure 2.4). Where possible the vegetation was inspected from a distance (i.e., from adjacent property boundaries or roads) and aerial photography allowed RE type to be estimated based on vegetation patterns from nearby properties. No unique vegetation communities are likely on un-surveyed properties. Extrapolation of similar vegetation/habitat on adjacent properties is therefore sufficient for this assessment.
- The survey estimated habitat value for fauna without trapping and therefore without meeting individual fauna species survey guideline requirements. As such the survey is not considered sufficient to determine/comment on species presence/absence, unless the habitat is deemed unsuitable. The report therefore provides an assessment of the likelihood of a species occurring in the proposed pipeline easements based on habitat conditions.
- Site Context, Site Condition and Species Stocking Rate have been calculated for each BioCondition site and represents a Habitat Quality score for the sampled polygon. Due to structural and conditional variation within each RE (i.e., Site Condition) and considerable variation in spatial context (Site Context), these scores may not represent an overall 'Habitat Quality' score for the target species throughout the study area.
- Targeted survey for Kogan Wax Flower was not undertaken and records are incidental where the species was present at an assessed BioCondition or quaternary survey site.

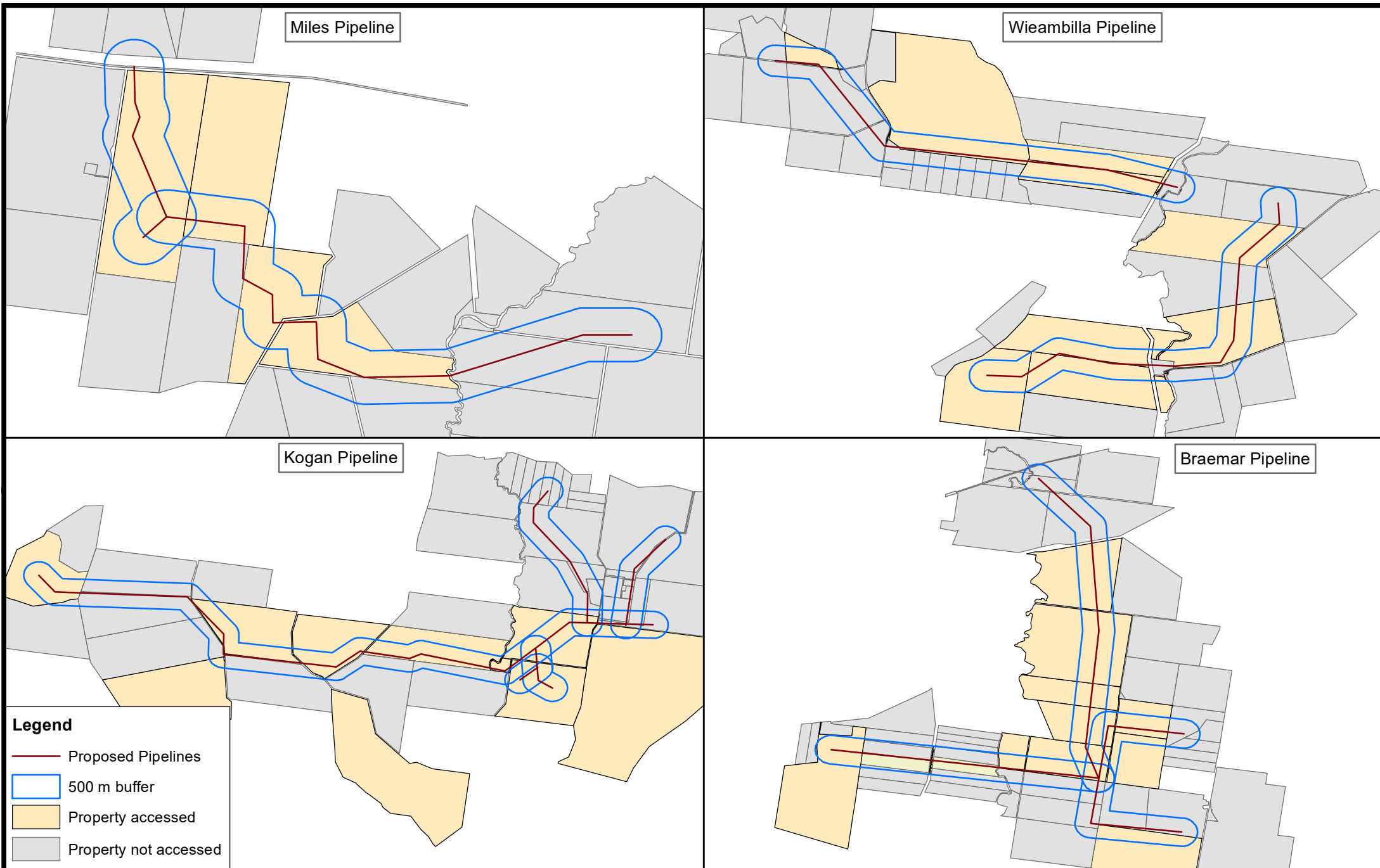
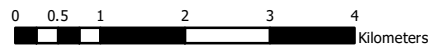


Figure 2.4
Property access



Client: Arrow Energy
Project: Off-tenure Terrestrial Ecological Survey



3.0 ASSESSMENT RESULTS

3.1 REGIONAL ECOSYSTEMS (VEGETATION COMMUNITIES)

Field surveys recognised 15 different RE's within the pipeline easement survey area. It is noted that the survey area for each pipeline easement is considerably larger (i.e. 500m wide) than the proposed Right of Way (e.g. average of 30m wide). Table 3.1 details their status and extent, and a vegetation map is provided in Figure 3.1. In total 9,374.9 ha of remnant vegetation was mapped including 74.4 ha of 'Endangered' and 3.3 ha of 'Of Concern' vegetation under the VM Act. Further information on Threatened Ecological Communities (TEC's) is provided in Section 3.4.1.

Table 3.1. Regional Ecosystem extent within assessment areas.

RE	Description	Status			Extent in Survey Area (ha)
		EPBC Act*	VM Act	Bio.	
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	End	End	End	21.0
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains.	-	OC	OC	3.3
11.3.14	<i>Eucalyptus</i> spp., <i>Angophora</i> spp., <i>Callitris</i> spp. woodland on alluvial plains	-	LC	NCAP	17.2
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium.	-	LC	NCAP	56.7
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.	-	LC	OC	157.9
11.3.27i	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer.		LC	OC	61.5
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	End	End	End	53.4
11.5.1	11.5.1: <i>Eucalyptus crebra</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains/remnant surfaces	-	LC	NCAP	596.5
	11.5.1a: <i>Eucalyptus populnea</i> woodland with <i>Allocasuarina luehmannii</i> low tree layer.	-			155.1
11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces		LC	NCAP	297.5
11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> / <i>E. pilligaensis</i> ± <i>E. crebra</i> woodland on Cainozoic sand plains.	-	LC	NCAP	320.3
11.7.2	<i>Acacia</i> spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	-	LC	NCAP	3.6
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> on Cainozoic lateritic duricrust.	-	LC	NCAP	612.8
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks.		LC	NCAP	30.4

RE	Description	Status			Extent in Survey Area (ha)
		EPBC Act*	VM Act	Bio.	
11.7.6	<i>Corymbia citriodora</i> or <i>Eucalyptus crebra</i> woodland on Cainozoic lateritic duricrust.	-	LC	NCAP	387.6
11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubila</i> ± <i>Corymbia</i> spp. ± <i>Eucalyptus</i> spp. on Cainozoic lateritic duricrust.	-	LC	NCAP	408.4

E = Endangered, OC = Of Concern, LC = Least Concern, NCAP = No Concern at Present

*Listed as an Endangered Threatened Ecological Community (TEC) under the EPBC Act.

3.2 FLORA

Although a dedicated floristic survey was not necessary or undertaken for this work, a total of 209 flora species were recorded during the survey including 26 exotic species. One threatened species was recorded, the Kogan Wax Flower (*Philotheca sporadica*) listed as Near Threatened under the NC Act and Vulnerable under the EPBC Act.

3.3 FAUNA

Field investigations identified 121 vertebrate fauna species within the off-tenure assessment area including three frogs, 22 reptiles, 83 birds and 13 mammals (see Appendix B).

3.4 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

3.4.1 Threatened Ecological Communities

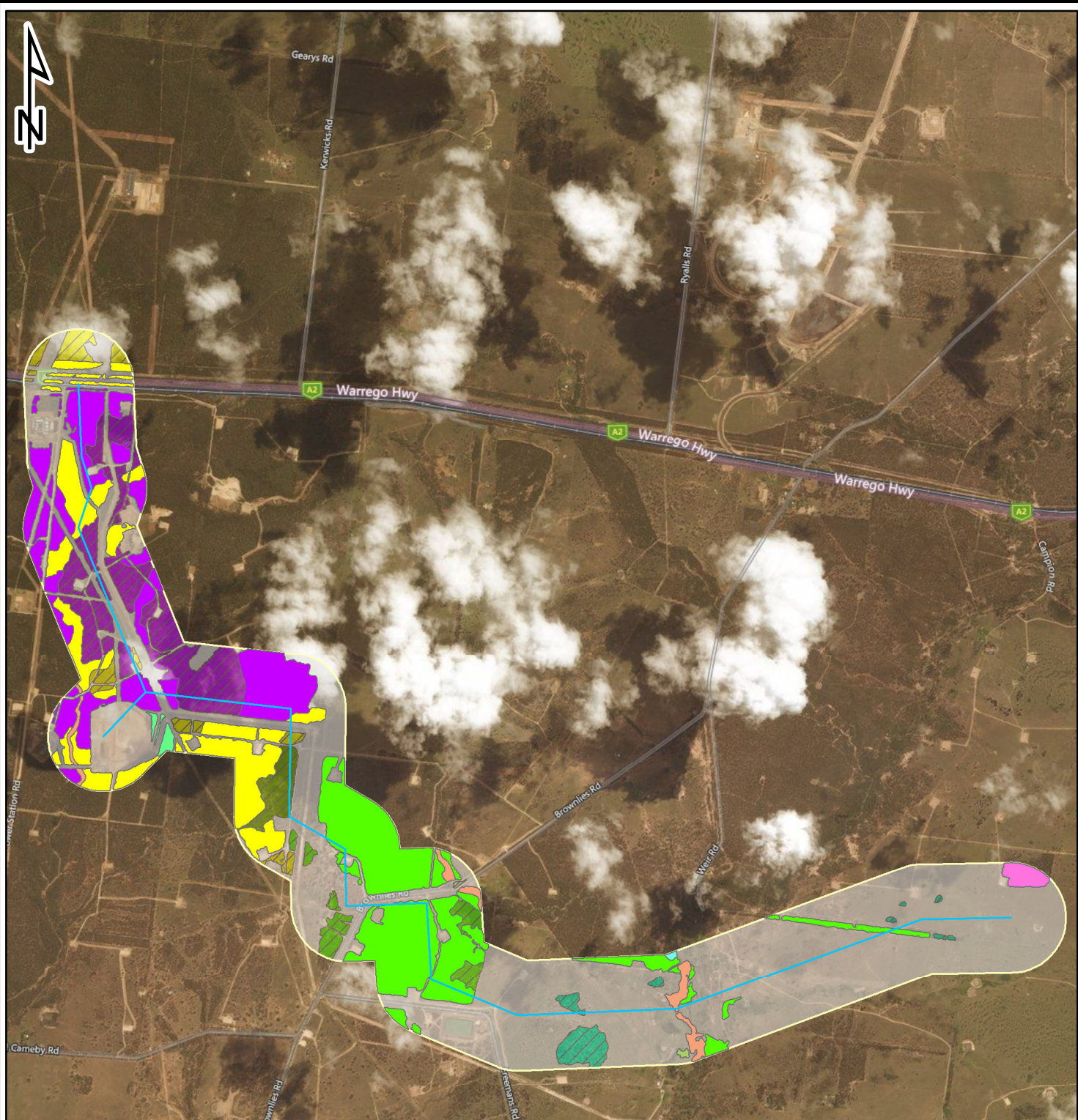
A total of 74.4 ha of the Brigalow TEC was mapped including representative areas of RE11.3.1 and 11.4.3. The location of the Brigalow TEC in the each of the pipeline corridors is provided in Figure 3.2.

3.4.1.1 Brigalow dominant and co-dominant threatened ecological community

Within the assessment area, the Brigalow Dominant and Co-dominant Ecological Community is formed by two regional ecosystems being RE11.3.1 and RE11.4.3. Mature regrowth derived from these ecosystems is also included within the TEC.

The ecosystem has been highly fragmented throughout the study area, generally existing as linear remnants within roadside reserves and easements. It is most extensive occurrences on the clay soils in the Braemar and Wieambilla pipeline sectors. Canopy heights range from 14 to 21 m in better preserved examples where projected canopy covers ranges from 30 to 60%. Whilst *Acacia harpophylla* generally forms the dominant canopy, *Casuarina cristata* also occurs. Typical sub-canopy trees include *A. harpophylla*, and *C. cristata* with shrubby layers often dominated by *Geijera parviflora*, *Pittosporum angustifolium*, *Melaleuca bracteata*, *Alectryon oleofolius* subsp. *elongatus*, *Alectryon diversifolius*, *Elaeodendron australe* var. *integrifolium*, *Ehretia membranifolium*, and *Optunia stricta*. Ground cover percentage is variable with typical species being *Paspalidium caespitosum*, *Ancistrachne uncinulata*, *Aristida* spp., *Enychleana tomentosa*, *Rhagodia spinescens*, *Einadia hastata*, and *Solanum parvifolium*, although *Harissia martinii* and *Bryophyllum delagoense* may be abundant.

The community is degraded in most occurrences as the result of extensive habitat fragmentation.



Legend

Pipeline	11.5.1	Non-remnant Veg.	11.5.1a - Regrowth
Pipeline Buffer (500m)	11.5.20	11.3.25 - Regrowth	11.7.4 - Regrowth
Regional Ecosystems	11.7.2	11.4.3 - Regrowth	11.7.7 - Regrowth
11.3.25	11.7.4	11.5.1 - Regrowth	Cleared Area
11.3.27i	11.7.7		
11.4.3			

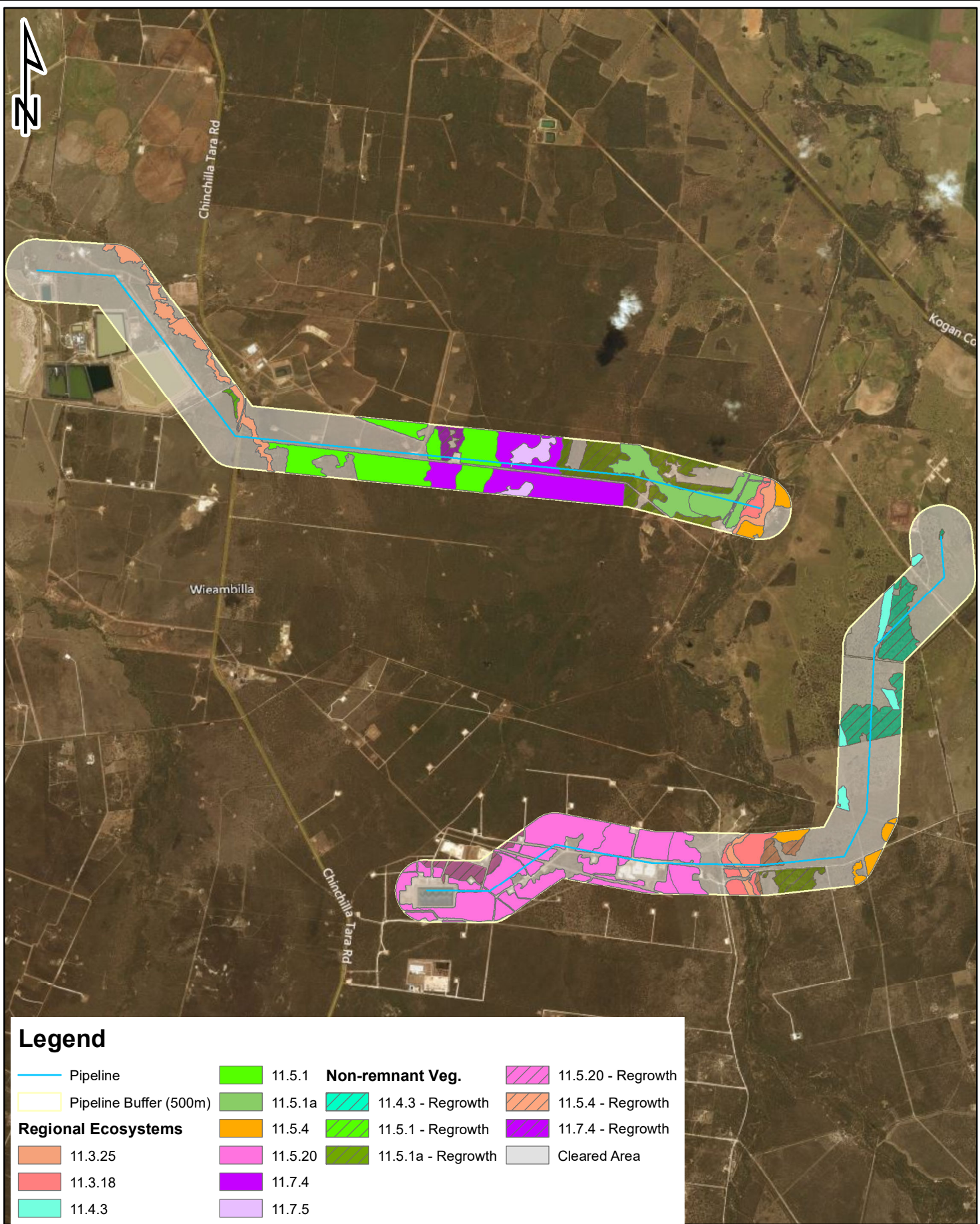
Figure 3.1a. Regional Ecosystems in the Miles survey area

Client			
ARROW ENERGY			
Scale	1:50,000	Drawn By	DG
Date	29-Jan-19		A4

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Legend

- Pipeline
- Pipeline Buffer (500m)
- Regional Ecosystems**
- 11.3.25
- 11.3.18
- 11.4.3
- 11.5.1
- 11.5.1a
- 11.5.4
- 11.5.20
- 11.7.4
- 11.7.5
- Non-remnant Veg.**
- 11.4.3 - Regrowth
- 11.5.1 - Regrowth
- 11.5.1a - Regrowth
- 11.5.20 - Regrowth
- 11.5.4 - Regrowth
- 11.7.4 - Regrowth
- Cleared Area

Figure 3.1b. Regional Ecosystems in the Wieambilla survey area.

Client

ARROW ENERGY



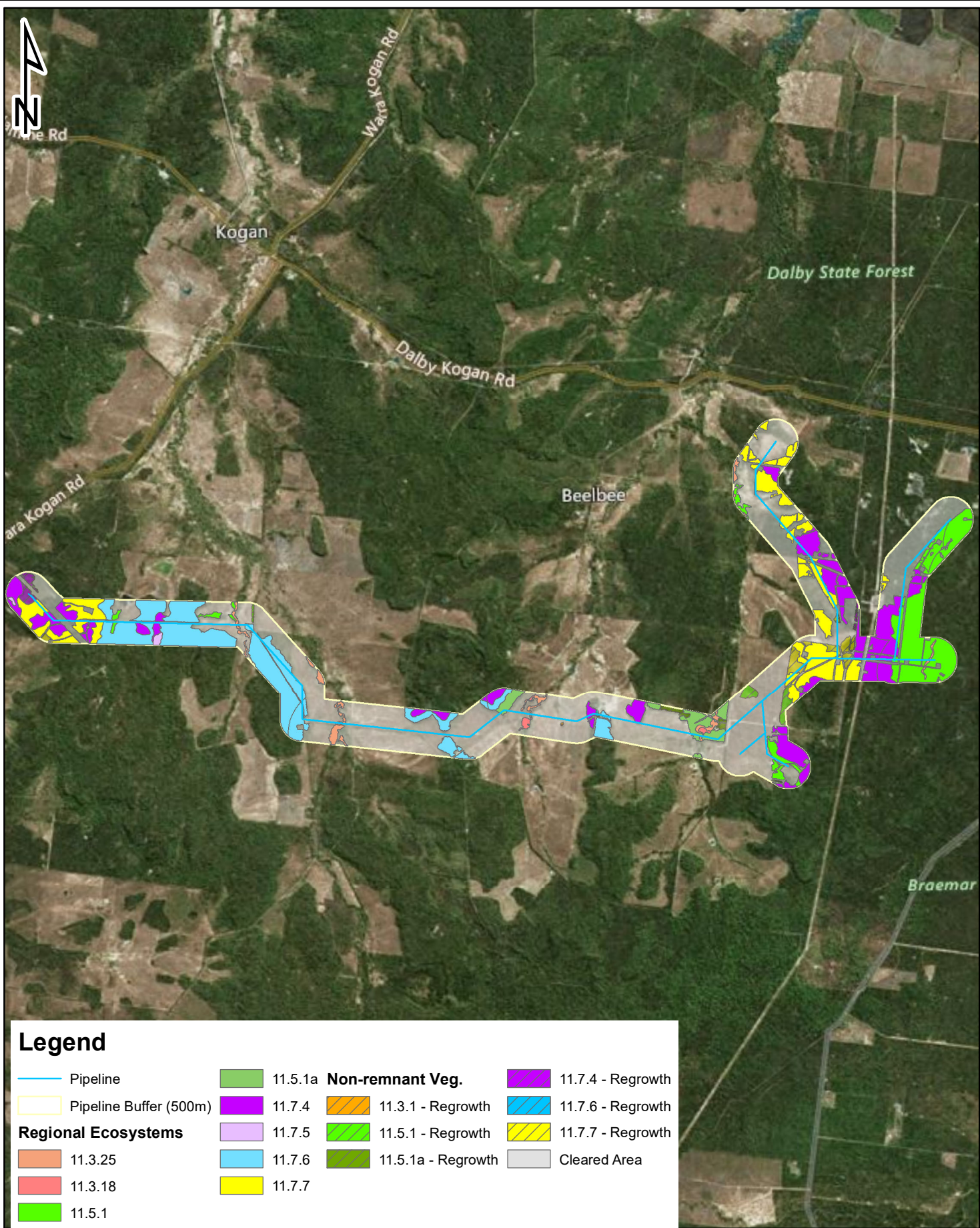
Scale 1:80,000 Drawn By DG Date 29-Jan-19 A4

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Legend

- Pipeline
- Pipeline Buffer (500m)
- Regional Ecosystems**
- 11.3.25
- 11.3.18
- 11.5.1
- 11.5.1a **Non-remnant Veg.**
- 11.7.4
- 11.7.5
- 11.7.6
- 11.7.7
- 11.3.1 - Regrowth
- 11.5.1 - Regrowth
- 11.5.1a - Regrowth
- 11.7.4 - Regrowth
- 11.7.6 - Regrowth
- 11.7.7 - Regrowth
- Cleared Area

Figure 3.1c. Regional Ecosystems in the Kogan survey area

Client
ARROW ENERGY

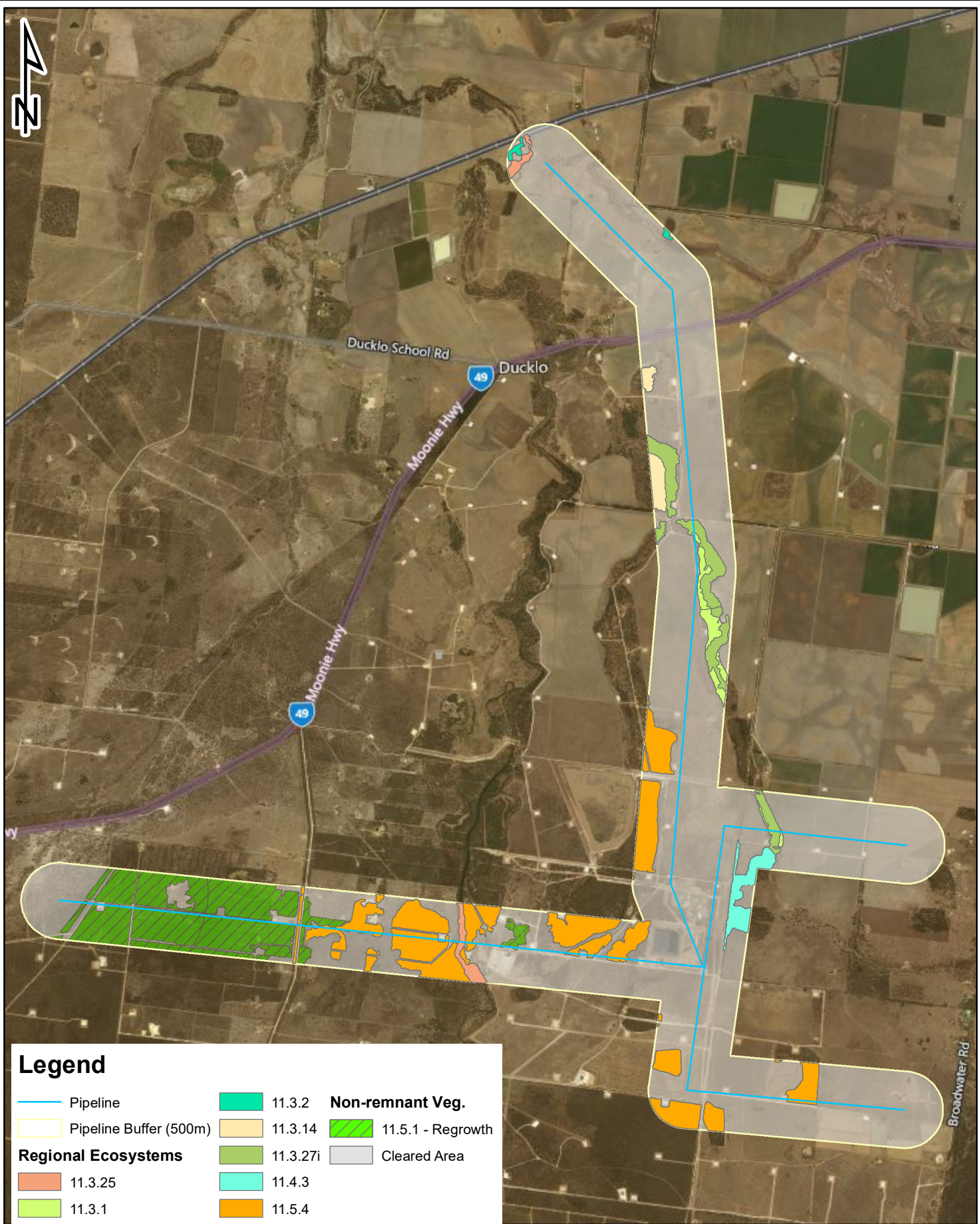
0 1.8 3.6 5.4 7.2
Kilometers

Scale 1:113,000	Drawn By DG	Date 29-Jan-19	A4
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Legend

- Pipeline
- Pipeline Buffer (500m)
- 11.3.2 **Non-remnant Veg.**
- 11.3.14 11.5.1 - Regrowth
- Regional Ecosystems**
- 11.3.27i Cleared Area
- 11.3.25 11.4.3
- 11.3.1 11.5.4

Figure 3.1d. Regional Ecosystems in the Braemar survey area

Client
ARROW ENERGY

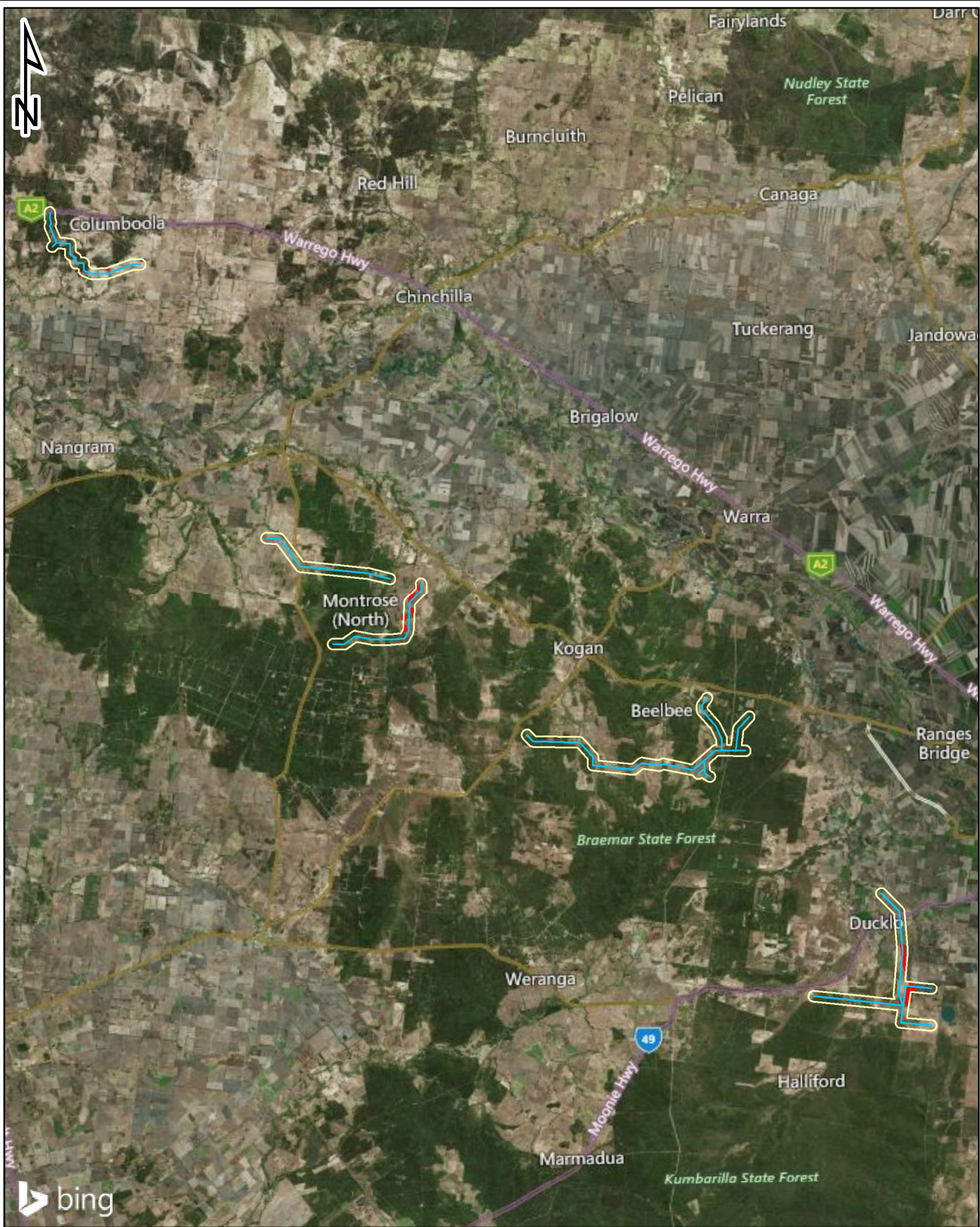
0 1 2 3 4
Kilometers

Scale 1:65,000	Drawn By DG	Date 29-Jan-19	A4
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Legend

- Pipeline
- Pipeline Buffer (500m)
- EPBC Status**
- Brigalow TEC (Endangered)

Figure 3.2. Location of the Brigalow TEC

Client			
ARROW ENERGY			
Scale	1:468,560	Drawn By	DG
Date	29-Jan-19	A4	

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The 'Habitat Score' at locations within these RE's using the DoEE suggested methodology is provided in Table 3.16.

Table 3.2. 'Habitat Quality' scores from locations within RE's which contribute to the Brigalow TEC.

REs	Extent (ha)	Site	Habitat Quality*			
			Site Context	Site Condition	Stocking Rates	Total (/10)
11.3.1	21.3	AE6	1.17	1.725	NA	2.89
11.4.3	173.7	AE01	1.5	1.96	NA	3.46
		AE45	0.65	1.89	0	2.54
		AE74	0.13	1.35	0	1.48

* See accompanying Excel database for calculations

3.4.2 MNES Flora Species

One Threatened flora species under the EPBC Act was identified during field surveys, the Kogan Wax Flower.

3.4.2.1 Kogan wax flower (*Philotheca sporadica*)

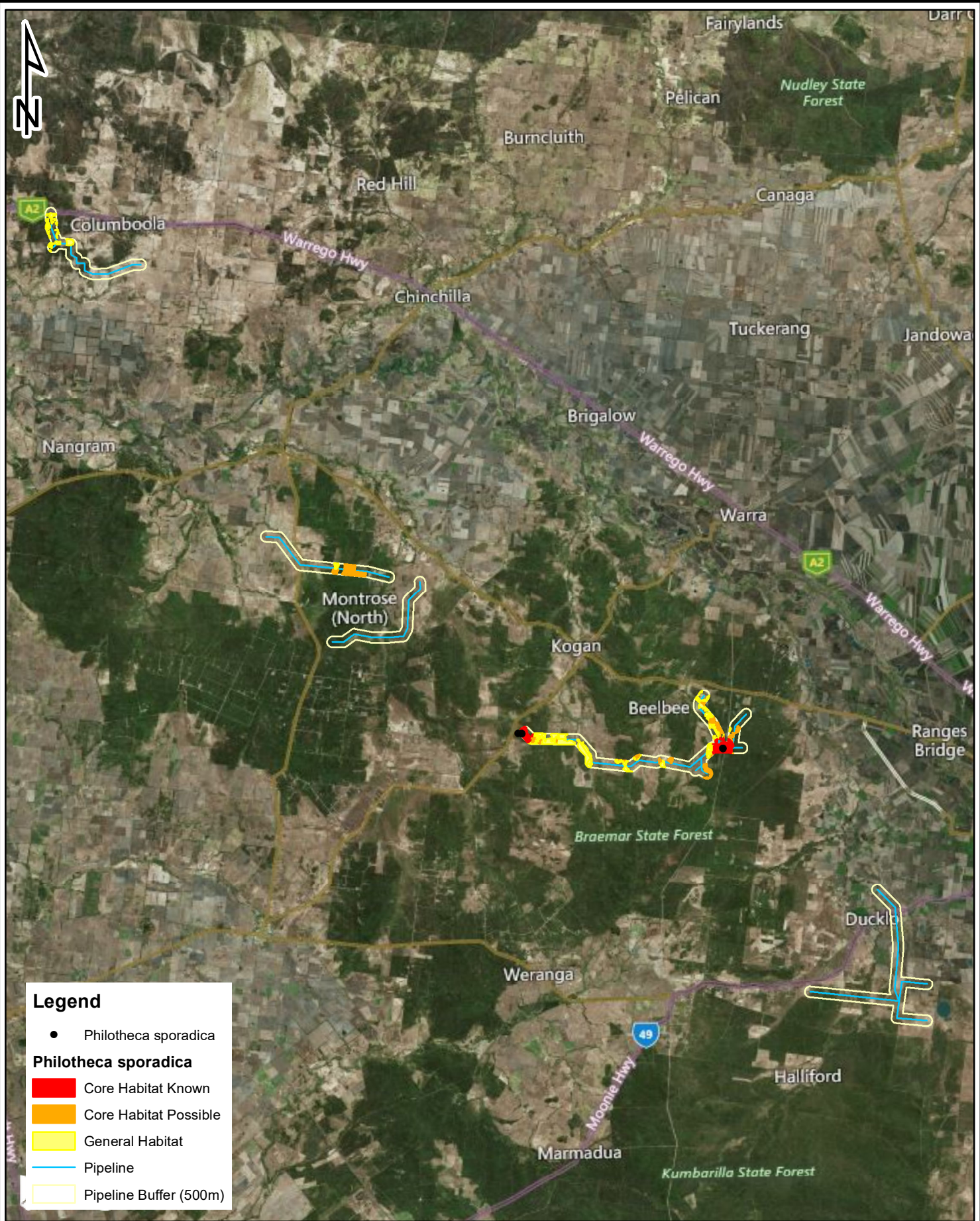
Philotheca sporadica is a Queensland and bioregional endemic known from just north of Tara, to approximately 12 km east of Kogan (TSSC 2008j). Of the 11 known populations, seven occur on road verges, seven extend onto freehold land, and one population is within Braemar State Forest (Halford 1995c in TSSC 2008j).

The majority of records are in low open forest and woodland of *Acacia burrowii*, *Eucalyptus exserta*, *Eucalyptus crebra*, *Eucalyptus fibrosa subsp. nubila* and *Callitris glaucophylla* (Halford 1995 in TSSC 2008j), and also on residual hills which are remnants of laterised Cretaceous sandstones, where the soils are shallow, uniform sandy loams to clay loams of extremely low fertility and poor condition (TSSC 2008j). Field survey indicates that the species occurs almost exclusively within RE 11.7.4 (*Eucalyptus decorticans* and/or *Eucalyptus spp.*, *Corymbia spp.*, *Acacia spp.*, *Lysicarpus angustifolius* on lateritic duricrust) and possibly RE11.7.5 with a few individual plants overlapping with RE11.7.7. The species has a tendency to form dense, locally restricted populations, particularly on scalded areas with limited soil.

Within the assessment area populations were identified at two locations (Figure 3.3), both associated with RE 11.7.4 and 11.7.5. Using the mapping rules provided in Appendix C, a total of 408.6 ha of 'Core Habitat Known' is mapped within the off-tenure assessment areas along with 550.9 ha of 'Core Habitat Possible', and 1,001.9 ha of General Habitat'.

The 'Habitat Scores' from locations within areas of 'Core Habitat Known' or 'Core Habitat Possible' using the DoEE suggested methodology is provided in Table 3.2. It is noted that a BioCondition assessment was not undertaken for RE11.7.5 due to the limited extent of this habitat. A maximum site condition score is assumed for this habitat. In regard to assessment of species stocking rates, Biocondition Site AE41 had a species density of 120 stems / ha, a relatively low density, equivalent to a Stocking Rate score of 2. Patches were observed within the area however which would have possessed maximum stem densities recorded for the species in other survey (>1500 stems / ha). Hence a Species Stocking Rate of 4 was applied as a conservative measure although this would not be consistent across the entire area mapped as Core Habitat Known.

C:\Users\Owner\Documents\Clients\3D Environmental\Arrow_Aug_2016\Arrow_Dec_18\3d_Arrow_A4P_Jan_19.mxd



Legend

- *Philotheca sporadica*

Philotheca sporadica

- Core Habitat Known
- Core Habitat Possible
- General Habitat
- Pipeline
- Pipeline Buffer (500m)

Figure 3.3. The location of Kogan Wax Flower records and habitat.

Client			
ARROW ENERGY			
Scale	1:468,560	Drawn By	DG
Date	06-Feb-19	A4	

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Table 3.3. 'Habitat Quality' scores from locations within RE's which contribute to Kogan Wax Flower 'Core Habitat Known' or 'Core Habitat Possible'.

RE	Extent (ha)	Site	Habitat Quality*			
			Site Context	Site Condition	Stocking Rates	Total (/10)
11.7.4	752.1	AE22	1.82	2.34	0	4.16
		AE41	2.41	2.30	4	8.71
		AE47	2.08	1.83	0	3.91
		AE50	1.63	2.03	0	3.66
		AE66	1.56	2.19	0	3.75
		AE70	1.56	1.98	0	3.54
11.7.5		Not Assessed				
11.7.6	388.6	AE28	1.43	2.03	0	3.46
		AE36	0.52	1.93	0	2.45
11.7.7	470.3	AE21	1.71	1.79	0	3.50
		AE38	2.20	2.18	0	4.38
		AE62	1.36	2.44	0	3.80
		AE69	1.50	2.43	0	3.93

* See accompanying excel database for calculations

3.4.3 MNES Fauna Species

Surveys did identify two Vulnerable fauna species, Painted Honeyeater (*Grantiella picta*) and Koala (*Phascolarctos cinereus*). Figure 3.4 shows the location of records.

MNES which are the subject of the DoEE further information request and the Painted Honeyeater are discussed below and habitat mapping has been included within the associated GIS dataset.

3.4.3.1 Murray Cod (*Maccullochella peelii*)

The Murray Cod is distributed throughout the Murray Darling Basin, including the Condamine River Catchment. It inhabits main channels of rivers and larger tributaries. They may move into floodplain channels and anabranches during inundation, though the use of these habitats seem limited. It has a strong association with waters that have structurally woody habitat (submerged logs and debris), deeper pools (>2.4 m) and are slow flowing (<0.2 m s⁻¹). Murray Cod reach sexual maturity between four and six years of age. They therefore require permanent waters in order to complete their life-cycle.

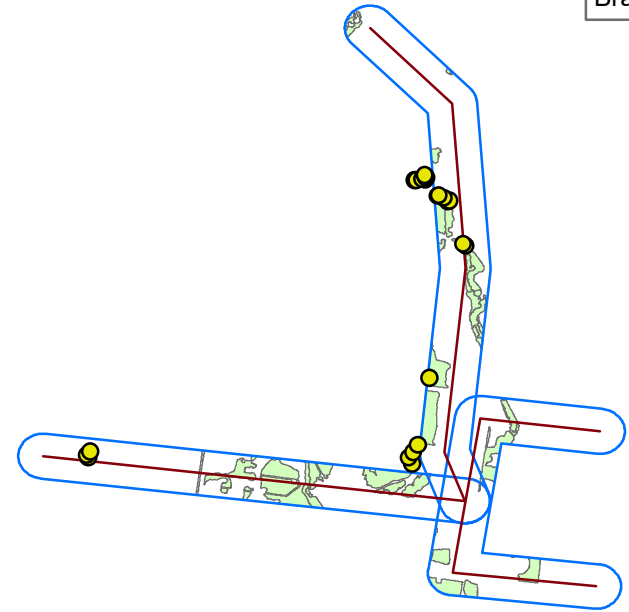
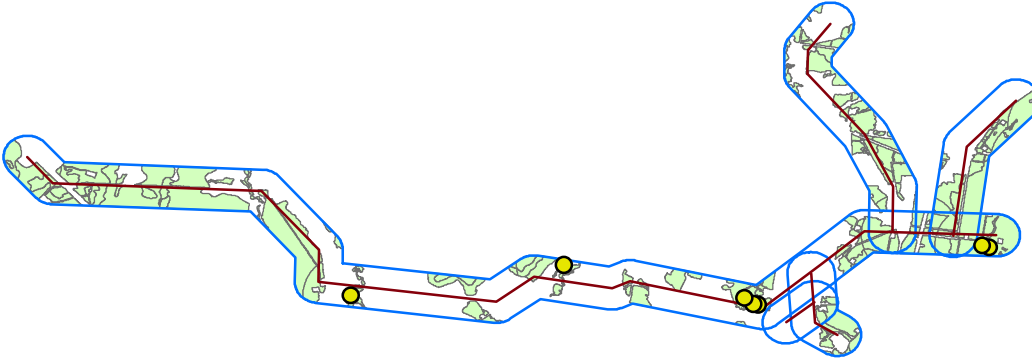
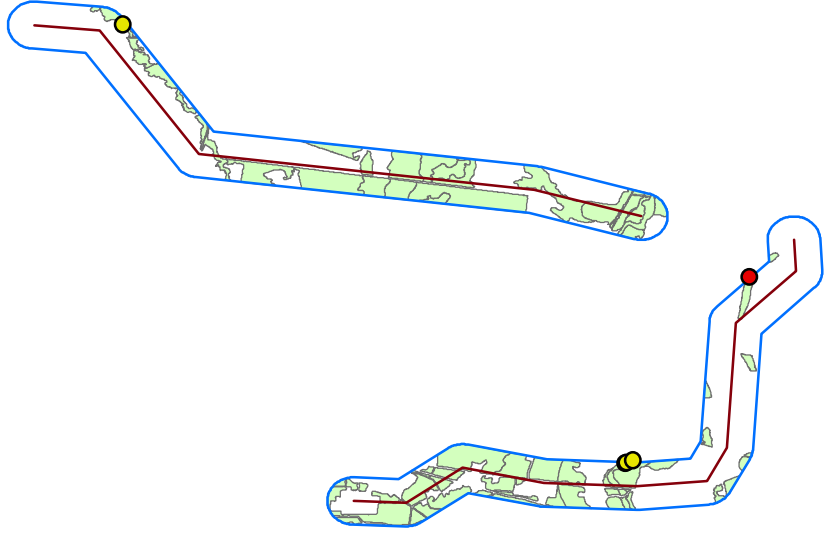
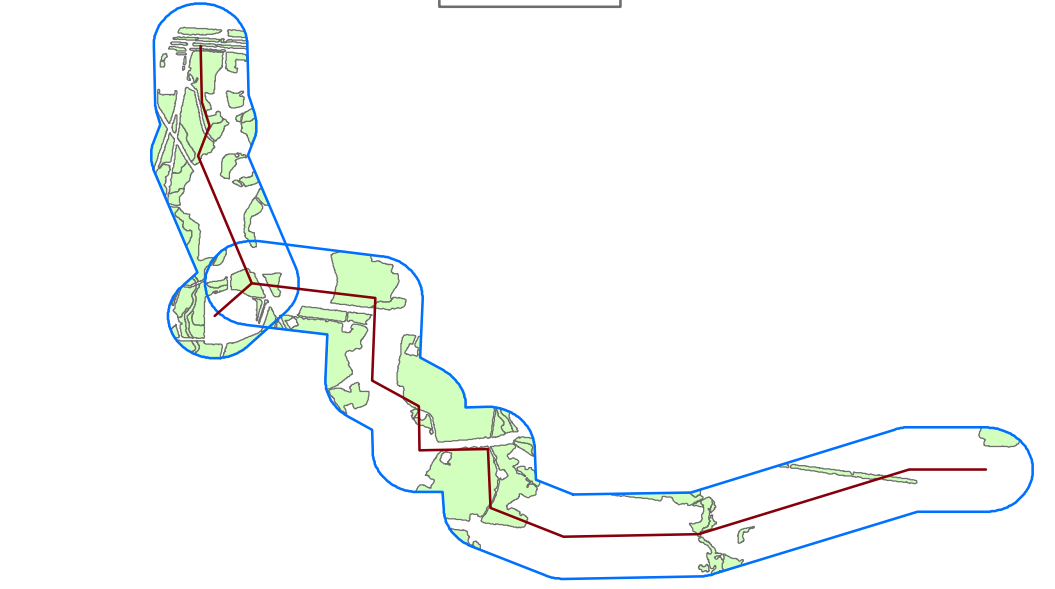
All river/riparian habitats within the off-tenure assessment area are minor tributaries. None contain permanent water with most pools likely to dry during an average rainfall year. Further, these channels are typically shallow and do not have abundant submerged timber/debris. No suitable habitat for the Murray Cod occurs within the assessment areas.

Miles Pipeline

Wieambilla Pipeline

Kogan Pipeline

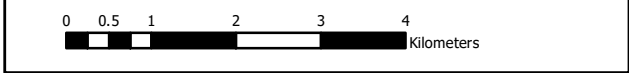
Braemar Pipeline



Legend

- Painted Honeyeater
- Koala
- Proposed Pipelines
- 500 m buffer
- Remnant vegetation

Figure 3.4
The location of MNES Fauna identified during the field survey



Client: Arrow Energy
Project: Off-tenure Terrestrial Ecological Survey



3.4.3.2 Yakka Skink (*Egernia rugosa*)

Records of Yakka Skink are scattered from Mungkan Kandju National Park (NP) on Cape York Peninsula to near St George and Billa Billa in southern QLD. They are coastal around Bundaberg and extend inland to near Charleville. Most records are centred on the Brigalow Belt between St George and Emerald, Chinchilla and Charleville. The off-tenure assessment areas are within the species distribution, but are located near its eastern extent. Few records are located south and east of Chinchilla and the species is regularly absent from seemingly suitable habitat.

The species inhabits a variety of vegetation communities including Brigalow (*Acacia harpophylla*), Mulga (*A. aneura*), Bendee (*A. catenulata*), Lancewood (*A. shirleyi*), Belah (*Casuarina cristata*), Poplar Box (*E. populnea*), Ironbarks and White Cypress Pine (*Callitris glaucophylla*). It may utilise landzones 3, 4, 5, 7, 9 and 10, but typically avoids locations that may be inundated or flooded. Small colonies inhabit burrow systems under partially buried rocks, logs and tree-stumps. Both used and abandoned rabbit warrens may also be utilised. Soil structure suitable for maintaining burrow integrity is important.

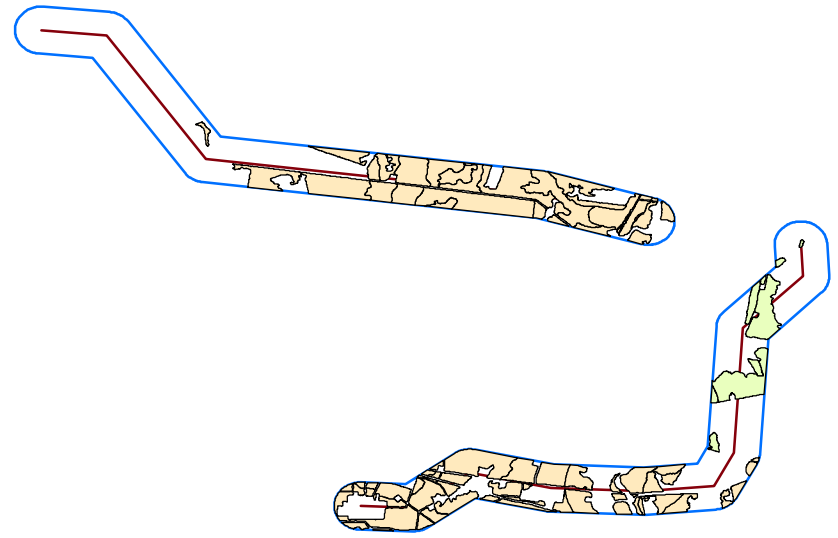
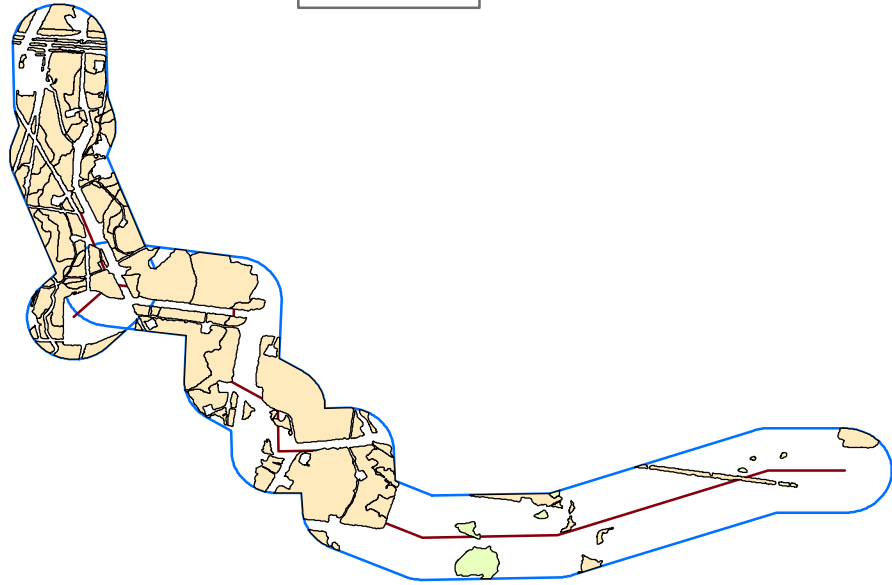
Based on the species poor representation within or near to Arrow tenements, this species has been previously considered 'unlikely' to occur and has not been the subject of habitat mapping. New rules have been generated for this species, with the resulting habitat mapping considered to have low accuracy (see Appendix C).

In total 4,567.3 ha of Yakka Skink 'Core Habitat Possible' is mapped within the off-tenure assessment areas; a further 173.7 ha of 'General Habitat' is also mapped (Figure 3.6). No 'Core Habitat Known' occurs within the assessment areas.

Table 3.6 provides an overview of the habitat characteristics in each RE assessed as Yakka Skink 'Core Habitat Possible'. The 'Habitat Score' for specific locations within these RE's using the DoEE suggested methodology is provided in Table 3.7. Raw calculations of these scores can be sourced from the accompanying Excel database.

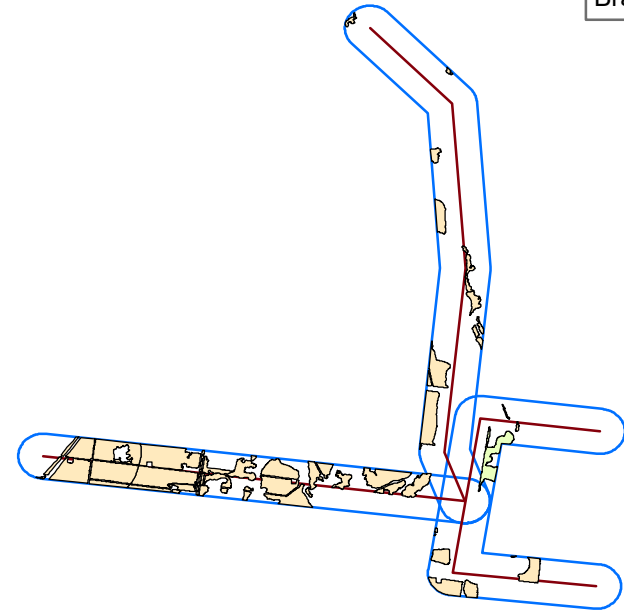
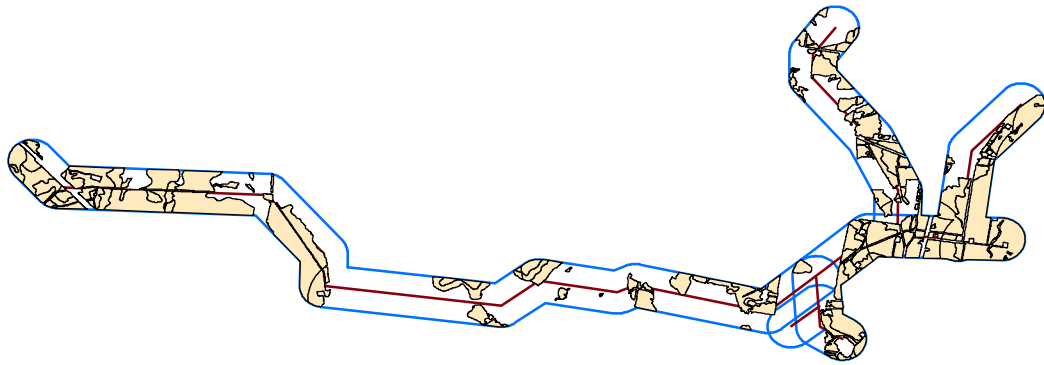
Miles Pipeline

Wieambilla Pipeline



Kogan Pipeline

Braemar Pipeline

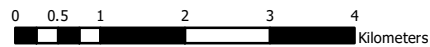


Legend

- Proposed Pipelines
- 500 m buffer
- Yakka Skink records
- Core Habitat Possible
- General Habitat

Figure 3.5

Yakka Skink records and habitat within the off-tenure assessment areas



Client: Arrow Energy
Project: Off-tenure Terrestrial Ecological Survey



Table 3.4. Habitat characteristics from RE's which contribute to Yakka Skink 'Core Habitat Known'

RE	Vegetation composition and structure	Available microhabitat features (shelter resources)	Possible habitat use
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Limited, some potential in uninspected areas that might have large logpiles, but none observed during surveys. The dark clay soils expand and compromising warren stability.	Shelter, breeding, possibly dispersal subject to spatial context
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Limited, some potential in uninspected areas for log piles and/or tunnel erosion, but none observed during surveys.	Shelter, breeding, possibly dispersal subject to spatial context
11.3.14	<i>Eucalyptus spp.</i> , <i>Angophora spp.</i> , <i>Callitris spp.</i> woodland on alluvial plains	Limited, no obvious log piles or tunnel erosion found in the two areas of 11.3.14 during surveys.	Shelter, breeding, possibly dispersal subject to spatial context
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	Limited, no obvious logs piles or tunnel erosion in inspected areas, low probability of these occur in uninspected areas. These habitats had loose sandy soils compromising warren/burrow stability.	Shelter, breeding, possibly dispersal subject to spatial context
11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	Scattered and uncommon, isolated larger fallen trees, only a few with hollows were observed during the survey; no partially buried log piles located. Some possibility in uninspected areas of larger log piles or hollow logs.	Shelter, breeding, and dispersal
11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	Scattered and uncommon, isolated larger fallen trees, only a few with hollows were observed during the survey; no partially buried log piles located. Some possibility in uninspected areas of larger log piles or hollow logs.	Shelter, breeding, and dispersal
11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	Scattered and uncommon, isolated larger fallen trees, only a few with hollows were observed during the survey; no partially buried log piles; one larger treefall with hollows represented the best possible Yakka Skink microhabitat observed anywhere during the survey but no evidence (latrines) was located despite careful inspection. Some possibility in uninspected areas of larger log piles or hollow logs.	Shelter, breeding, and dispersal
11.7.2	<i>Acacia spp.</i> woodland on Cainozoic lateritic duricrust. Scarp retreat zone	While soil structure is suitable for burrow stability, large piles of buried fallen timber was absent, most fallen timber lacked hollows and had a small diameter (typically <25 cm)	Shelter, breeding, possibly dispersal subject to spatial context
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus spp.</i> , <i>Corymbia spp.</i> , <i>Acacia spp.</i> , <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	Soil structure generally suitable for burrow stability; large fallen trees with hollows most abundant in this RE (and RE11.7.6), but still scattered; no observed partially buried log-piles. Potential for suitable microhabitats in uninspected areas	Shelter, breeding, and dispersal

RE	Vegetation composition and structure	Available microhabitat features (shelter resources)	Possible habitat use
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	Shallow soils prevent burrow creation in many locations, most likely where anthropogenic disturbance has created partially buried log piles, but no such disturbance identified during surveys.	Shelter, breeding, possibly dispersal subject to spatial context
11.7.6	<i>Corymbia citriodora</i> or <i>Eucalyptus crebra</i> woodland on Cainozoic lateritic duricrust	Soil structure generally suitable for burrow stability; large fallen trees with hollows most abundant in this RE (and RE11.7.4), but still scattered; no observed partially buried log-piles. Potential for suitable microhabitats in uninspected areas	Shelter, breeding, and dispersal
11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. woodland on Cainozoic lateritic duricrust	Soil structure generally suitable for burrow stability; large fallen trees with hollows scattered; no observed partially buried log-piles. Many areas historically logged, removing larger trees which might create large treefalls/log piles. Potential for suitable microhabitats in uninspected areas	Shelter, breeding, and dispersal

Table 3.5. 'Habitat Quality' scores from locations within RE's which contribute to Yakka Skink 'Core Habitat Possible'. The provided extent includes advanced regrowth areas.

RE	Extent (ha)	Site	Habitat Quality*			
			Site Context	Site Condition	Stocking Rates	Total (/10)
11.3.1	31.3	AE6	1.29	1.71	0	3
11.3.14	17.2	AE17	1.45	1.98	0	3.43
11.3.18	56.7	AE26	1.66	2.34	0	4
		AE32	0.96	1.72	0	2.68
		AE42	2.14	1.77	0	3.91
11.5.1	1,216.2	AE19	1.13	0.8	0	1.93
		AE20	1.82	1.79	0	3.61
		AE24	1.82	1.7	0	3.52
		AE46	2.3	1.74	0	4.04
		AE49	1.77	1.31	0	3.08
		AE73	1.71	1.95	0	3.66
11.5.4	316.1	AE02	1.13	2.1	0	3.23
		AE03	1.88	2.09	0	3.97
		AE10	1.18	2.04	0	3.22
		AE11	1.18	2.22	0	3.4
		AE12	1.55	2.09	0	3.64
		AE55	1.45	2.07	0	3.52
11.5.20	349.3	AE58	2.46	2.31	0	4.77
		AE59	2.46	1.97	0	4.43
		AE60	2.36	1.94	0	4.3
11.7.4	752.1	AE22	2.14	2.33	0	4.47
		AE41	2.3	2.45	0	4.75
		AE47	2.36	2.07	0	4.43
		AE50	2.46	2.22	0	4.68
		AE66	2.09	2.21	0	4.3
		AE70	1.88	2.19	0	4.07
11.7.6	388.6	AE28	1.82	2.22	0	4.04
		AE36	1.23	1.97	0	3.2

RE	Extent (ha)	Site	Habitat Quality*			
			Site Context	Site Condition	Stocking Rates	Total (/10)
11.7.7	470.3	AE21	1.66	1.79	0	3.45
		AE38	2.25	2.09	0	4.34
		AE62	1.98	2.55	0	4.53
		AE69	1.93	2.4	0	4.33

* See accompanying Excel database for calculations

3.4.3.3 Dunmall's Snake (*Furina dunmalli*)

Dunmall's Snake (*Furina dunmalli*) is confined to the Brigalow Belt bioregion of south-eastern Queensland and north-eastern New South Wales, occurring north to Clermont and near Rockhampton. Most records are from the Dalby-Tara area of the Darling Downs (Hobson 2012a). The assessment areas are entirely contained within the species distribution.

The Dunmall's Snake has been recorded from a wide range of habitats, including forests and woodlands dominated by brigalow (*Acacia harpophylla*) and other acacias (*A. burowii*, *A. deanii*, *A. leiocalyx*), cypress (*Callitris* sp.) or bulloak (*Allocasuarina luehmannii*) on black alluvial cracking clay and clay loams (Covacevich *et al.* 1988; Stephenson and Schmida 2008; Brigalow Belt Reptiles Workshop 2010; Hobson 2012a). It also occurs in spotted gum (*Corymbia citriodora*) and ironbark (*Eucalyptus crebra* and *E. melanophloia*) on sandstone derived soils and there is a record from the edge of dry vine scrub (Stephenson and Schmida 2008; Brigalow Belt Reptiles Workshop 2010). However, preferred habitat appears to be brigalow growing on cracking black clay and clay loams (Cogger *et al.* 1993), with the majority of records from between 200 to 500 m elevation (Hobson 2012a). The species can, on rare occasions, inexplicably appear in sub-optimal vegetation. Advanced regrowth habitat should not be discounted, particularly when adjacent or linking areas of suitable habitat.

Dunmall's Snake has been recorded on only three occasions since 1970 within 20 km of the SGP, the most recent from 2000 (see Appendix C for details).

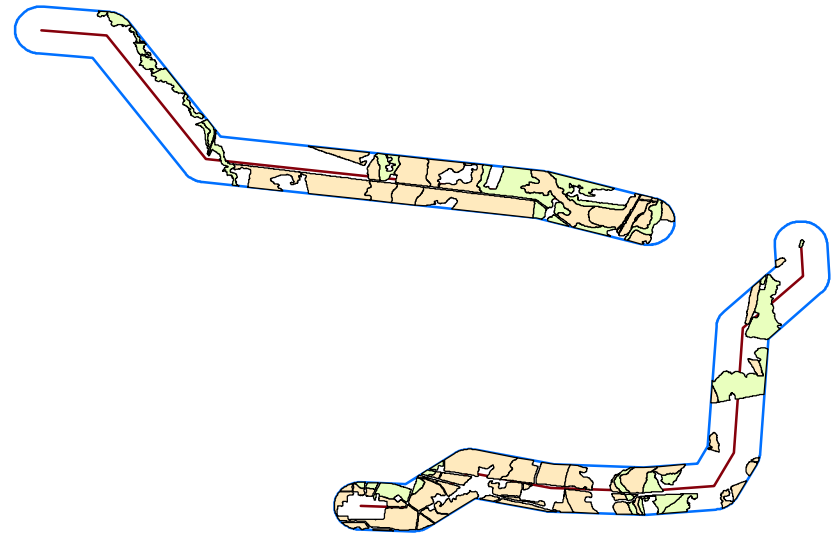
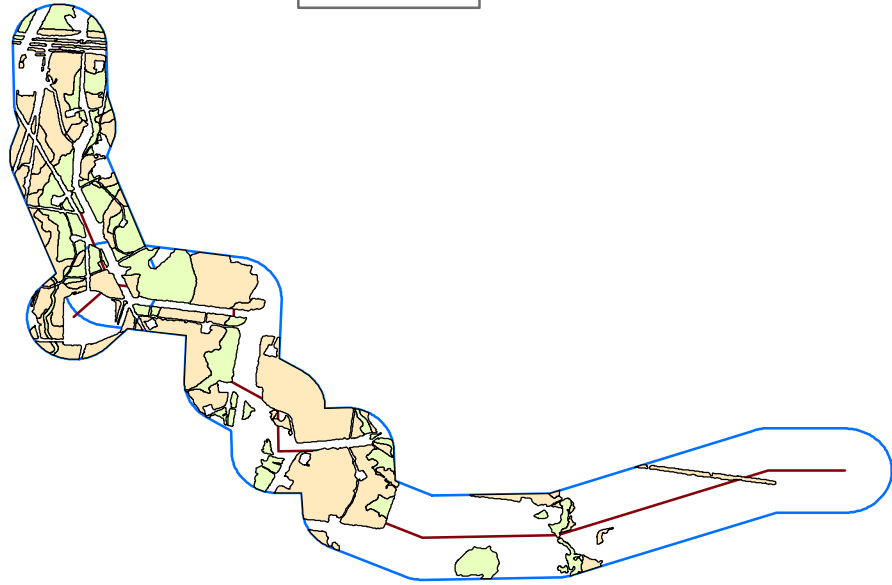
Based on experiential and documented knowledge of the species habitat requirements, mapping rules were defined to identify areas of 'core habitat' for the SGP (EcoSmart Ecology 2017). Regional Ecosystems that are recognised as potentially important and occur within the off-tenure assessment areas include RE 11.3.1, 11.3.14, 11.3.18, 11.4.3, 11.5.1, 11.5.4, 11.5.20, 11.7.2, 11.7.4, 11.7.6 and 11.7.7.

In total 3,655.3 ha of Dunmall's Snake 'Core Habitat Possible' occurs within the assessment areas; a further 1,312.4 ha of 'General Habitat' is also mapped (Figure 3.6). No 'Core Habitat Known' occurs within the assessment areas.

Table 3.6 provides an overview of the habitat characteristics in each RE assessed as Dunmall's Snake 'Core Habitat Possible'. The 'Habitat Score' for specific locations within these RE's using the DoEE suggested methodology is provided in Table 3.7. Raw calculations of these scores can be sourced from the accompanying Excel database.

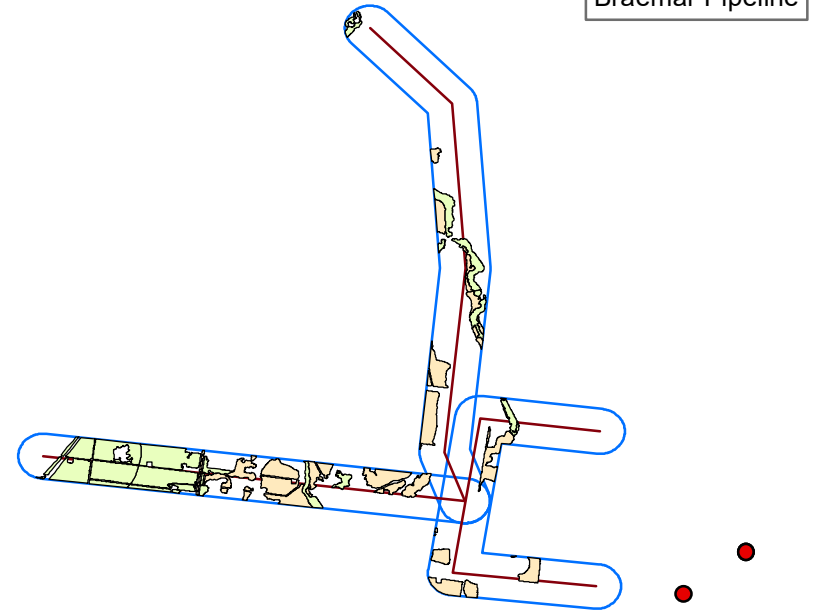
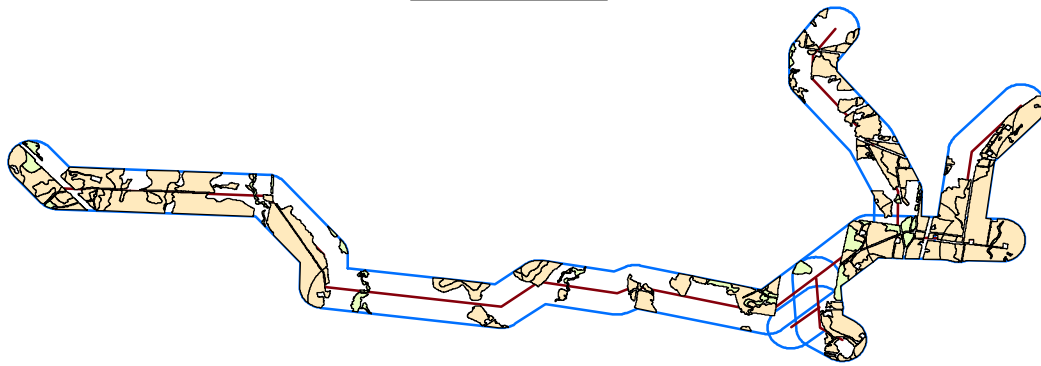
Miles Pipeline

Wieambilla Pipeline



Kogan Pipeline

Braemar Pipeline

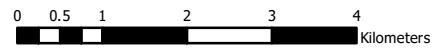


Legend

- Proposed Pipelines
- 500 m buffer
- Dunmall's Snake records
- Core Habitat Possible
- General Habitat

Figure 3.6

Dunmall's Snake records and habitat within the off-tenure assessment areas



Client: Arrow Energy
Project: Off-tenure Terrestrial Ecological Survey



Table 3.6. Habitat characteristics from RE's which contribute to Dunmall's Snake 'Core Habitat Possible'

Regional Ecosystem (RE)	Vegetation composition and structure	Available microhabitat features (shelter resources)	Foraging resource availability	Possible habitat use
11.3.1 (inc advanced regrowth)	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Deep cracking dark clays, gilgai, fallen small logs and debris (including bark strips)	Abundant small ground-dwelling lizards, limited ground-dwelling geckos	Foraging, shelter and dispersal
11.3.14	<i>Eucalyptus spp.</i> , <i>Angophora spp.</i> , <i>Callitris spp.</i> woodland on alluvial plains	Some soil cracks and fallen debris surrounded by thick grass	Low to moderate abundance of small ground-dwelling reptiles	Foraging, shelter and dispersal
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	Limited soil cracks, some larger fallen timber	Low abundance of ground-dwelling reptiles	Foraging, shelter and dispersal
11.4.3 (inc advanced regrowth)	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	Deep cracking dark clays, gilgai, abundant fallen logs and debris (including bark strips); larger logs and log piles absent or rare	Abundant small ground-dwelling lizards, limited ground-dwelling geckos	Foraging, shelter and dispersal
11.5.1 (inc advanced regrowth)	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	Moderate to abundant fallen timber and debris; limited or no larger log piles	Moderately abundant ground-dwelling skinks and geckos	Foraging, shelter and dispersal
11.5.4 (inc advanced regrowth)	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	Moderate to abundant fallen timber and debris; limited or no larger log piles	Moderately abundant ground-dwelling skinks and geckos	Foraging, shelter and dispersal
11.5.20 (inc advanced regrowth)	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	Low to moderate fallen debris, limited soil cracks	Moderate to abundant ground-dwelling reptiles	Foraging, shelter and dispersal
11.7.2	<i>Acacia</i> spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	Low, generally no fallen debris, but thick shrub cover	Moderate, some ground-dwelling reptiles likely	Foraging, shelter and dispersal

Regional Ecosystem (RE)	Vegetation composition and structure	Available microhabitat features (shelter resources)	Foraging resource availability	Possible habitat use
11.7.4 (inc advanced regrowth)	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus spp.</i> , <i>Corymbia spp.</i> , <i>Acacia spp.</i> , <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	Moderate to abundant fallen debris; open low native grasses and low small shrubs; some locations with scattered grass trees (<i>Xanthorrhoea</i>) and deep leaf litter; some larger, but isolated, larger logs	High ground-dwelling reptile abundant	Foraging, shelter and dispersal
11.7.6 (inc advanced regrowth)	<i>Corymbia citriodora</i> or <i>Eucalyptus crebra</i> woodland on Cainozoic lateritic duricrust	Abundant fallen debris including larger logs and some timber dumps; some steeper slopes with medium-sized surface rocks (rarely forming piles); rarely rocky ledges; open low native grasses and areas with deeper leaf litter	Ground-dwelling reptiles likely to be abundant	Foraging, shelter and dispersal
11.7.7 (inc advanced regrowth)	<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia spp.</i> +/- <i>Eucalyptus spp.</i> woodland on Cainozoic lateritic duricrust	High to very high density of fallen timber/debris, including larger log piles and timber dumps; open low native grasses and low shrubs	Ground-dwelling reptiles likely to be abundant	Foraging, shelter and dispersal

Table 3.7. 'Habitat Quality' scores from locations within RE's which contribute to Dunmall's Snake 'Core Habitat Possible'. Extent includes advanced regrowth.

REs	Extent (ha)	Site	Habitat Quality*			
			Site Context	Site Condition	Stocking Rates	Total (/10)
11.3.1	21.3	AE6	1.29	1.83	0	3.12
11.3.14	17.2	AE17	1.45	2.1	0	3.55
11.3.18	56.7	AE26	1.66	2.49	0	4.15
		AE32	1.12	1.74	0	2.86
		AE42	2.14	1.92	0	4.06
11.4.3	173.7	AE01	1.39	2.18	0	3.57
		AE45	0.86	2.12	0	2.98
		AE74	0.75	1.68	0	2.43
11.5.1	1,216.2	AE19	1.13	0.92	0	2.05
		AE20	1.82	1.94	0	3.76
		AE24	1.82	1.7	0	3.52
		AE46	2.3	1.89	0	4.19
		AE49	1.77	1.46	0	3.23
11.5.4	316.1	AE73	1.71	1.95	0	3.66
		AE02	1.13	2.07	0	3.2
		AE03	1.88	2.24	0	4.12
		AE10	1.18	2.19	0	3.37
		AE11	1.18	2.37	0	3.55
11.5.20	349.3	AE12	1.55	2.24	0	3.79
		AE55	1.45	2.22	0	3.67
		AE58	2.46	2.31	0	4.77
11.5.20	349.3	AE59	2.46	2.12	0	4.58
		AE60	2.36	2.09	0	4.45
11.7.2	3.6	AE68	1.82	2.43	0	4.25
11.7.4	752.1	AE22	2.14	2.48	0	4.62

REs	Extent (ha)	Site	Habitat Quality*			
			Site Context	Site Condition	Stocking Rates	Total (/10)
		AE41	2.3	2.45	0	4.75
		AE47	2.36	2.07	0	4.43
		AE50	2.46	2.22	0	4.68
		AE66	2.09	2.36	0	4.45
		AE70	1.88	2.19	0	4.07
11.7.6	388.6	AE28	1.82	2.22	0	4.04
		AE36	1.23	1.97	0	3.2
11.7.7	388.6	AE21	1.66	1.94	0	3.6
		AE38	2.25	2.24	0	4.49
		AE62	1.98	2.55	0	4.53
		AE69	1.93	2.55	0	4.48

* See accompanying Excel database for calculations

3.4.3.4 Squatter Pigeon (*Geophaps scripta scripta*)

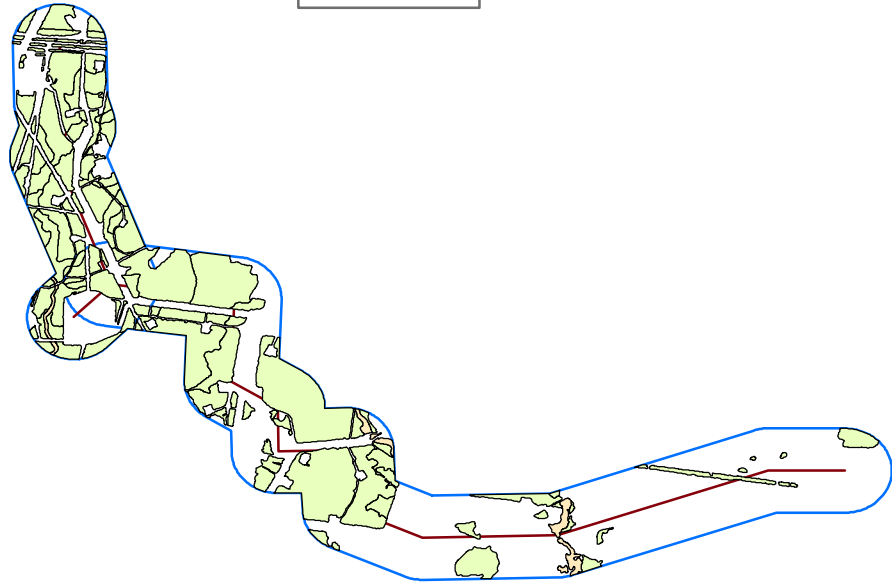
The off-tenure areas occur entirely within the distribution of the Squatter Pigeon. However Squatter Pigeons have been recorded on only six occasions within, or in proximity to (<20 km), the SGP and off-tenure areas since 2010 (see Appendix C for details). On average the species is recorded less than once a year, despite being a relatively easy species to observe and locate. There are no repeat records from the same location or general area, not even at Lake Broadwater which would probably be the best Squatter Pigeon habitat within the eastern Condamine Catchment. All Squatter Pigeons recorded from this greater area to date are suspected transient individuals and no resident or breeding populations are known to occur.

The Squatter Pigeon inhabits open-forests to sparse open woodlands that are dominated by *Eucalyptus* and in close to permanent or semi-permanent water. This includes remnant and non-remnant habitats, often including grazing lands. Sandy or gravely soils which have a sparse to patchy ground layer that rarely exceeds 33% are particularly favoured. Individual birds may also be sporadically observed in other habitats which are not suitable for breeding or foraging. This can include more heavily wooded vegetation (e.g., similar to most RE's on landzone 5 and 7 within the off-tenure assessment area), when birds are periodically observed along roadsides, tracks and other areas where there is a break in the canopy.

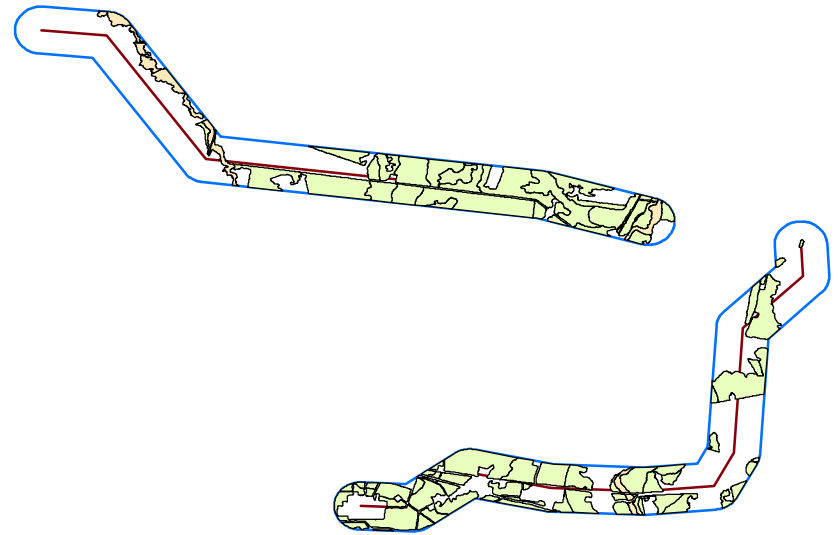
Based on the lack of frequent or repeated representation within or near to Arrow tenements, or any evidence of resident/seasonal populations within the region, previous assessments have considered Squatter Pigeons to be a 'transient' species and no detailed habitat mapping has been undertaken. To comply with DoEE requirements, new rules have been developed for this assessment. However it should be noted that the mapped habitats are unlikely to represent areas inhabited by a population that is important for the species' survival. Rather, they likely represent habitats that might be used if the species was to undergo expansion.

In total 269.3 ha of Squatter Pigeon 'Core Habitat Possible' is mapped within the off-tenure assessment areas; a further 4,741.3 ha of 'General Habitat' is also mapped (Figure 3.6). No 'Core Habitat Known' occurs within the assessment areas.

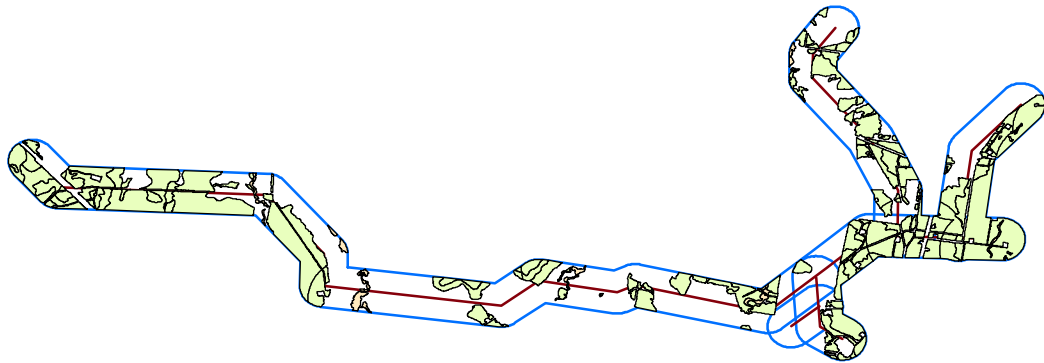
Miles Pipeline



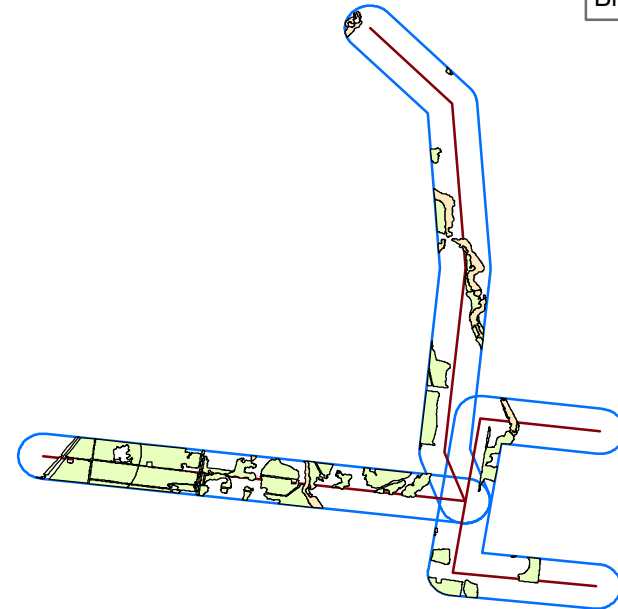
Wieambilla Pipeline



Kogan Pipeline



Braemar Pipeline

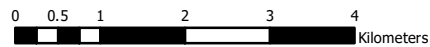


Legend

- Proposed Pipelines
- 500 m buffer
- Squatter Pigeon records
- Core Habitat Possible
- General Habitat

Figure 3.7

Painted Honeyeater records and habitat within the off-tenure assessment areas



Client: Arrow Energy
Project: Off-tenure Terrestrial Ecological Survey



Table 3.6 provides an overview of the habitat characteristics in each RE assessed as Squatter Pigeon 'Core Habitat Possible'. The 'Habitat Score' for specific locations within these RE's using the DoEE suggested methodology is provided in Table 3.7. Raw calculations of these scores can be sourced from the accompanying excel database.

Table 3.8. Habitat characteristics from RE's which contribute to Squatter Pigeon 'Core Habitat Known'

RE	Vegetation composition and structure	Available microhabitat features (water availability and ground cover)	Possible habitat use
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Only two small areas within approximately 1 and 1.5 km of permanent water. Ground cover is typically dense (~70% cover) and includes the following native species: <i>Bothriochloa decipiens</i> , <i>Heteropogon contortus</i> , <i>Cympogon refractus</i> , <i>Eriachne pallens</i> , <i>Themeda triandra</i> , <i>Cyperus javanicus</i> , <i>Cyperus gracilis</i> and <i>Microlaena stipoides</i> .	Population expansion/dispersal
11.3.25 (inc advanced regrowth)	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Many areas are likely to have seasonal/semi-permanent pools and with the exception of only a few occur within 1 km of permanent water. Ground cover is typically dense (see Table 3.7) and often includes the following native species: <i>Chrysopogon fallax</i> , <i>Juncus continus</i> , <i>Imperata cylindrica</i> , <i>Schoenoplectus littoralis</i> , <i>Aristida caput-madusae</i> , <i>Cyperus javanicus</i> , <i>Bothriochloa decipiens</i> , <i>Heteropogon contortus</i> .	
11.3.27i	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer	Many areas are likely to have seasonal/semi-permanent pools and with the exception of only a few occur within 1 km of permanent water. Ground cover is typically dense (see Table 3.7) and often includes the following native species: <i>Panicum decompositum</i> , <i>Eleocharis blakeana</i> , <i>Spermacocae sp.</i> , <i>Bothriochloa decipiens</i> .	

Table 3.9. 'Habitat Quality' scores from locations within RE's which contribute to Squatter Pigeon 'Core Habitat Possible'.

RE	Extent (ha)	Site	Ground Cover [#]		Habitat Quality [*]			
			Non-grass	Native grass	Site Context	Site Condition	Stocking Rates	Total (/10)
11.3.25	158.2	AE25	31.3	19.8	1.66	2.43	0	4.09
		AE31	13.4	17.5	1.39	2.3	0	3.69
		AE34	33.8	12.8	2.04	2.19	0	4.23
		AE44	17.2	27.5	2.3	2.19	0	4.49
		AE56	15.6	36.5	2.14	2.63	0	4.77
		AE76	22.3	10.8	1.71	2.21	0	3.92
11.3.27i	61.5	AE04	6.5	17.2	1.23	2.42	0	3.65
		AE07	22.0	13.3	1.23	2.33	0	3.56
		AE08	35.7	17.8	1.34	2.18	0	3.52
		AE14	39.5	17.8	1.61	2.16	0	3.77

[#] Percent of 1x1 m quadrat; ^{*} See accompanying Excel database for calculations

3.4.3.5 Painted Honeyeater (*Grantiella picta*)

The off-tenure assessment areas occur entirely within the distribution of the Painted Honeyeater and the species has been frequently recorded within 20 km of the SGP. However until this survey all historic records from the SGP have been restricted to the immediate vicinity of Lake Broadwater (see Appendix C for details). This survey located Painted Honeyeater at a small Brigalow fragment within the Wieambilla Assessment Area (see Figure 3.8).

Painted Honeyeaters inhabit woodlands which have abundant Mistletoe. Within the southern Brigalow belt vegetation which supports abundant Needle-leaved (*Amyema cambagei*) and Grey Mistletoe (*A. quandang*) are particularly favoured. Needle-leaved Mistletoe is typically located on *Casuarina cunninghamiana* and *Casuarina cristata*, while Grey Mistletoe is associated with larger *Acacia* species (especially *A. harpophylla*). Riparian woodlands (e.g., *E. camaldulensis* waterways) can also be utilised if mistletoe is abundant.

Using the above habitat preferences to develop mapping rules, a total 65.8 ha of Painted Honeyeater 'Core Habitat Possible' occurs within the off-tenure assessment areas, and a further 385.4 ha of 'General Habitat' (Figure 3.6). 22.7 ha of 'Core Habitat Known' is associated with the Painted Honeyeater record in the Wieambilla Area.

Table 3.6 provides an overview of the habitat characteristics in each RE assessed as Painted Honeyeater 'Core Habitat Possible'. The 'Habitat Score' for specific locations within these RE's using the DoEE suggested methodology is provided in Table 3.7. Raw calculations of these scores can be sourced from the accompanying excel database.

Table 3.10. Habitat characteristics from RE's which contribute to Painted Honeyeater 'Core Habitat Known/Possible'

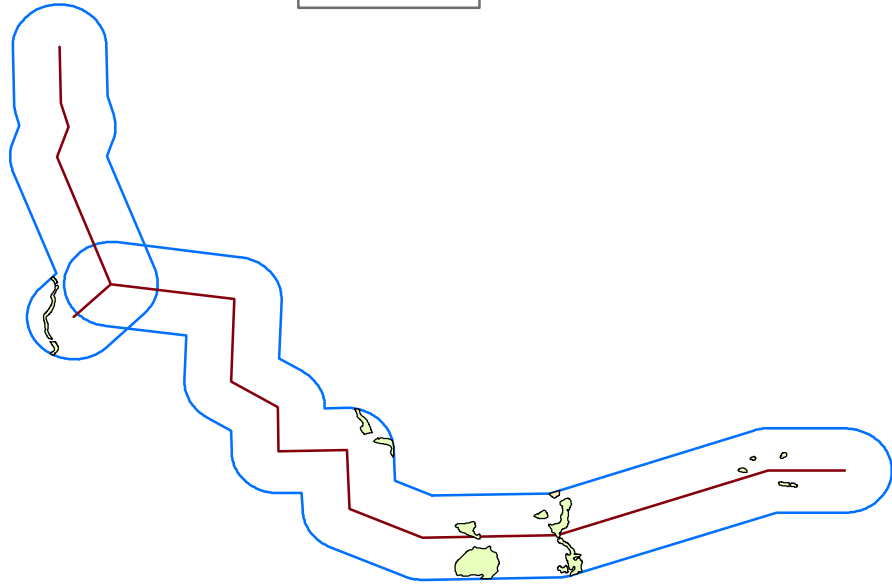
RE	Vegetation composition and structure	Available microhabitat features (water availability and ground cover)	Possible habitat use
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Mistletoe density variable, but abundant mistletoe was often noted in this RE type.	Foraging and breeding
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	Mistletoe density variable, but abundant mistletoe was often noted in this RE type.	Foraging and breeding

Table 3.11. 'Habitat Quality' scores from locations within RE's which contribute to Painted Honeyeater 'Core Habitat Possible'.

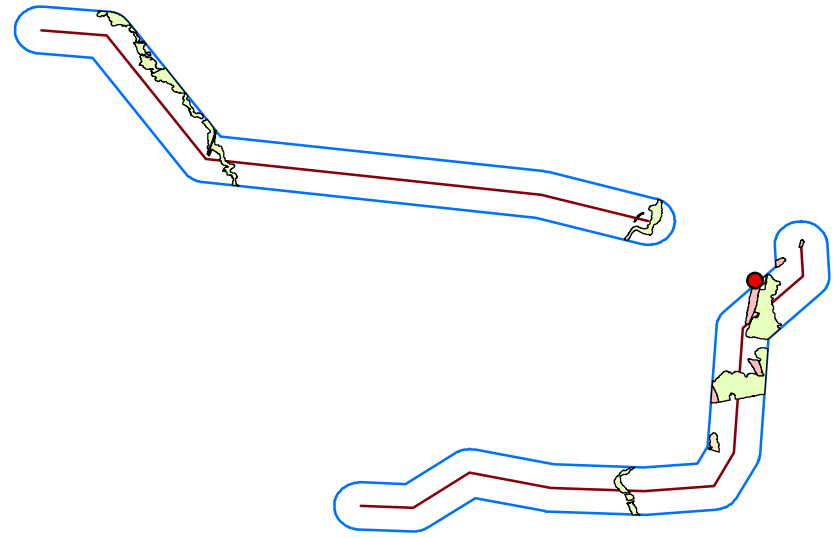
RE	Extent (ha)	Habitat Quality*				
		Site	Site Context	Site Condition	Stocking Rates	Total (/10)
11.3.1	21.3	AE6	2.04	1.56	0	3.6
11.4.3	173.7	AE01	2.3	2.18	0	4.48
		AE45	1.88	2.12	1	5.00
		AE74	2.14	2.00	0	4.14

Percent of 1x1 m quadrat; * See accompanying Excel database for calculations

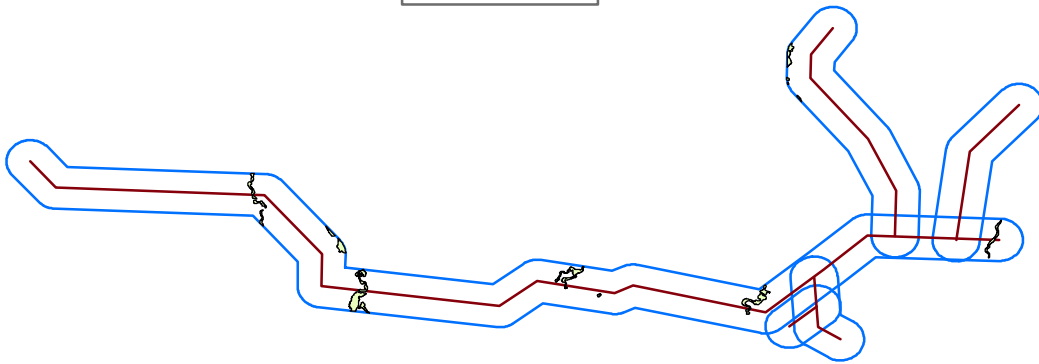
Miles Pipeline



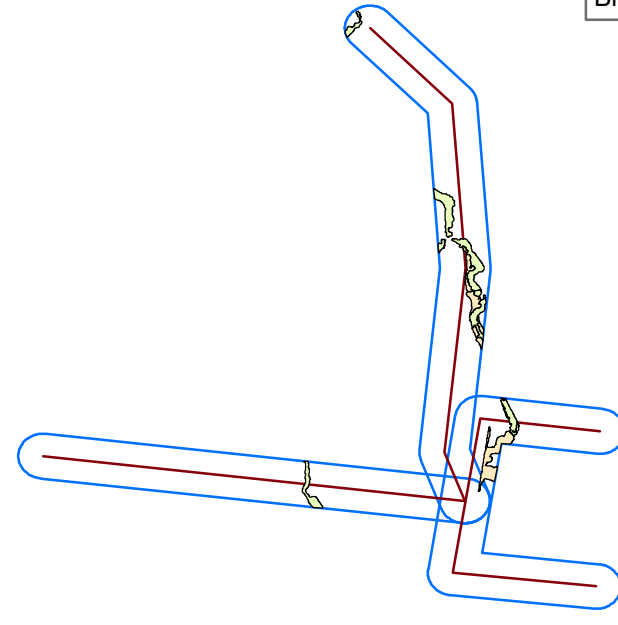
Wieambilla Pipeline



Kogan Pipeline



Braemar Pipeline

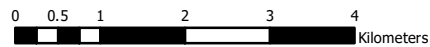


Legend

- Proposed Pipelines
- 500 m buffer
- Painted Honeyeater records
- Core Habitat Known
- Core Habitat Possible
- General Habitat

Figure 3.8

Painted Honeyeater records and habitat within the assessment areas



Client: Arrow Energy
Project: Off-tenure Terrestrial Ecological Survey



3.4.3.6 Greater Glider (*Petauroides volans*)

The Greater Glider extends from the Windsor Tableland in north Queensland south to Wombat State Forest in central Victoria (Woinarski *et al.* 2014). While the SGP and the associated areas entirely overlap with the distribution of the Greater Glider, they are located at the species western extremity. West of Toowoomba the species becomes increasingly patchy, often apparently absent from otherwise seemingly suitable habitat.

Greater Gliders are predominately restricted to eucalypt forests and woodlands, peaking in abundance in taller, montane, moist eucalypt forests with large old trees (Andrews *et al.* 1994; Kavanagh 2000; Eyre 2004; van der Ree *et al.* 2004; Vanderduys *et al.* 2012). In areas west of the Great Dividing Range, they are found in low woodlands (McKay 2008) but being hollow-roosting obligates require large hollows.

Based on experiential and documented knowledge of the species habitat requirements, mapping rules were defined to identify areas of 'core habitat' for the SGP (EcoSmart Ecology 2017). Regional Ecosystems that are recognised as potentially important and occur within the off-tenure areas are restricted to RE 11.3.25 and 11.3.27.

Using the established mapping rules a total 265.6 ha of Greater Glider 'Core Habitat Possible' occurs within the assessment areas; a further 610.3 ha of 'General Habitat' is also mapped (Figure 3.6). No 'Core Habitat Known' occurs within the assessment areas.

Table 3.12 provides an overview of the habitat characteristics in each RE assessed as Greater Glider 'Core Habitat Possible'. The 'Habitat Score' at locations within these RE's using the DoEE suggested methodology is provided in Table 3.13. Raw calculations of these scores can be sourced from the accompanying Excel database.

Table 3.12. Habitat characteristics from RE's which contribute to Greater Glider 'Core Habitat Possible'

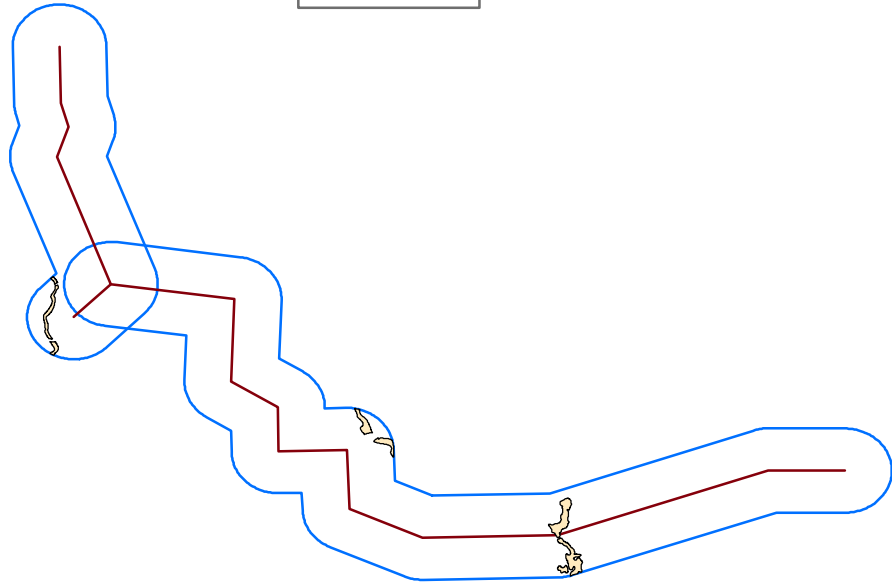
RE	Vegetation composition and Structure	Hollow Availability	Possible habitat use
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Variable, some areas have numerous very large, old trees with moderately hollows, other areas have low hollow density	Foraging, shelter and dispersal
11.3.27i	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer		

Table 3.13. 'Habitat Quality' scores from within Greater Glider 'Core Habitat Possible'.

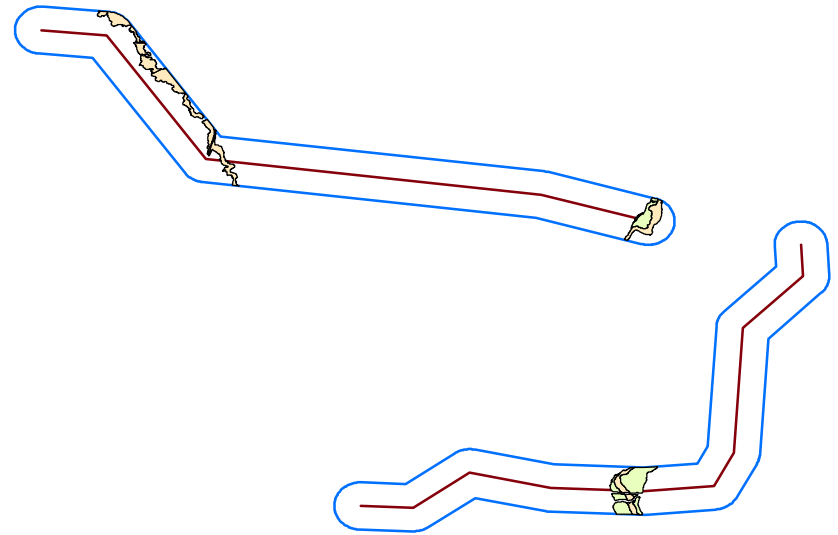
RE	Extent (ha)	Site	Habitat Quality*			
			Site Context	Site Condition	Stocking Rates	Total (/10)
11.3.25	158.2	AE25	1.66	2.43	0	4.09
		AE31	1.21	2.3	0	3.51
		AE34	1.71	2.19	0	3.9
		AE44	2.14	2.34	0	4.48
		AE56	2.14	2.63	0	4.77
		AE76	1.55	2.36	0	3.91
11.3.27i	61.5	AE04	1.07	2.57	0	3.64
		AE07	1.07	2.48	0	3.55
		AE08	1.18	2.33	0	3.51
		AE14	1.45	2.31	0	3.76

* See accompanying Excel database for calculations

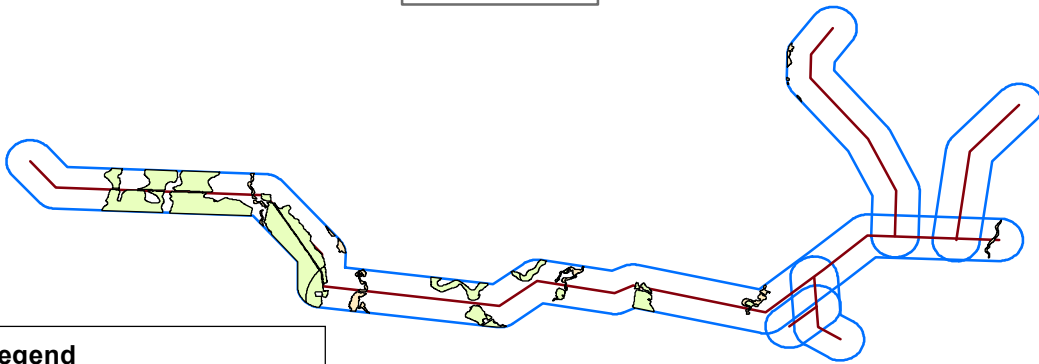
Miles Pipeline



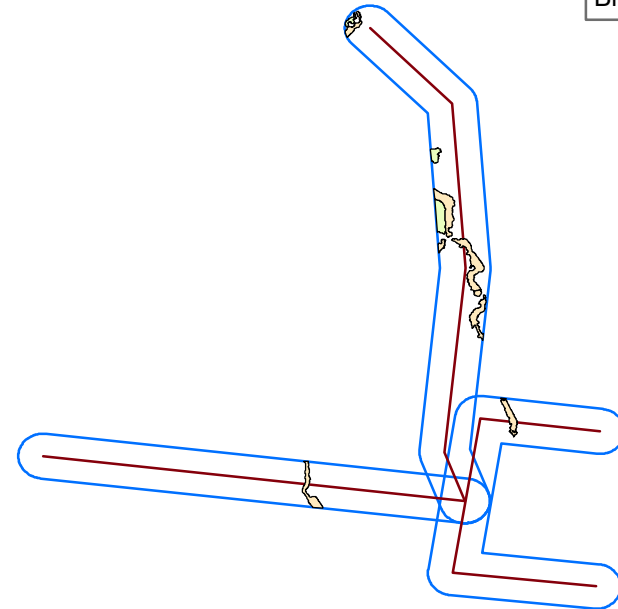
Wieambilla Pipeline



Kogan Pipeline



Braemar Pipeline



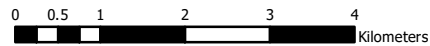
Legend

- Proposed Pipelines
- 500 m buffer
- Greater Glider records
- Core Habitat Possible
- General Habitat



Figure 3.9

Greater Glider records and habitat within the assessment areas



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3.4.3.7 Koala (*Phascolarctos cinereus*)

In Queensland Koala's can be found from Atherton Tableland west of Cairns south to the NSW/QLD border and inland to central and western Queensland. The assessment areas are contained entirely within the Koala distribution.

Koalas occur in a diversity of habitats including temperate, sub-tropical and tropical forest, woodland and semi-arid communities, and sclerophyll forest, on foothills, plains and in coastal areas (Martin and Handasyde 1999; Martin et al. 2008). Koalas near the western edge of their range are often associated with watercourses though are not restricted to them (Melzer *et al.* 2000; Sullivan *et al.* 2003). Favoured feed tree species west of the Great Dividing Range include *E. camaldulensis*, *E. coolabah* and *E. populnea*.

Based on experiential and documented knowledge of Koala habitat requirements, mapping rules were defined to identify areas of 'Core Habitat' for the SGP (EcoSmart Ecology 2017). Regional Ecosystems that were recognised as important included RE 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27d and 11.3.27f. These were predominantly associated with riparian vegetation. Other RE's which might also be used by the species but significantly less frequently (11.4.3, 11.4.3a, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.7.2, 11.7.4, 11.7.6, 11.7.7, 11.9.2 and 11.9.7) were mapped as 'General Habitat'. However the assessment noted that a small number of Koala records within the Wilkie Creek catchment were located in 'General Habitat' and recognised the possibility that General Habitat in the Wilkie Creek catchment may play a more important role for the species than previously understood.

Both this work and other studies since 2017 (e.g., EcoSmart Ecology 2018) have continued to find Koala in 'General Habitat', and two notable trends have emerged. Firstly, Koala evidence is more frequently located in the east (i.e., the Wilkie Creek catchment) than in the west (i.e., around Miles). Surveys around Wilkie Creek frequently locate Koala evidence, while surveys around Miles rarely locate Koala evidence (see the example provided in Table 3.14). Secondly, Koalas associate with *both* riparian and non-riparian habitats (i.e., Landzone 5, 7 and 9) in the east but become increasingly more restricted to riparian habitats (Landzone 3) in the west. It appears that the SGP and associated works are placed uniquely on a transitional zone of Koala abundance and habitat use.

Table 3.14. Comparison of Koala records in the assessment areas during this work. Note that as the distance from Dalby increases (i.e., moving west) the number of Koala records decrease and Koala activity is more restricted to riparian habitats (Landzone 3).

Assessment Area	Braemar	Kogan	Wieambilla	Miles
Approximate Distance west of Dalby	21 km	40 km	70 km	90 km
No. riparian Koala records ¹ (Landzone 3)	14	4	4	0
No. non-riparian Koala records ¹ (Landzone 5 & 7)	9	3	0	0
Total	23	7	4	0

¹ Records based on Koala scat evidence

Based on this more refined understanding of Koala use, a more conservative approach to Koala habitat mapping is required. A modified list of RE's for 'Core Habitat Possible' is provided in Table 3.15.

Table 3.15. Recommended changes to the list of RE's used to calculated Koala 'Core Habitat Possible'.

	Core Habitat Possible*	General Habitat*
Previous mapping	11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27d and 11.3.27f	11.4.3, 11.4.3a, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.7.2, 11.7.4, 11.7.6, 11.7.7, 11.9.2 and 11.9.7
Refined (new) mapping	11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27, 11.4.3, 11.5.1, 11.5.4, 11.5.20, 11.7.4, 11.7.6, 11.9.2, 11.9.7, 11.9.10	11.5.21, 11.7.2, 11.7.7

* List includes all RE's identified from the SGP and adjacent infrastructure areas, not all these RE's are present within the off-tenure assessment areas. See Table 3.16 for a list of RE's from the assessment areas.

Using the above modified rules 1,342.5 ha of Koala 'Core Habitat Known', 3,643.2 ha of 'Core Habitat Possible' and 3.6 ha of 'General Habitat' occurs within the assessment areas (Figure 3.6). However the above estimate of 'Core Habitat Possible' is likely to overestimate the extent of habitat as it takes a conservative approach and maps RE's throughout the assessment area with equal value, despite Koala's restricting their activities to riparian (Landzone 3) vegetation in the west.

Table 3.16 provides an overview of the habitat characteristics in each RE assessed as Koala 'Core Habitat Known' or 'Core Habitat Possible'. The 'Habitat Score' at locations within these RE's using the DoEE suggested methodology is provided in Table 3.17. Raw calculations of these scores can be sourced from the accompanying Excel database.

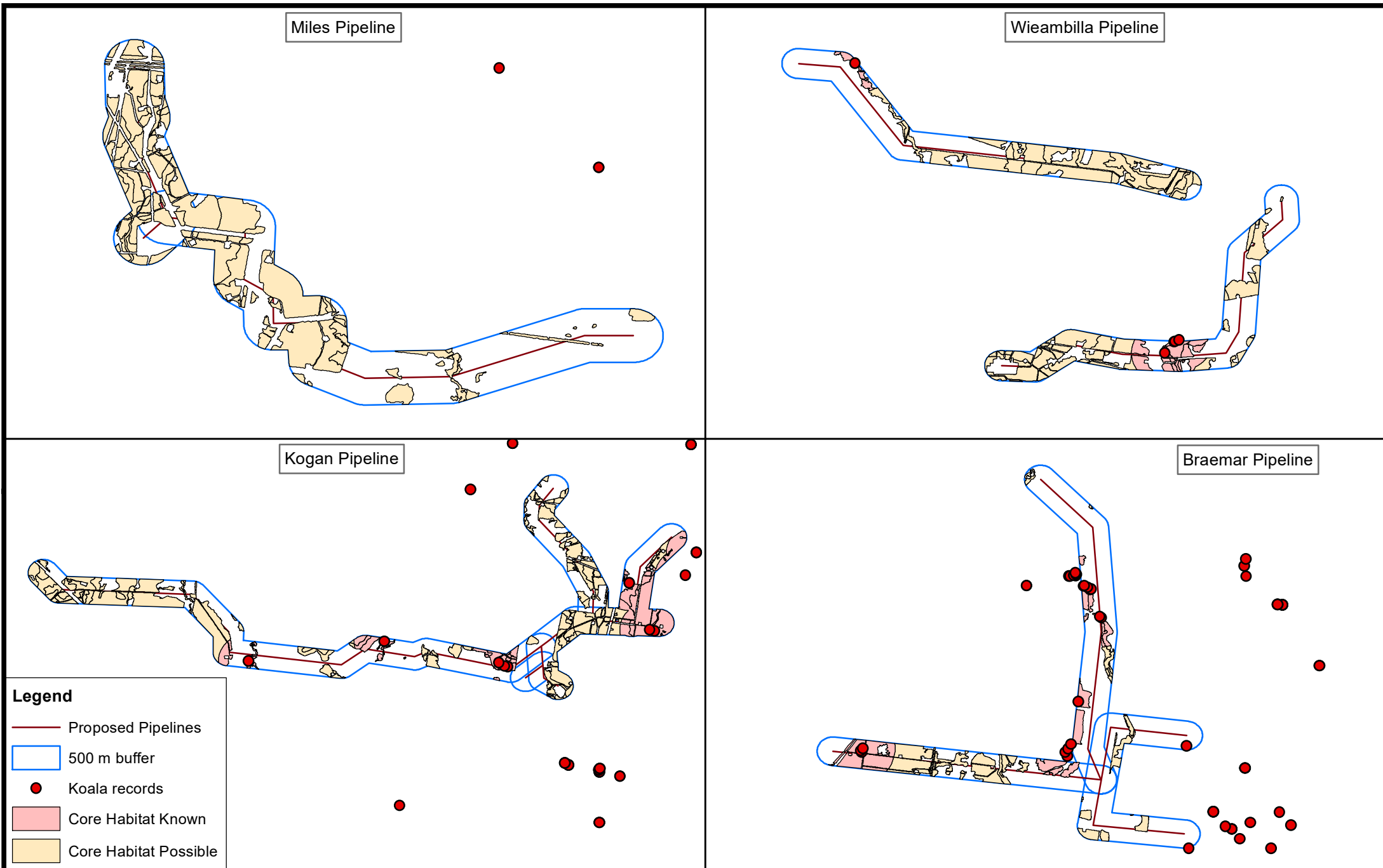
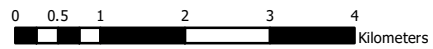


Figure 3.10
Koala records and habitat within the assessment areas



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Project: Off-tenure Terrestrial Ecological Survey



Table 3.16. Habitat characteristics from RE's which contribute to Koala 'Core Habitat Known' and 'Core Habitat Possible'

RE	Vegetation composition and Structure	Eucalypt tree density/ha ¹	Likely habitat use	Quality and availability of food score
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	0 (1)	Foraging, shelter and dispersal	1
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Not sampled	Foraging, shelter and dispersal	10
11.3.14	<i>Eucalyptus spp.</i> , <i>Angophora spp.</i> , <i>Callitris spp.</i> woodland on alluvial plains	100 (1)	Foraging, shelter and dispersal	5
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	326.7 (3)	Foraging, shelter and dispersal	10
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	236.7 (6)	Foraging, shelter and dispersal	10
11.3.27i	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer	220 (4)	Foraging, shelter and dispersal	10
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	0 (3)	Foraging, shelter and dispersal	1
11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	143.3 (6)*	Foraging, shelter and dispersal	10 (due to <i>E. populnea</i>)
11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	152 (5)	Foraging, shelter and dispersal	10 (due to <i>E. chloroclada</i>)
11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	213.3 (3)	Foraging, shelter and dispersal	5
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus spp.</i> , <i>Corymbia spp.</i> , <i>Acacia spp.</i> , <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	210 (6)	Foraging, shelter and dispersal	5
11.7.6	<i>Corymbia citriodora</i> or <i>Eucalyptus crebra</i> woodland on Cainozoic lateritic duricrust	210 (2)	Foraging, shelter and dispersal	5
11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubila</i> ± <i>Corymbia spp.</i> ± <i>Eucalyptus spp.</i> on Cainozoic lateritic duricrust	240 (4)	Foraging, shelter and dispersal	5

¹ Based on BioCondition data gathered from locations within each RE; the number of sampling locations within each RE is provided in parenthesis. * weighted mean (remnant 11.5.1, 11.5.1a and regrowth 11.5.1)

Table 3.17. 'Habitat Quality' scores from locations within RE's which contribute to Koala 'Core Habitat Known' or 'Core Habitat Possible'.

RE	Extent (ha)	Site	Habitat Quality*			
			Site Context	Site Condition	Stocking Rates	Total (/10)
11.3.1	21.3	AE6	1.34	1.56	0	2.9
11.3.14	17.2	AE17	1.5	2.25	1	4.75
11.3.18	56.7	AE26	1.71	2.49	1	5.2
		AE32	1.34	1.89	1	4.23
		AE42	2.36	1.77	0	4.13
11.3.25	158.2	AE25	1.71	2.43	1	5.14
		AE31	1.45	2.45	1	4.9
		AE34	2.09	2.19	1	5.28
		AE44	2.36	2.34	0	4.7
		AE56	2.36	2.63	1	5.99
		AE76	1.77	2.36	0	4.13
11.3.27i	61.5	AE04	1.13	2.57	0	3.7
		AE07	1.13	2.48	0	3.61
		AE08	1.23	2.33	1	4.56
		AE14	1.5	2.31	1	4.81
11.4.3	173.7	AE01	1.61	1.91	0	3.52
		AE45	1.18	1.85	1	4.03
		AE74	1.13	1.41	0	2.54
11.5.1	1,216.2	AE19	1.18	1.07	1	3.25
		AE20	1.88	1.94	1	4.82
		AE24	1.88	1.85	1	4.73
		AE46	2.52	1.89	0	4.41
		AE49	1.82	1.46	0	3.28
		AE73	1.93	1.8	0	3.73
11.5.4	316.1	AE02	1.23	2.07	0	3.3
		AE03	1.82	2.24	1	5.06
		AE10	1.23	2.19	0	3.42
		AE11	1.23	2.37	1	4.6
		AE12	1.61	2.24	1	4.85
		AE55	1.66	2.22	0	3.88
11.5.20	349.3	AE58	2.52	2.16	0	4.68
		AE59	2.52	1.97	0	4.49
		AE60	2.41	1.94	0	4.35
11.7.4	752.1	AE22	2.2	2.18	0	4.38
		AE41	2.36	2.3	0	4.66
		AE47	2.41	1.92	0	4.33
		AE50	2.52	2.07	0	4.59
		AE66	2.04	2.21	0	4.25
		AE70	1.82	2.04	0	3.86
11.7.6	388.6	AE28	1.88	2.07	0	3.95
		AE36	1.45	1.82	0	3.27
11.7.7	470.3	AE21	1.71	1.79	0	3.5
		AE38	2.3	2.09	0	4.39
		AE62	1.93	1.95	0	3.88
		AE69	2.04	2.13	0	4.17

* See accompanying excel database for calculations

4.0 REFERENCES

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Appendix A: GIS/Data Package

DATASET		
Dataset	Contents	Notes
GIS		
Arrow_veg_5119 (Additional Dataset)	RE vegetation mapping and fauna habitat mapping	Primary vegetation mapping database which identifies vegetation type in terms of Regional Ecosystem, Threatened Ecological Community and Conservation Status under relevant state and federal legislation. Provides the basis for mapping of EVNT fauna habitats based on vegetation type. Incorporates Core Habitat Known, Core Habitat Possible and General Habitat mapping for target fauna species
HabitatAssessSites_Scores (Additional Dataset)	Compilation of all BioCondition and Quaternary sites collected in the survey and associated Habitat Quality scores	Habitat Quality Scores calculated as per DoEE suggested methodology.
SGP_EVNT_Database (Replaces; SGP_EVNT_Recs)	EVNT Terrestrial Fauna records for the regional area from both database and field surveys.	Updated data
EXCEL		
Habitat Quality Sites_Jan19 (Additional Dataset)	Habitat Assessment details/data for each survey site	

Appendix B: Fauna Species List

Appendix B: Recorded fauna species

LC = Least Concern, I = Introduced, Vul = Vulnerable, Mig = Migratory

GROUP	<i>Scientific Name</i>	Common Name	Status	
			NC Act	EPBC Act
Butterflies ¹				
	<i>Jalmenus eubulus</i>	Pale Imperial hairstreak		Vul
FROGS				
	<i>Litoria latopalmata</i>	Broad-palmed Rocket Frog		LC
	<i>Litoria peronii</i>	Emerald Spotted Tree Frog		LC
	<i>Litoria rubella</i>	Ruddy Tree Frog		LC
REPTILES				
	<i>Anomalopus leuckarti</i>	Two-clawed Worm-skink		LC
	<i>Lygisaurus foliorum</i>	Tree-based Litter-skink		LC
	<i>Carlia rubigo</i>	Orange-flanked Rainbow Skink		LC
	<i>Cryptoblepharus pulcher</i>	Wall Skink		LC
	<i>Ctenotus allatropis</i>	Brown-blazed Wedge-snouted Ctenotus		LC
	<i>Ctenotus robusta</i>	Robust Ctenotus		LC
	<i>Egernia striolata</i>	Tree Skink		LC
	<i>Gehyra dubia</i>	Dubious Dtella		LC
	<i>Gehyra versicolor</i>	Variable Dtella		LC
	<i>Heteronotia binoei</i>	Binoe's Gecko		LC
	<i>Lerista fragilis</i>	Eastern Mulch Slider		LC
	<i>Lerista punctatovittata</i>	Eastern Robust Slider		LC
	<i>Lerista timida</i>	Dwarf Three-toed Slider		LC
	<i>Morelia spilota</i>	Carpet Python		LC
	<i>Morethia boulengeri</i>	Boulenger's Morethia		LC
	<i>Nebulifera robusta</i>	Robust Velvet Gecko		LC
	<i>Paradelma orientalis</i>	Brigalow Scaly-foot		LC
	<i>Physignathus lesueurii</i>	Eastern Water Dragon		LC
	<i>Pogona barbata</i>	Bearded Dragon		LC
	<i>Varanus panoptes</i>	Yellow-spotted Monitor		LC
	<i>Varanus varius</i>	Lace Monitor		LC
	<i>Vermicella annulata</i>	Bandy Bandy		LC
BIRDS				
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater		LC
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill		LC
	<i>Acanthiza nana</i>	Yellow Thornbill		LC
	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill		LC
	<i>Aegotheles cristatus</i>	Australian Owlet Nightjar		LC
	<i>Aprosmictus erythropterus</i>	Red-winged Parrot		LC

¹ This group was not systematically surveyed. Records were only noted for priority species

GROUP	Scientific Name	Common Name	Status	
			NC Act	EPBC Act
	<i>Apus pacificus</i>	Fork-tailed Swift	LC	Mig
	<i>Ardea pacifica</i>	White-necked Heron	LC	
	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	LC	
	<i>Cacatua sanguinea</i>	Little Corella	LC	
	<i>Cacomantis pallidus</i>	Pallid Cuckoo	LC	
	<i>Chrysococcyx lucidus</i>	Shining Bronze-Cuckoo	LC	
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	LC	
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	LC	
	<i>Coracina papuensis</i>	Little Cuckoo-shrike	LC	
	<i>Coracina tenuirostris</i>	Cicadabird	LC	
	<i>Corvus coronoides</i>	Australian Raven	LC	
	<i>Corvus orru</i>	Torresian Crow	LC	
	<i>Coturnix ypsilophora</i>	Brown Quail	LC	
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	LC	
	<i>Cracticus torquatus</i>	Grey Butcherbird	LC	
	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	LC	
	<i>Daphoenositta chrysoptera</i>	Varied Sittella	LC	
	<i>Dicaeum hirundinaceum</i>	Mistletoebird	LC	
	<i>Dromaius novaehollandiae</i>	Emu	LC	
	<i>Elanus axillaris</i>	Black-shouldered Kite	LC	
	<i>Eolophus roseicapillus</i>	Galah	LC	
	<i>Eopsaltria australis</i>	Eastern Yellow Robin	LC	
	<i>Eurostopodus mystacalis</i>	White-throated Nightjar	LC	
	<i>Eurystomus orientalis</i>	Dollarbird	LC	
	<i>Falco cenchroides</i>	Nankeen Kestrel	LC	
	<i>Falco longipennis</i>	Australian Hobby	LC	
	<i>Geopelia striata</i>	Peaceful Dove	LC	
	<i>Gerygone olivacea</i>	White-throated Gerygone	LC	
	<i>Glossopsitta pusilla</i>	Little Lorikeet	LC	
	<i>Grallina cyanoleuca</i>	Magpie-lark	LC	
	<i>Grantiella picta</i>	Painted Honeyeater	Vul	Vul
	<i>Gymnorhina tibicen</i>	Australian Magpie	LC	
	<i>Haliastur sphenurus</i>	Whistling Kite	LC	
	<i>Hirundapus caudacutus</i>	White-throated Needle-tail	LC	Mig
	<i>Hirundo neoxena</i>	Welcome Swallow	LC	
	<i>Lichenostomus leucotis</i>	White-eared Honeyeater	LC	
	<i>Lichenostomus pinicillatus</i>	White-plumed Honeyeater	LC	
	<i>Licheonstomus chrysops</i>	Yellow-faced Honeyeater	LC	
	<i>Licheonstomus virescens</i>	Singing Honeyeater	LC	
	<i>Lichmera indistincta</i>	Brown Honeyeater	LC	
	<i>Malurus cyaneus</i>	Superb Fairy-wren	LC	
	<i>Malurus lamberti</i>	Variegated Fairy-wren	LC	
	<i>Malurus leucopterus</i>	White-winged Fairy-wren	LC	
	<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	LC	
	<i>Manorina melanocephala</i>	Noisy Miner	LC	

GROUP	Scientific Name	Common Name	Status	
			NC Act	EPBC Act
	<i>Megalurus cruralis</i>	Brown Songlark	LC	
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	LC	
	<i>Merops ornatus</i>	Rainbow Bee-eater	LC	
	<i>Microeca leucophaea</i>	Jacky Winter	LC	
	<i>Myiagra rubecula</i>	Leaden Flycatcher	LC	
	<i>Ninox novaeseelandiae</i>	Southern Boobook	LC	
	<i>Nycticorax caledonicus</i>	Nankeen Night Heron	LC	
	<i>Ocyphaps lophotes</i>	Crested Pigeon	LC	
	<i>Pachycephala rufiventris</i>	Rufous Whistler	LC	
	<i>Pardalotus striatus</i>	Striated Pardalote	LC	
	<i>Petrochelidon nigricans</i>	Tree Martin	LC	
	<i>Petroica goodenovii</i>	Red-capped Robin	LC	
	<i>Phaps chalcoptera</i>	Common Bronzewing	LC	
	<i>Philemon citrogularis</i>	Little Friarbird	LC	
	<i>Philomen corniculatus</i>	Noisy Friarbird	LC	
	<i>Platycercus adscitus</i>	Pale-headed Rosella	LC	
	<i>Plectorhyncha lanceolata</i>	Striped Honeyeater	LC	
	<i>Podargus strigoides</i>	Tawny Frogmouth	LC	
	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	LC	
	<i>Ptilotula fusca</i>	Fuscous Honeyeater	LC	
	<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	LC	
	<i>Rhipidura fuliginosa</i>	Grey Fantail	LC	
	<i>Rhipidura leucophrys</i>	Willie Wagtail	LC	
	<i>Smicrornis brevirostris</i>	Weebill	LC	
	<i>Strepera graculina</i>	Pied Currawong	LC	
	<i>Struthidea cinerea</i>	Apostlebird	LC	
	<i>Taeniopygia bichenovii</i>	Double-barred Finch	LC	
	<i>Todiramphus sanctus</i>	Sacred Kingfisher	LC	
	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	LC	
	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	LC	
	<i>Tyto javonica</i>	Eastern Barn Owl	LC	
	<i>Vanellus tricolor</i>	Banded Lapwing	LC	
Mammals				
	<i>Aepyprymnus rufescens</i>	Rufous Bettong	LC	
	<i>Macropus dorsalis</i>	Black-striped Wallaby	LC	
	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	LC	
	<i>Macropus rufogriseus</i>	Red-necked Wallaby	LC	
	<i>Oryctolacus cuniculus</i>	European Rabbit	I	
	<i>Petaurus breviceps</i>	Sugar Glider	LC	
	<i>Petaurus norfolcensis</i>	Squirrel Glider	LC	
	<i>Phascolarctos cinereus</i>	Koala	Vul	Vul
	<i>Pteropus scapulatus</i>	Little Red Flying-fox	LC	
	<i>Sus scrofa</i>	Feral Pig	I	
	<i>Tachyglossus aculeatus</i>	Echidna	LC	

GROUP	<i>Scientific Name</i>	Common Name	Status	
			NC Act	EPBC Act
	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	LC	
	<i>Wallabia bicolor</i>	Swamp Wallaby	LC	

Appendix C: Species Mapping Rules

MNES SPECIES MAPPING RULES

The rules below have been developed for the SGP and associated off-tenure assessment areas. In developing these rules the following RE's have been considered: RE 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.2.27, 11.4.3, 11.4.10, 11.5.1, 11.5.4, 11.5.20, 11.5.21, 11.7.2, 11.7.4, 11.7.5, 11.7.6, 11.7.7, 11.9.2, 11.9.5, 11.9.7 and 11.9.10.

These REs represent all the vegetation types known from *both* the SGP and off-tenure assessment areas. Any RE's not within the above list have not been considered and require separate assessment. All sub RE units (e.g., 11.5.1a) should be treated as per their parental type.

The rules listed below for Kogan Wax Flower, Yakka Skink, Dunmall's Snake, Squatter Pigeon, Painted Honeyeater, Greater Glider and Koala are based on the most current and recent knowledge of the species at the time of writing. Rules for the below species may have been altered since their development and should there be any inconsistencies or confusion, these rules take precedence.

KOGAN WAX FLOWER (*PHILOTHECA SPORADICA*)

Six localised populations are identified in the Kogan area both within both private land and State Forest. Populations may cover extensive areas although the margins of populations are generally discrete. The

Rule(s) for Habitat Mapping:

1. The species will most likely occur within a 25 km wide buffer surrounding Kogan although cannot be discounted as occurring within suitable habitats throughout the SGP assessment area.
2. REs 11.7.4 and 11.7.5 are classified as "Core habitat Possible" within 25 km from Kogan.
3. Regrowth habits (non-remnant) derived from RE11.7.4 and 11.7.5 within 25 km of Kogan are classified as "General Habitat".
4. REs 11.7.6, 11.7.7 and 11.7.2 within 25 km of Kogan are mapped as "General Habitat".
5. All "Core Habitat Possible" and "General Habitat" within 1km of a recent (1980+), accurate ($\pm 100m$) record is reclassified as "Core Habitat Known".
6. The remaining areas of RE11.7.4 throughout the SGP assessment area are classified as "General Habitat"

Mapping Confidence

The detailed ground surveys undertaken throughout habitats for this species in the SGP area and highly localised populations gives supports high confidence in the habitat mapping.

YAKKA SKINK (*EGERNIA RUGOSA*)

Records Relevant to the SGP and off-tenure areas

Only three Yakka Skink records have been recorded within 20 km of the SGP or the off-tenure assessment areas:

- Approximately 5.5 km west of the SGP and 25.5 km north-west of Miles off-tenure area. Recorded in 1998,
- Approximately 4 km to the south of the SGP and 4 km to the west of the Miles off-tenure assessment area. Recorded in 1987, and
- Approximately 18 km to the west of the SGP and 8 km to the north-west of the Wieambilla off-tenure assessment area. No date is associated with this record, which is usually indicative of very records prior to systematic data collection.

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire SGP area.
2. The species has wide habitat preferences and all remnant vegetation with a combined extent >50ha of RE 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.26, 11.5.1, 11.5.4, 11.5.20, 11.5.21, 11.7.4, 11.7.5, 11.7.6, 11.7.7, 11.9.2, 11.9.5, 11.9.7 and 11.9.10 should be classed as "Core Habitat Possible".
3. Smaller vegetation patches of the above RE's may be mapped as "General Habitat" if they are in close proximity to large areas of "Core Habitat Possible".
4. All remnant vegetation with a combined extent >50ha of RE 11.3.1, 11.4.3 and 11.4.10 should be mapped as 'General Habitat'.
5. Core Habitat Possible or General Habitat within 1km of a recent (1980+), accurate ($\pm 500\text{m}$) record is classed as "Core Habitat Known".
6. Advanced regrowth areas >50 ha of all the above RE's (Core Habitat Possible and General Habitat RE's) are mapped as "General Habitat" if they are adjacent to or connect areas of "Core Habitat Possible" or "General Habitat".

Mapping Confidence

LOW; the occurrence of is species is highly unpredictable, and it is frequently recorded from both remnant and non-remnant habitats. It may be absent from habitats which seem otherwise suitable.

DUNMALL'S SNAKE (*FURINA DUNMALLI*)

Records Relevant to the SGP and off-tenure areas

Dunmall's Snake records within 20 km of the SGP and associated off-tenure infrastructure include:

- Approximately 6.5 km west of the SGP and 8.5 km west of the Miles off-tenure area. Record from 1978,
- Approximately 6.7 km west of the SGP and 5.5 km north of the Wieambilla off-tenure assessment area. Record from 2000, and
- Lake Broadwater within the SGP, approximately 2.5 km east of the Braemar off-tenure area. Six records are associated with this location, four dated as 1770 and one each from 1984 and 1993. It is likely that the four 1770 records are duplicates captured in multiple databases and it is understood that this relates to an un-dated specimens held at the small Lake Broadwater Museum; the only locality data associated with the specimen is 'Lake Broadwater' and may represent collection from the broader area. There is some location ambiguity surrounding all six records.

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire SGP and off-tenure assessment areas.
2. Remnant vegetation with a combined extent of >50ha of RE 11.3.1, 11.3.14, 11.3.17, 11.3.18, 11.4.3, 11.4.10, 11.5.1, 11.5.4, 11.5.20, 11.5.21, 11.7.2, 11.7.4, 11.7.6, 11.7.7, 11.9.2, 11.9.5, 11.9.7 and 11.9.10 should be classed as "Core Habitat Possible".
3. Smaller vegetation patches of the above RE's may be mapped as "General Habitat" if they are in close proximity (<500 m) to areas of "Core Habitat Possible".
4. Remnant vegetation with a combined extent of >50ha of RE 11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.3.26, and 11.3.27 are mapped as "General Habitat".
5. Core Habitat Possible and General Habitat within 1km of a recent (1980+), accurate (± 500 m) record is classed as "Core Habitat Known".
6. Advanced regrowth of all the above RE's are mapped as "General Habitat" if they are adjacent to or connect large areas of "Core Habitat Possible" or "General Habitat".

Mapping Confidence

This species is very poorly understood and records are scarce. Predicting its occurrence is extremely difficult and the mapping is likely to have LOW accuracy.

SQUATTER PIGEON (*GEOPHAPS SCRIPTA SCRIPTA*)

Records Relevant to the SGP and off-tenure areas

Despite Squatter Pigeons being relatively easy to detect and readily identifiable in the field, and considerable ecological work within the SGP and surrounding areas, the species has only been detected within Arrow tenements at three locations:

- North of Miles within the Gurulmundi wildflower area of Conloi Reserve in 1997,

- Approximately 11 km west-north-west of Myall Park, recorded in 2012, and
- Approximately 11.5 km west of Myall Park. This record is not associated with a date and has very low accuracy, it is likely to be a very old record.

These records are located 32, 10 and 7 km to the north of the Miles off-tenure assessment area.

Thirteen other records are located within 20 km of the SGP tenements and/or the off-tenure assessment areas (see accompanying GIS dataset). Eight of these records have no associated date, two are pre-1900, leaving only three post-2010 records (one from 2011 and two in 2016). No records occur within the off-tenure assessment areas.

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire SGP and off-tenure assessment areas.
2. Open woodlands and grasslands which lack an overlapping canopy are mapped as "Core Habitat Possible", these include RE 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.5.20, 11.9.2 and 11.9.7.
3. Mid-dense woodlands which are associated with drainage lines and waterways are also to be mapped as "Core Habitat Possible" due to their proximity to possible water sources. These RE's include: 11.3.18 11.3.25, 11.3.26, and 11.3.27.
4. Core Habitat Possible within 2 km of a recent (1980+), accurate ($\pm 500\text{m}$) record is classed as "Core Habitat Known".
5. All remaining areas of remnant vegetation should be mapped as "General Habitat".
6. Advanced regrowth of the above RE's should be mapped as per their parental RE type.

Mapping Confidence

Squatter Pigeon habitat preferences are well understood and predictable; they are a ground-dwelling species that avoids vegetation that has a dense tree canopy (i.e., trees with an overlapping canopy). In addition to natural habitats, they can also be frequently found in non-remnant areas such as exotic grasslands and farmland, but generally not cropping land. Open verges along roads and tracks surrounded by otherwise unsuitable vegetation may also be used for dispersal.

A number of existing Squatter Pigeon records within the mapped SGP and off-tenure areas fall within areas mapped as 'General Habitat', these however, are almost always associated with a roadway or tracks.

Due to the species ability to occur and frequent non-remnant habitats, and use small minor tracks and roads not captured at the mapped scale, many records of the species are likely to fall outside the areas mapped as "Core Habitat Possible", and as such the mapping is considered to have a LOW accuracy.

PAINTED HONEYEATER (*GRANTIELLA PICTA*)

Records Relevant to the SGP and off-tenure areas

The Painted Honeyeater is well known from areas surrounding the SGP and the off-tenure assessment areas. Relevant records to the project include:

- A single record from 1997 to the east of Myall Park, approximately 100 m from the SGP and approximately 9 km to the north of the Kogan pipeline,
- Four records in 2003 and two in 2005 from 'Gavindale', a property south of Goombi; these records are located 6.5 km to the south-east of the Kogan pipeline and 9 km south of the SGP,
- Five records from Charnley Creek or Chinchilla. At least three of these records are undated and likely early records prior to GPS. The most recent record is from 1985,
- Three records from 'Riverside'/Old Man Lagoon from 1975, 1978 and 2015. These records are 16 km from the SGP and > 20km from the nearest pipeline assessment area,
- Five records (possibly of the same bird), all from 2001, located in the Condamine State Forest south of Nangram; these records are 12 km to the west of the Wieambilla pipeline,
- There is a large cluster of 30+ records centred around the intersection of the Warra-Cananga Ck Rd and Inverai Rd; these records are approximately 20 km from the SGP well west of the nearest pipeline assessment area. The most recent record is from 2017,
- A single 1997 record from Weranga State Forest, some 8.5 km to the north of the SGP and > 20 km to the west of Wilkie Creek pipeline assessment area,
- Two records (likely the same bird) from 2017 on Fagans Rd Weranga, approximately 15 km from the SGP, and
- Three records from Lake Broadwater, the most recent from 2017.

The bulk of records are associated with Brigalow fragments where *Amyae quandang* is likely to be abundant.

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire SGP and off-tenure assessment areas.
2. RE's 11.3.1, 11.3.17, 11.4.3, 11.4.3a and 11.9.5 (including 'disturbed' communities) are mapped as "Core Habitat Possible".
3. The above RE's and RE's 11.5.20 and 11.5.27 are mapped as "Core Habitat Known" around Lake Broadwater.
4. Regrowth RE 11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5, and 'Regrowth Brigalow (>15yrs)' are mapped as "General Habitat".
5. All areas of RE 11.3.25 and 11.3.27 are mapped as "General Habitat",
6. All "Core Habitat Possible" within 2km of a recent (1980+), accurate (\pm 500m) record is classed as "Core Habitat Known".
7. All remaining regional ecosystems and non-remnant areas are "Absence Suspected"

Mapping Confidence

Important habitat characteristics for this species are well understood, though RE units do not account for mistletoe abundance. Abundant mistletoe abundance is most often associated with the REs mapped as 'Core Habitat Possible', though these RE's do not always have abundant mistletoe. As such, the mapping product is likely to overestimate habitat availability and has a moderate-high accuracy.

GREATER GLIDER (*PETAUROIDES VOLANS*)

Records Relevant to the SGP and off-tenure areas

The Greater Glider is currently known from 11 observations within the SGP, but none in the off-tenure assessment areas. Most records are associated with riparian corridors, with a few located in stands of Spotted Gum with large hollow-bearing trees.

Rule(s) for Habitat Mapping:

8. The species may occur throughout the entire SGP and off-tenure assessment areas.
9. "Core Habitat Possible" includes RE's 11.3.4, 11.3.25, 11.3.26 and 11.3.27.
10. RE 11.7.6 as well as polygons of RE 11.3.2, 11.3.3, 11.3.14, 11.3.17, 11.3.18 and 11.3.26 immediately adjacent Core Habitat Possible are mapped as "General Habitat".
11. All Core Habitat Possible and General Habitat within 1 km of a recent (1980+), accurate (\pm 500m) record is classed as "Core Habitat Known".

Mapping Confidence

Important habitat characteristics for this species are well understood and can be matched to regional ecosystem descriptions. The mapping is considered to have a HIGH accuracy.

KOALA (*PHASCOLARCTOS CINEREUS*)

Records Relevant to the SGP and off-tenure areas

More than 70 Koala records are now known from SGP and a further 34 were added during this work in the off-tenure assessment areas. The significant majority of these records are based on scat evidence and observations of live animals have been rare. Most records are located in the Condamine and Wilkie Creek catchments.

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire EIS area.
2. RE's 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27, 11.4.3, 11.5.1, 11.5.4, 11.5.20, 11.7.4, 11.7.6, 11.7.7, 11.9.2, 11.9.7, 11.9.10 are mapped as "Core Habitat Possible".
3. RE's 11.5.21, and 11.7.2 are mapped as "General Habitat".
4. Regrowth and disturbed vegetation should be mapped as per their parent RE.
5. All Core Habitat Possible and General Habitat within 1 km of a recent (1980+), accurate (\pm 500m) record is classed as "Core Habitat Known".

Mapping Confidence

The SGP and off-tenure assessment areas uniquely straddle a transitional zone of Koala habitat use. In the east they can be found in a wider variety of habitats, while in the west they are largely uncommon and restricted to riparian habitats (landzone 3). This transition in habitat use was not fully appreciated in earlier versions of Koala mapping which was considered to be moderately accurate. Refined mapping in this work has increased the number of RE's which are considered to contribute to Core Habitat Possible, which better accounts for the species habitat use in the east, but is likely to over-estimate habitat use in the west.