Investigation and Assessment of Potential Biodiversity Offsets

Baralaba North Project and Associated Infrastructure

December 2014

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1. INTRODUCTION AND BACKGROUND

As part of the proposed expansion of Baralaba North Coal Mine, upgrade of the associated coal haulage route and construction of train load out infrastructure, Cockatoo Coal Limited, has given commitments to provide offsets for a range of Matters of State Environmental Significance (MSES) and Matters of National Environmental Significance (MNES) across several different project areas. Four potentially suitable properties, with a range of different biodiversity attributes, have been identified by Cockatoo Coal for investigation (email dated 23 September 2014).

Footprints Environmental Consultants and QTree Vegetation Assessment have subsequently been engaged to assess the four nominated properties as to their potential suitability for use as offsets for the specific MSES and MNES species/communities identified.

The assessment of the proposed offset areas has been undertaken in three stages:

- Stage 1 – Desktop Suitability Assessment
- Stage 2 – Field Validation of Habitat Suitability and Detailed Flora Assessments
- Stage 3 – Detailed Fauna Assessments including Targeted Species Surveys

The findings of these investigations are detailed herein.

1.1. Offset Requirements (MSES and MNES)

Cockatoo Coal has identified and/or committed to the following biodiversity offsets:

Baralaba North Continued Operations Project (BNCOP)

MNES under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- Brigalow Threatened Ecological Community (TEC) – residual impact of 9 ha
- Ornamental Snake Potential Habitat – residual impact of 33.5 ha
- Squatter Pigeon (Southern) Habitat – residual impact of 277 ha
- South-eastern Long-eared Bat potential habitat – residual impact of 277 ha

Train Load Out

MSES under the Queensland *Nature Conservation Act 1992* (NC Act)

- *Solanum elachophyllum* habitat – residual impact 4 ha, offset requirement of 5:1

Dawson Highway

MSES

- *Solanum elachophyllum* and *Solanum johnsonianum* habitat – residual impact 12 ha, offset requirement of a maximum of 4:1

Coal Haulage Route Upgrade

MNES

- Potential Ornamental Snake Habitat – residual impact 19 ha

1.2. Potential Offset Areas

Cockatoo Coal has nominated the following four properties (see Table 1-1) for investigation as to the suitability for use as offset areas. The location of these properties is shown in Figure 1-1.

Table 1-1 Details of Potential Offset Locations for Further Investigation

Property Name	Lot & Plan	Location	Owner	Potential Offset Value
Bushblock	Lot 21 Plan AU37	20 km North of Miles	Cockatoo Coal	Potential Habitat: • Squatter Pigeon (Southern Habitat) • South-eastern Long-eared Bat
Bushblock	Lot 22 Plan AU37	20 km North of Miles	Cockatoo Coal	Potential Habitat: • Squatter Pigeon (Southern Habitat) • South-eastern Long-eared Bat
Zamia	Lot 9 (north) Plan BH194	50 km West of Moura	Woorabinda Shire Council	Brigalow TEC *Solanum elachophyllum*, *Solanum johnsonianum* Potential Habitat: • Ornamental Snake
Little Sorrell	Lot 5 Plan KM135	30 km North of Duaringa	Woorabinda Shire Council	Brigalow TEC *Solanum elachophyllum*, *Solanum johnsonianum* Potential Habitat: • Ornamental Snake

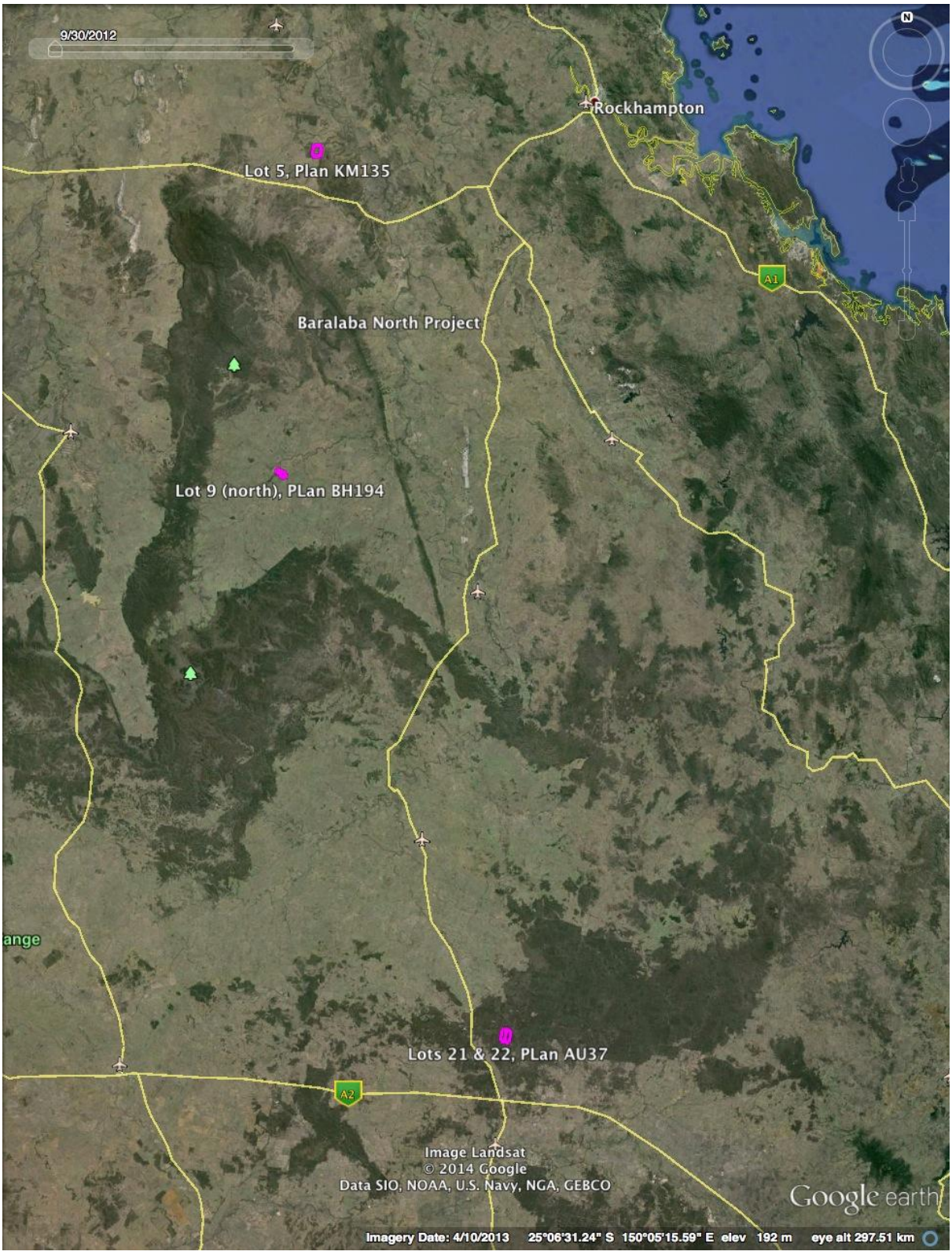

Figure 1-1 Potential Offset Locations – Overview Map

2. TERMINOLOGY AND NOMENCLATURE

2.1. General

For this report, the term *project area* refers generally to the lands and associated habitats surrounding the study area and the *study area* refers to each of the lots identified as proposed offset areas area as depicted in Figure 1-1.

A *search area* is an area established within the study area where a set of standardised survey methodologies are applied and/or continuously implemented throughout the whole field survey period. Nominally, a search area encompasses an area of approximately four hectares. Search areas were selected within representative habitats that were supported across the study area.

The study area is located within the southern Brigalow Belt Bioregion. The Brigalow Belt Bioregion is defined as one of 13 biogeographical areas of Queensland, and extends from the Queensland-New South Wales border to Townsville and encompasses approximately 36 million hectares of sub-humid and semi-arid environments (see Sattler and Williams 1999).

2.2. Legislation

Legislation and policy documents relevant to this study are set out in the following sections.

2.2.1. Flora and Fauna

- Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) – this Act protects Threatened species and Vegetation Communities at the National level.
- Queensland *Vegetation Management Act 1999* (VM Act) – this Act protects vegetation from unauthorised clearing (*i.e.* it focuses on plant communities, not individual plants).
- Queensland *Nature Conservation Act 1992* (NC Act) (and Regulations and Conservation Plans) – this Act protects Threatened species at the State level. Protected plants are listed under the *Nature Conservation (Wildlife) Regulation 2006.*
- Queensland *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) – this Act protects lands from a number of pest factors including invasion or infestation by Declared Plants (formerly noxious weeds).

2.2.2. Biodiversity Offsets

In relation the statutory requirements for the proposed biodiversity offsets proposed for this project, the following are relevant for this study:

- Commonwealth *EPBC Act Environmental Offsets Policy 2012*.
- Queensland *Environmental Offsets Act 2014* (and Regulations).
- Queensland *Environmental Offsets Policy* (Version 1.0).
- Queensland *Biodiversity Offsets Policy* (superseded by the *Environmental Offsets Policy*).

2.3. Flora

In reference to vegetation, the definition of a Regional Ecosystem (RE) follows that provided by Sattler and Williams (1999). For the purpose of this report, the status of RE's follows that of the Regional Ecosystem Description Database (REDD, Version 6.0b and Version 7.0) published by Department of Environment and Heritage Protection (DEHP) (2014a). Regrowth vegetation means woody vegetation that is not remnant as defined under the *Vegetation Management Act 1999* (VM Act). A declared plant refers to a species declared under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act).

In this report, descriptions of vegetation types are based on the structural types described by Specht (1970). Standard references relevant to the study area or region that have been employed for the taxa listed in this report are as follows: Queensland Herbarium (2002); Royal Botanic Gardens (1993); Sharpe (1986); Simon (1993); and Stanley & Ross (1983, 1986, 1989). Additional nomenclatural changes have been incorporated via regular, personal communication with staff at the Queensland Herbarium.

2.4. Fauna

Fauna refers to all vertebrate fauna and the nomenclature used in this report follows Strahan (2000) for non-flying mammals, Churchill (1998) for bats, Christidis and Boles (1994, 2008) for birds, and Cogger (2000) for reptiles and amphibians (though common names for frogs follow Ingram *et al.* 1993).

2.5. Conservation Status

Within this report, the conservation status of a species or community may be described as *Endangered, Vulnerable, Near Threatened, Of Concern* or *Least Concern*.

These terms are used in accordance with the provisions of the following:

- Queensland *Nature Conservation Act 1992* (NC Act) and its regulations and amendments (endangered, vulnerable, near threatened, special least concern and least concern);
- Queensland *Vegetation Management Act 1999* (VM Act) and its regulations and amendments (endangered, of concern and least concern); and/or
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (endangered and vulnerable).

Fauna species listed as endangered, vulnerable or near threatened under the NC Act and/or EPBC Act are collectively referred to as "*threatened species*".

2.6. Abbreviations

Abbreviations commonly used in this report are shown in Table 2-1 below.

Table 2-1 Abbreviations

Abbreviation	Full name
AVH	Australia's Virtual Herbarium
DEHP	Queensland Department of Environment and Heritage Protection
DNRM	Queensland Department of Resources and Mines
DOTE	Commonwealth Department of the Environment
DSITIA	Queensland Department of Science, Information Technology, Innovation and the Arts
EEM	Ecological Equivalence Methodology
EPBC Act	*Environment Protection Biodiversity Conservation Act 1999*
GIS	Geographical Information System
GPS	Global Positioning System
LP Act	*Land Protection (Pest and Stock Route Management) Act 2002*
MNES	Matter of National Environmental Significance
MSES	Matter of State Environmental Significance
NC Act	*Nature Conservation Act 1992*
RE	Regional Ecosystem
REDD	Regional Ecosystem Description Database
SoW	Scope of Works
TEC	Threatened Ecological Community
VM Act	*Vegetation Management Act 1999*
WoNS	Weed of National Significance

3. DESKTOP ASSESSMENTS

3.1. Database Searches

To confirm the status and existing biodiversity value of the proposed offset areas, a review of aerial photography and desktop searches of relevant databases were undertaken using a centroid search with 10km buffer applied as follows:

- EPBC Act Protected Matters Search Tool (for MNES);
- DSITIA Wildlife Online Database Extract (for MSES);
- DNRM Vegetation Mapping;
- Australia's Virtual Herbarium (AVH); and
- Atlas of Living Australia.

3.2. General Suitability – Commonwealth EPBC Act Offsets Policy, October 2013.

This Policy relates to MNES potentially impacted upon that require provision of offset areas.

The *EPBC Act environmental offsets policy* has five key aims, to:

1. Ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act.
2. Provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act.
3. Deliver improved environmental outcomes by consistently applying the policy.
4. Outline the appropriate nature and scale of offsets and how they are determined.
5. Provide guidance on acceptable delivery mechanisms for offsets.

The overarching offset principles that are applied in determining the suitability of offsets are that suitable offsets must:

1. Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action;
2. Be built around direct offsets but may include other compensatory measures;
3. Be in proportion to the level of statutory protection that applies to the protected matte;
4. Be of a size and scale proportionate to the residual impacts on the protected matter;
5. Effectively account for and manage the risks of the offset not succeeding;
6. Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action, see section 7.6);
7. Be efficient, effective, timely, transparent, scientifically robust and reasonable; and
8. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

In assessing the suitability of an offset, government decision-making will be:

1. Informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty; and
2. Be conducted in a consistent and transparent manner.

Assessment of the Commonwealth Offsets policy and direction given from DOTE suggests that targeted field surveys should be undertaken to ascertain/confirm the presence of targeted species supported within proposed offsets.

3.3. General Suitability – Queensland Superseded Biodiversity Offsets Policy, January 2014.

Under the superseded system, offset decisions for state approvals were guided by five separate Queensland environmental offset policies. The overarching Queensland Government Environmental Offset Policy (QGEOP) provided the principles for offsets in Queensland and was supported by four specific-issue policies:

- Policy for Vegetation Management Offsets;
- Queensland Biodiversity Offsets Policy;
- Marine Fish Habitat Offsets Policy; and
- Offsets for a Net Gain in Bushland Koala Habitat in South East Queensland Policy.

The superseded Queensland Government Environmental Offsets Policy (QGEOP) set principles for environmental offsets in Queensland. These policy principles established a framework to guide applicants to meet the standards established by the Queensland Government to ensure that offsets are implemented and secured in an integrated, consistent and transparent manner. The seven QGEOP principles are:

1. Offsets will not replace or undermine existing environmental standards or regulatory requirements, or be used to allow development in areas otherwise prohibited through legislation or policy.
2. Environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact.
3. Offsets must achieve an equivalent or better environmental outcome.
4. Offsets must provide environmental values as similar as possible to those being lost.
5. Offset provision must minimise the time-lag between the impact and delivery of the offset.
6. Offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values. For example, an offset cannot be an area that is already protected by another State government law, or an area that is required to be retained as part of a development permit.
7. Offsets must be legally secured for the duration of the offset requirement.

Under this policy, specific requirements are given for protected plants which detail:

a) How the offset will achieve a net gain for the species affected.

b) How the offset is consistent with the requirements of an approved recovery plan for the species or in the absence of an approved recovery plan, consistent with written advice provided from a recognised expert for the species with regards to the conditions and requirements for the survival of the species.

Offset proposals must provide:

a) details of how the criteria contained in this policy have been met;

b) tenure of offset area;

c) details of any rights to take forestry products;

d) details of any mining encumbrances, including exploration permits; and

e) an analysis of the proposed location of the offset area in relation to existing and future land uses, and the implications of the land use on the offset area's long-term viability. Matters to be considered as part of the analysis include:

i. zoning and regional land-use category (if available) of the offset area and surrounding area under the local government planning scheme and regional plan produced either under the repealed *Integrated Planning Act 1997* or *Sustainable Planning Act 2009*;

ii. maps spatially identifying the current and potential future land-uses, including proposals for major infrastructure, mining, petroleum and gas activities on or in the general vicinity of the offset area; and

iii. threatening processes which may impact on the effectiveness of the management actions on the proposed offset area.

The Train Load Out facility impacts upon one MSES listed under the NC Act and therefore requires offsetting under this superseded offsets policy.

As such, an offset proposal must meet the mandatory requirements of criteria B2, A2 and A3 of the superseded policy for a biodiversity offset that is required for a clearing permit to take endangered, vulnerable or near threatened protected plants under the NC Act.

Offsets cannot be provided for plants prescribed as 'extinct in the wild' wildlife under the NC Act Regulations, and if such plants are found to be in the impact area, they must be protected.

Criteria A2 Legally Securing Biodiversity Offsets

All land-based offsets must be must be legally secured using a legally binding mechanism. A legally binding mechanism includes any of the following:

- Gazettal as a protected area (e.g. a nature refuge) under the *Nature Conservation Act 1992*;
- Declaration of an area of high nature conservation value under the *Vegetation Management Act 1999*;
- Use of a covenant under the *Land Title Act 1994* or *Land Act 1994*; and
- Other mechanism administered and approved by the State.

The legally binding mechanism for the offset area must be noted on the title of the relevant parcel of land being used as an offset area. The legally binding mechanism must also be supported by an offset area management plan that identifies the actions required to ensure an offset area is managed to meet the objective/s of the offset area.

Direct offsets

Direct offsets are provided with the development application or during assessment and must be legally secured within four months of the relevant development permit being issued, unless specifically identified elsewhere in this policy.

That is, where the offset area, legally binding mechanism, and offset area management plan are approved and a development permit is issued, the applicant has four months to ensure the legally binding mechanism is finalised, e.g. a covenant under the *Land Act 1994* is registered on title with the Lands Title Registry within four months of the development permit being issued.

Offset transfer

Where a contractual agreement with an offset broker is provided with the development application or during assessment, an offset area must be legally secured within 12 months of the relevant development permit being issued, unless specifically identified elsewhere in this policy.

Criteria A3 Information Requirement

Where an offset is proposed, applicants must provide the following information to demonstrate how the legislative and policy requirements relating to the offsets and this policy are to be achieved to the satisfaction of the administering authority.

General assessment requirements

These requirements must be addressed by all applicants:

a) how the development has been designed and located on the lot/s to avoid and minimise the extent of impact; and

b) tenure of the impact area.

Specific requirements for resource activities

a) an offset strategy is provided as part of the application documents or submitted Environmental Management Plan. This strategy is to outline:

- when (at time of approval or rolling plan) and how (the offset delivery mechanism) offsets will be provided;
- the expected impacts of the project/s represented spatially;
- the known values (including extent) which will be impacted relevant to this policy;
- other known values which are being addressed through other offset policies;
- the likelihood of an offset being available which meets the policy requirements; and
- whether the impact area includes an existing offset area.

b) a reporting framework, using the existing reporting tools such as the annual return, which;

- reports progress of offsetting requirements as specified in the agreement;
- demonstrates whether or not the offset requirements are being met; and
- identifies any changes to offset delivery during the reporting period is available for auditing by a third party to identify where investigation and/or compliance action is required by the department.

Specific requirements for protected plants

a) how the offset will achieve a net gain for the species affected; and

b) how the offset is consistent with the requirements of an approved recovery plan for the species or in the absence of an approved recovery plan, consistent with written

advice provided from a recognised expert for the species with regards to the conditions and requirements for the survival of the species.

Specific requirements for offset proposals (to be provided for all offset proposals)

a) details of how the criteria contained in this policy have been met

b) tenure of offset area

c) details of any rights to take forestry products

d) details of any mining encumbrances, including exploration permits

e) an analysis of the proposed location of the offset area in relation to existing and future land uses, and the implications of the land use on the offset area's long-term viability. Matters to be considered as part of the analysis include:

   i. zoning and regional land-use category (if available) of the offset area and surrounding area under the local government planning scheme and regional plan produced either under the repealed Integrated Planning Act 1997 or Sustainable Planning Act 2009;

   ii. maps spatially identifying the current and potential future land-uses, including proposals for major infrastructure, mining, petroleum and gas activities on or in the general vicinity of the offset area; and

   iii. threatening processes which may impact on the effectiveness of the management actions on the proposed offset area.

Furthermore, there are prescribed specific requirements for offset area management plans

Criteria B2 Nature Conservation Act 1992 Specific Requirements

A biodiversity offset for protected plants:

a) may be any of the following:

   i. a direct offset; and

   ii. an offset transfer.

b) may be used to satisfy multiple offset requirements, where an offset is required under another Act or policy of Commonwealth, State or local government for the one development application, providing the requirements of this policy are met;

c) may be located on land owned by the applicant or by a third party; and

d) must be in an area where the protected plant species has the conditions and requirements necessary to survive.

The offset must:

a) be within the known or historical distribution of the species being offset;

b) be in an area which contains the conditions necessary for the survival of the species being offset, such as sunlight, water availability, soil type or position in the landscape;

c) demonstrate like for like for the species being cleared, by replacing the species being impacted on in the impact area with the same species in the offset area;

d) achieve a net conservation gain for the species affected, using the following offset ratios:

i. at least 1: 5 for endangered species (i.e. 5 plants must be re-planted to replace 1 plant cleared);

ii. at least 1: 3.5 for vulnerable species

e) be replaced in an area likely to be viable and display the inter-relationships the species needs to survive; and

f) have a management plan that clearly identifies how the offset area will be managed to ensure a self-sustaining wild plant population is created.

For endangered plants, the offset must be consistent with the requirements of an approved recovery plan (where it exists) for the species or relevant community as well as the *Nature Conservation (Protected Plants) Conservation Plan 2000* which is available on the Office of the Queensland Parliamentary Counsel. Where a specific plan for the species does not exist, advice from the Queensland Herbarium (or from a suitably qualified and experienced person) should be sought and provided about the conditions and requirements for the survival of the species.

At this stage of the assessment process, it is considered that the proposed offset areas may potentially support habitat for the MSES impacted by the proposed Train Load Out facility. This will be confirmed following the field investigations.

3.4. General Suitability – Queensland Environmental Offsets Policy, July 2014

Environmental offsets delivered under the Queensland Environmental Offsets Policy are required to achieve a conservation outcome for the impacted matters by providing an offset in the most strategic location to achieve a conservation outcome for the impacted prescribed environmental matter (DEHP 2014b).

Under the new Queensland Environmental Offsets Policy, the five superseded offset policies have been replaced with a policy that offers standardised offset delivery for State and local government. Compared to the superseded offset policies, the new single policy is intended to provide greater flexibility for offset provision, greater consistency with Commonwealth offset principles and to enable earlier start-up of projects. The adoption of a single offsets policy has also removed duplication and inconsistency associated with the previous policies.

When considering the potential suitability of a proposed offset location, wherever possible, offsets should be delivered within a Strategic Offset Investment Corridor closest to the impacted site; and in the case of a land-based offset, in the most strategic location to achieve a conservation outcome. In order of preference, offsets are generally located in:

1. the same local government area
2. the same sub-region
3. the same bioregion or adjacent bioregion

Strategic Offset Investment Corridor mapping has been undertaken for the Galilee Basin to the west of the general project area, however at this time, mapping does not exist for the proposed offset areas.

In terms of general offset suitability for those areas specified, the following is noted.

Local Government Area (LGA) – not preferred.

- Lot 5 KM135 and Lot 9 (north) BH194 are located in Woorabinda Aboriginal Shire Council LGA

- The proposed areas of disturbance for the Train Load Out and Dawson Highway projects are within Banana Shire LGA.

Sub-region - partially suitable.

- Lot 5 KM135 straddles two sub-regions – Woorabinda and Isaac-Comet Downs
- Lot 9 (north) BH194 is within the Dawson River Downs sub-region
- The proposed areas of disturbance for the Train Load Out and Dawson Highway projects are within Dawson River Downs sub-region.

Bioregion – suitable:

- All proposed disturbance and offset areas are located within the Brigalow Belt Bioregion (Southern).

Table 3-1 provides a summary of general offset suitability, with suitability matrices for LGAs and sub-regions provided in Table 3-2 and Table 3-3 respectively. Relative suitability (or not) of these potential offset areas should be considered by Cockatoo Coal in terms of the likelihood of acceptance of these offset areas by DEHP.

Table 3-1 Proposed Disturbance/Offset Area General Preference Criteria

Location	LGA	Sub-Region	Bioregion
Lot 5 KM135	Woorabinda Aboriginal Shire Council	Woorabinda and Isaac-Comet Downs	Brigalow Belt Bioregion (Southern)
Lot 9 (north) BH194	Woorabinda Aboriginal Shire Council	Dawson River Downs	Brigalow Belt Bioregion (Southern)
Train Load Out	Banana Shire	Dawson River Downs	Brigalow Belt Bioregion (Southern)
Dawson Highway	Banana Shire	Dawson River Downs	Brigalow Belt Bioregion (Southern)

Table 3-2 LGA Preference Matrix

	BNCOP	Train Load Out	Dawson Hwy	Haulage Route
Lot 5 KM135	×	×	×	×
Lot 9 (north) BH194	×	×	×	×

× Not Preferred

Table 3-3 Sub-region Preference Matrix

	Train Load Out	Dawson Hwy
Lot 5 KM135	×	×
Lot 9 (north) BH194	✓	✓

✓ Preferred; × Not Preferred.

3.5. Offset Suitability – Flora Perspective

The following section discusses the findings of the desktop assessment as related to flora offset requirements for the following prescribed environmental matters:

- Brigalow TEC (Status: Endangered – EPBC Act);
- *Solanum elachophyllum* (Status: Endangered – NC Act);
- *Solanum johnsonianum* (Status: Endangered – NC Act); and

The following sections discuss each of the proposed offset areas, with a summary of the salient points presented in Table 3-4.

3.5.1. Lot 21 and 22, Plan AU37, Bushblock

These two adjacent lots are characterised by RE11.7.4/11.7.7/11.7.5/11.7.2 (ironbark, scalds and lancewood), RE11.5.21/11.7.4/11.5.4 (bloodwood, cypress, ironbark and/or others) and RE11.7.4 (ironbark). In terms of meeting requirements for offsets, from a flora perspective, these two lots are not relevant as they are highly unlikely to contain any of the vegetation communities/species that are required to be offset.

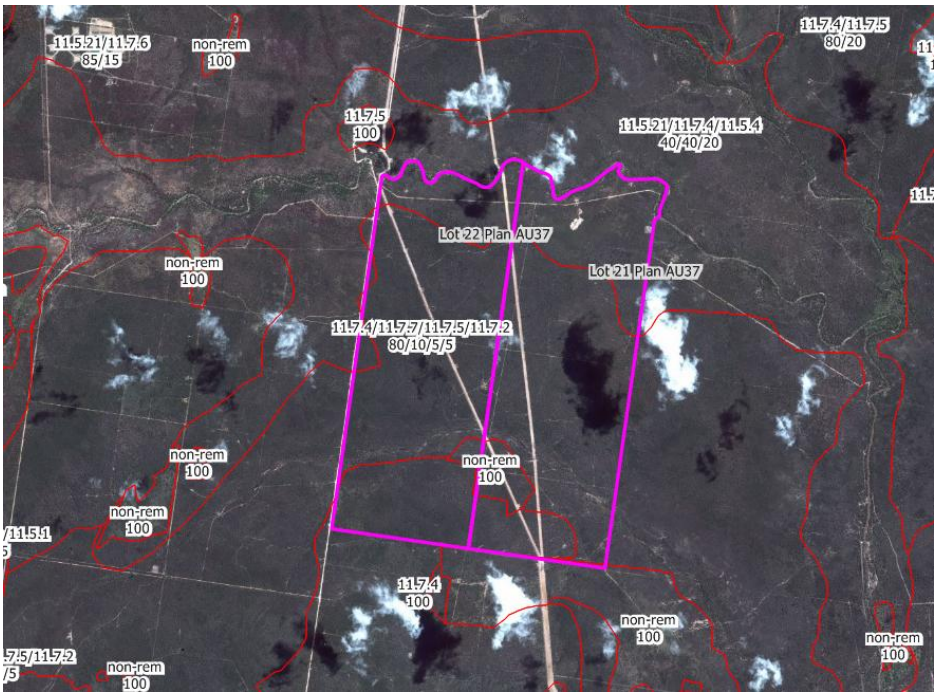

Figure 3-1 Regional Ecosystem Mapping for Lot 21 and 22, Plan AU37

A search of the Atlas of Living Australia did not provide any records for the offset target species.

3.5.2. Lot 9 (north), Plan BH194, Zamia

Lot 9 (north), located on the northern side of the Dawson Highway situated on and to the east of Zamia Creek, is characterised by RE11.3.3/11.3.4 (floodplain coolabah, floodplain eucalypt woodland), regrowth of RE11.4.9a/11.4.8 (brigalow-bauhinia, blackbutt-brigalow) and RE11.9.5 (brigalow).

In terms of meeting requirements for offsets, from a flora perspective, the RE11.4.9a/11.4.8 is considered highly likely for the occurrence of *Solanum elachophyllum.* In addition, *Solanum johnsonianum* is considered possible within the regrowth brigalow areas of RE11.4.9a/11.4.8 and the remnant area of RE11.9.5.

Solanum elachophyllum is typically associated with fertile cracking clays in association with brigalow, belah, bonewood or blackbutt, whilst *Solanum johnsonianum* has a greater likelihood of occurrence in brigalow communities on heavy clays (Bean 2004). A search of the Lot and Plan number of various databases returned a positive record for an EVNT (Endangered, Vulnerable or Near Threatened) flora species (see Figure 3-3). Whilst there is no confirmed record noted on AVH, this is likely to be *Solanum elachophyllum.*

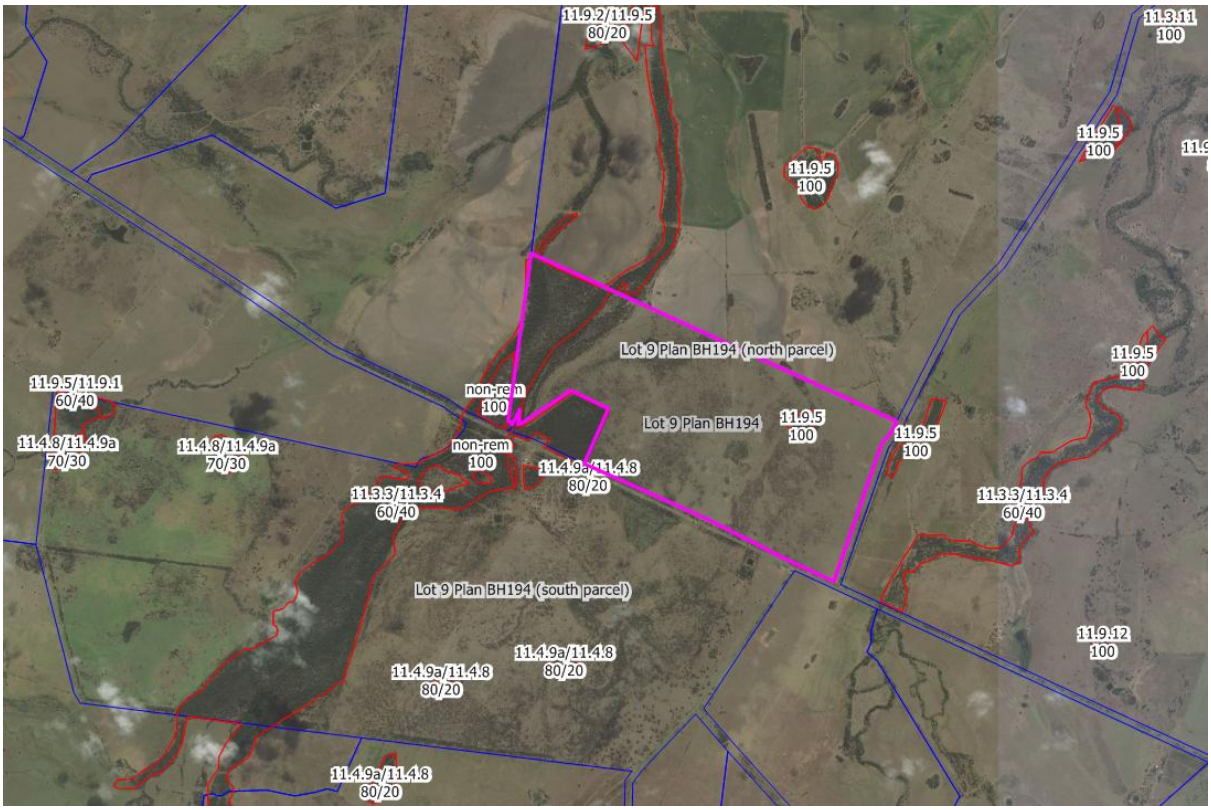

Figure 3-2 Regional Ecosystem Mapping for Lot 9, Plan BH194

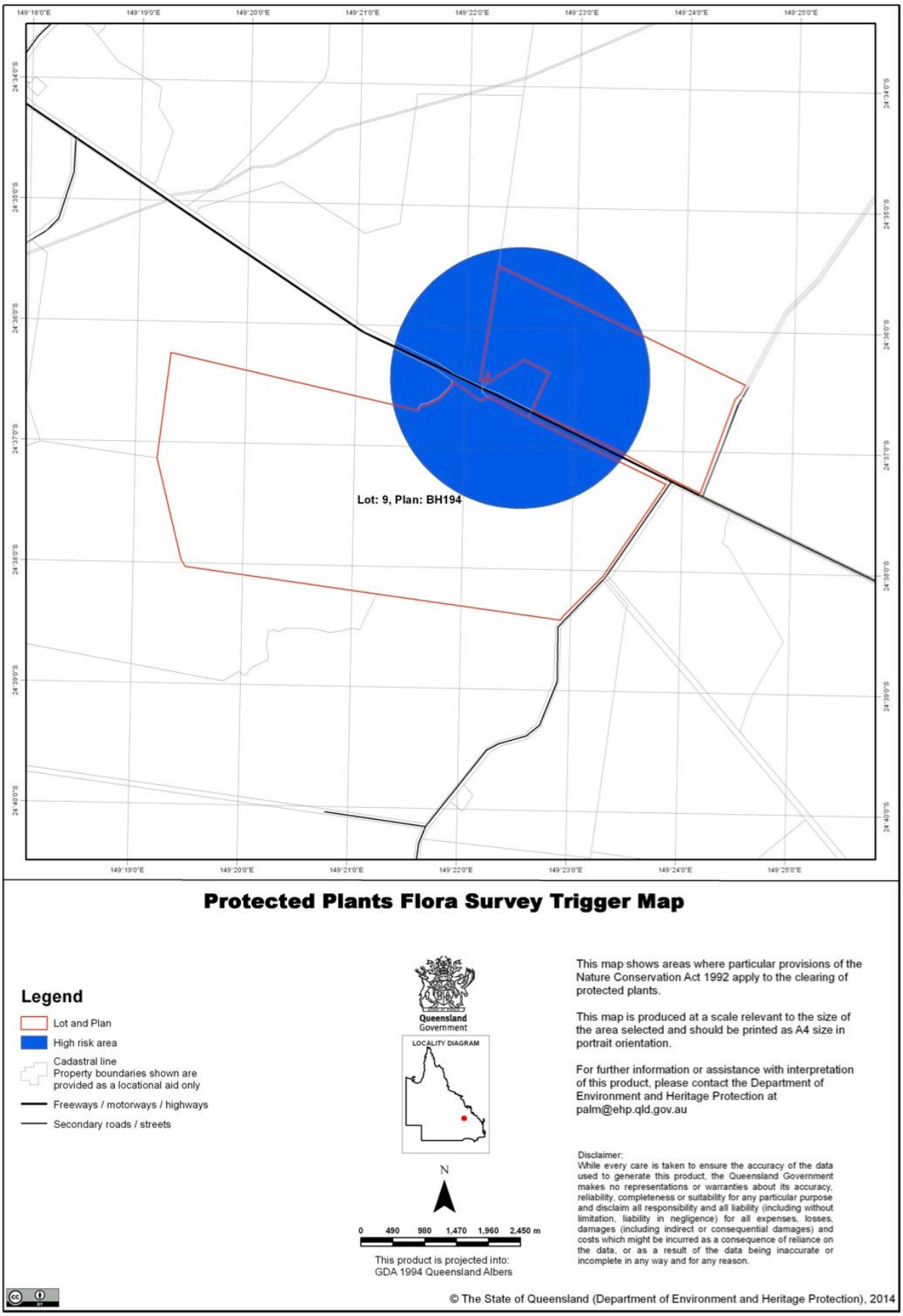

Figure 3-3 Protected Plants Survey Trigger Map for Lot 9, Plan BH194

There were no records of the target flora species from the Atlas of Living Australia (Figure 3-4) in or adjacent to Lot 9. However, records of all three species were identified to the south east of the Lot which would suggest that there is potential for them to occur within the proposed offset area as there are similar supported habitat types.

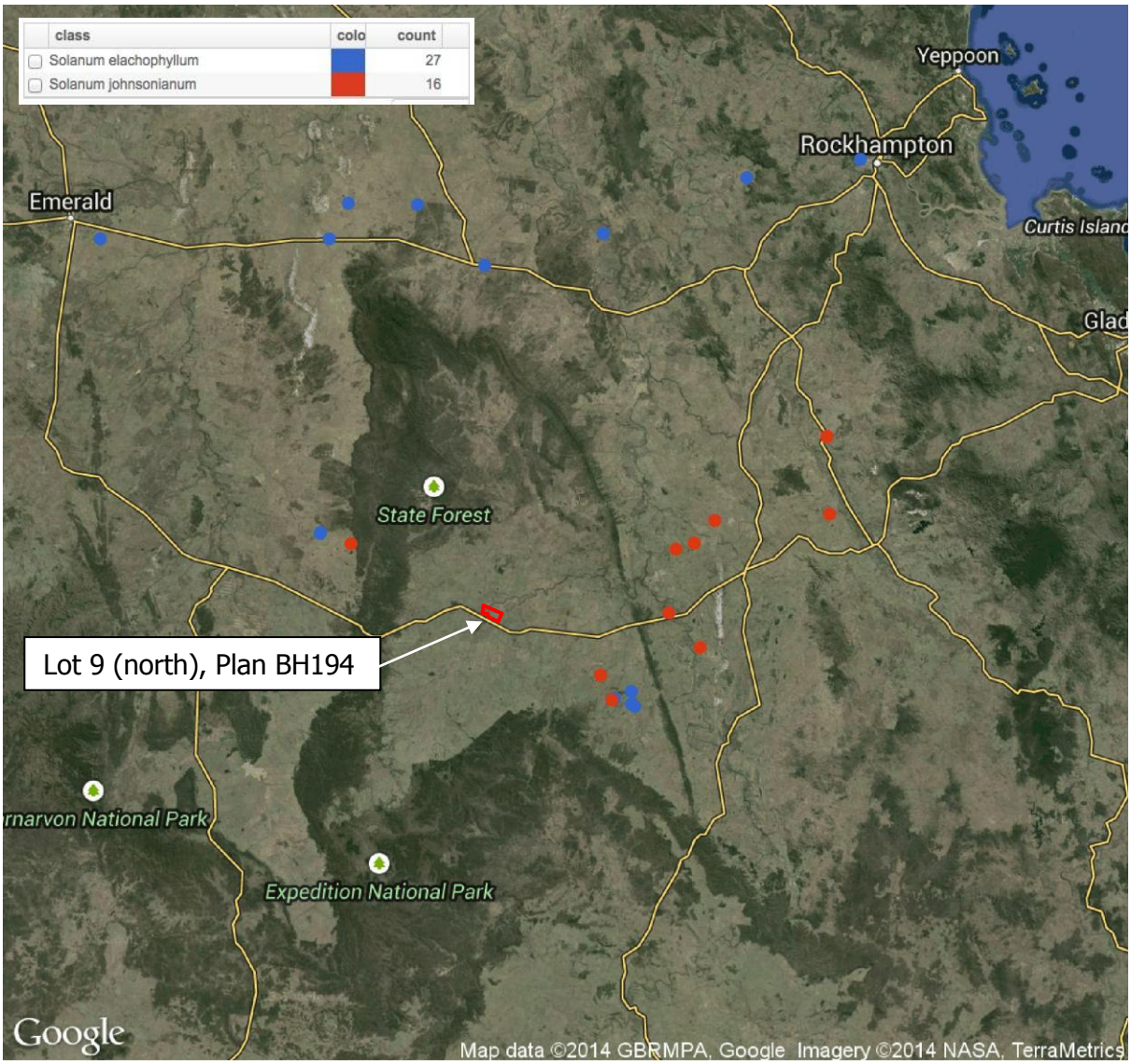

Figure 3-4 Flora Records for Lot 9 (north) from Atlas of Living Australia

3.5.3. Lot 5 Plan KM135, Little Sorrel

This lot is characterised by RE11.7.2 (lancewood jump-up), RE11.4.3/11.4.8 (brigalow-belah, blackbutt-brigalow), RE11.5.9b (ironbark and others (*E. crebra, E. tenuipes, Lysicarpus angustifolius*) - appears to be at the top of the jump-up).

In terms of meeting requirements for offsets, from a flora perspective, the RE11.4.3/11.4.8 (approximately 1 ha of remnant area) is considered possible for the occurrence of *Solanum elachophyllum* and *Solanum johnsonianum*.

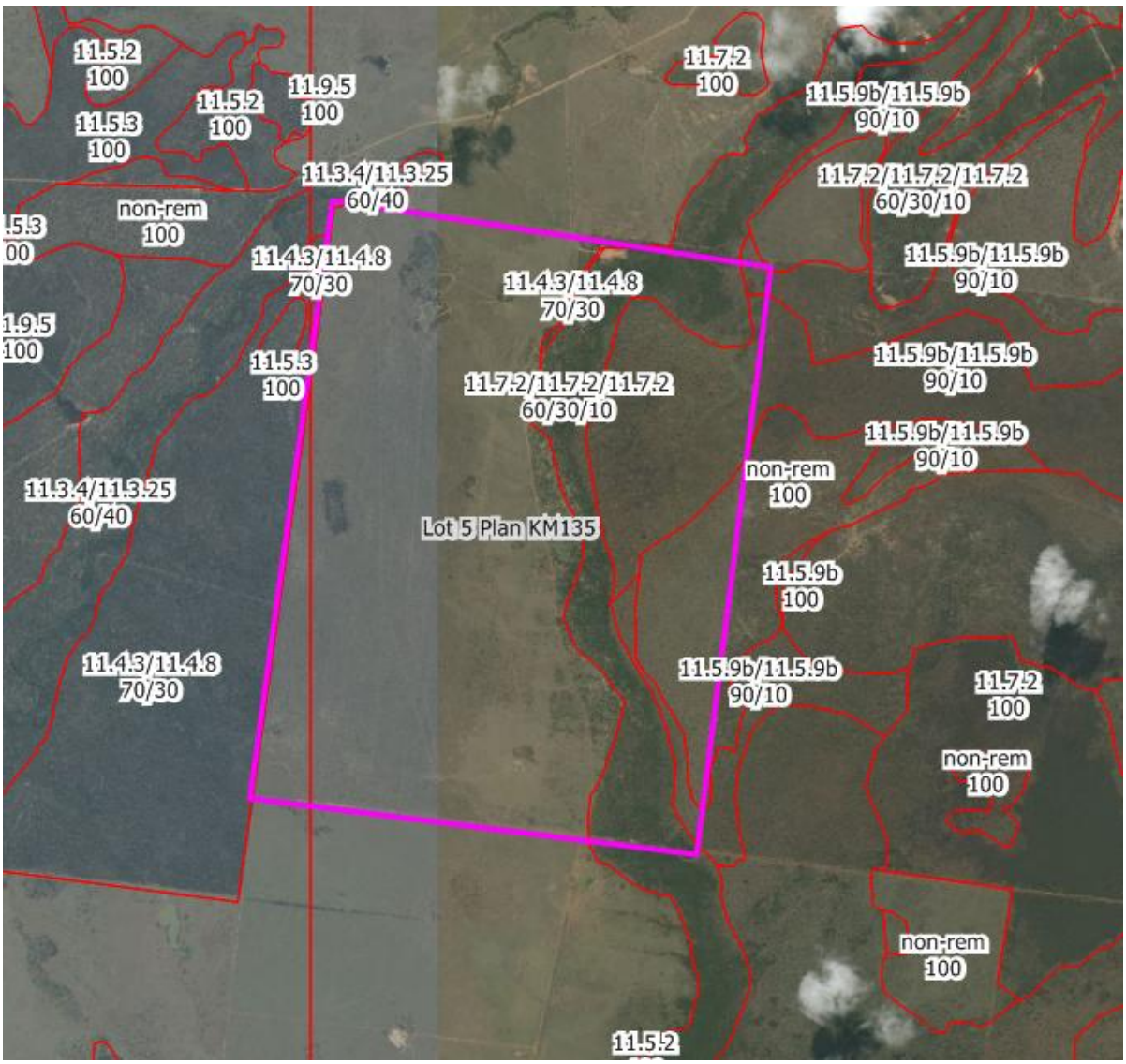

Figure 3-5 Regional Ecosystem Mapping for Lot 5, Plan KM135

There were no records for the target species located within or immediately adjacent to Lot 5 in the Atlas of Living Australia. Records for *S. elachophyllum* were observed to the east, south west and west of the site (Figure 3-6).

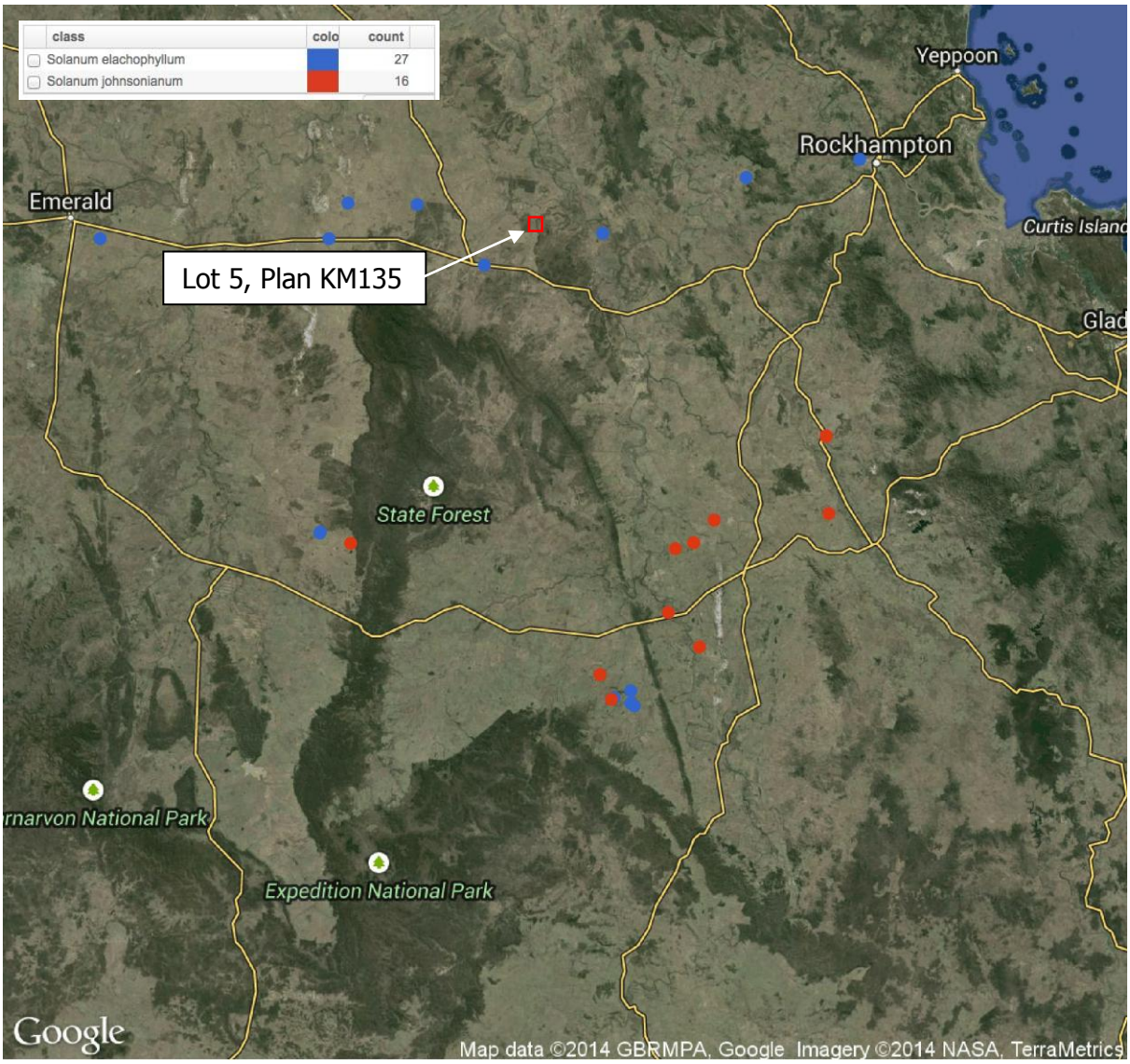

Figure 3-6 Flora Records for Lot 5 from the Atlas of Living Australia

A summary of the salient points discussed above for each of the proposed offset areas is presented in Table 3-4 below.

Table 3-4 Summary of Flora Characteristics of Potential Offset Areas

Property	Nearest Locality	Regional Ecosystems	Summary of mapped remnant vegetation	Remnant Area Ha (approx)	Threatened species that may occur	Preferred habitat	Likelihood of occurrence
Lots 21 & 22 Plan AU37 Bushblock	Barakula	11.7.4/11.7.7/ 11.7.5/11.7.2	Ironbark, scalds and lancewood.	1000		No.	(REs checked for flora suitability in case of possible habitat suitability). Highly unlikely for target flora species. Too dry.
		11.5.21/11.7.4/ 11.5.4	Bloodwood, cypress, ironbark and/or others.	220		No.	(REs checked for flora suitability in case of possible habitat suitability). Highly unlikely for target flora species. Too dry.
		11.7.4	Ironbark.	170		No.	(REs checked for flora suitability in case of possible habitat suitability). Highly unlikely for target flora species. Too dry.
Lot 9 Plan BH194 (north parcels) Zamia	Bauhinia	11.3.3/11.3.4	Floodplain coolabah, floodplain eucalypt woodland.	60		Target species are found in brigalow but clay soils might provide habitat in well wooded shady areas.	N/A.

Property	Nearest Locality	Regional Ecosystems	Summary of mapped remnant vegetation	Remnant Area Ha (approx)	Threatened species that may occur	Preferred habitat	Likelihood of occurrence
		11.4.9a/11.4.8	Brigalow-bauhinia, blackbutt-brigalow.	0*	*S. elachophyllum, S. johnsonianum*	Brigalow.	High for *Solanum elachophyllum.* Trigger map indicates occurrence here, but no record on AVH. Possible for *S. johnsonianum*.
		11.9.5	Brigalow.	4	*S. elachophyllum, S. johnsonianum*	Brigalow.	Possible.
Lot 5 Plan KM135 Little Sorrel	Duaringa	11.7.2	Lancewood jump-up.	150		No.	Highly unlikely. Too dry.
		11.4.3/11.4.8	Brigalow-belah, blackbutt-brigalow.	1	*S. elachophyllum, S. johnsonianum*	Brigalow.	Possible.
		11.5.9b	Ironbark and others (*E. crebra, E. tenuipes, Lysicarpus angustifolius*). Appears to be at top of jump-up.	100		No.	Highly unlikely. Too dry.

* - None mapped, but directly adjacent to approx 40 Ha within Conservation Park. There also appears to be an unmapped patch of approximately 3 Ha within Lot 9 (north)

NB - all RE mapping needs to be confirmed - particularly small polygons of unusual RE. Area estimates are approximate and indicative only.

3.6. Offset Suitability – Fauna Perspective

The following section discusses the findings of the desktop assessment as related to fauna offset requirements for offsetting the residual environmental impact to the following prescribed environmental matters:

- *Denisonia maculata* - Ornamental Snake (Status: Vulnerable – NC Act and EPBC Act);
- *Geophaps scripta scripta* - Squatter Pigeon (Southern) (Status: Vulnerable – NC Act and EPBC Act); and
- *Nyctophilus corbeni/timoriensis* - South-eastern Long-eared Bat (Status: Vulnerable – NC Act and EPBC Act).

3.6.1. Lot 21 and 22, Plan AU37, Bushblock

These two lots have been identified as potential offset habitat for squatter pigeon and south-eastern long-eared bat. Review of the fauna databases and RE mapping for the lots and surrounds suggests that these lots potentially support suitable habitat for these species. Review of the Atlas of Living Australia for this local area has identified that there are records for squatter pigeon in the region as depicted in Figure 3-7. These lots may potentially support habitat for the south-eastern long-eared bat as there are numerous records to the south east (out of view in Figure 3-7) within the same mountain range system, which potentially support similar habitats. Lack of records in this area is most likely due to lack of survey effort.

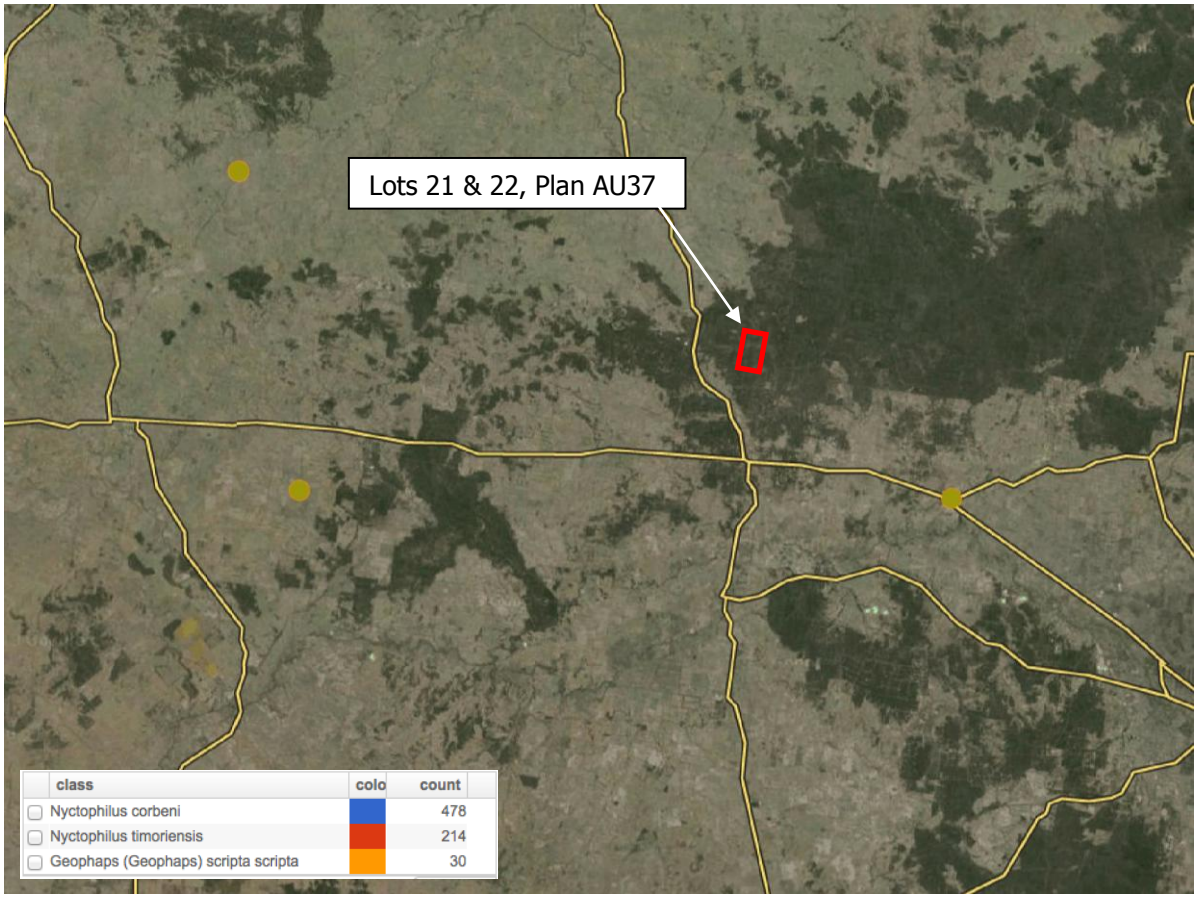

Figure 3-7 Fauna Records for Lots 21 & 22 from Atlas of Living Australia

3.6.2. Lot 9 (north), Plan BH194, Zamia

Identified as supporting suitable habitat for the ornamental snake, this lot potentially supports suitable habitat for the squatter pigeon as well. Review of RE mapping and fauna databases did not reveal specific records, however, given the distribution of significant species records in the local region from the Atlas of Living Australia (Figure 3-8) located in similar habitats, it is considered likely that suitable habitats may potentially be supported within Lot 9 (north). It should be noted that there is a small possibility that the south-eastern long-eared bat may be present within habitats supported within riparian vegetation along Zamia Creek providing suitable roosting resources are supported. As such, consideration of this species in this lot should also be given.

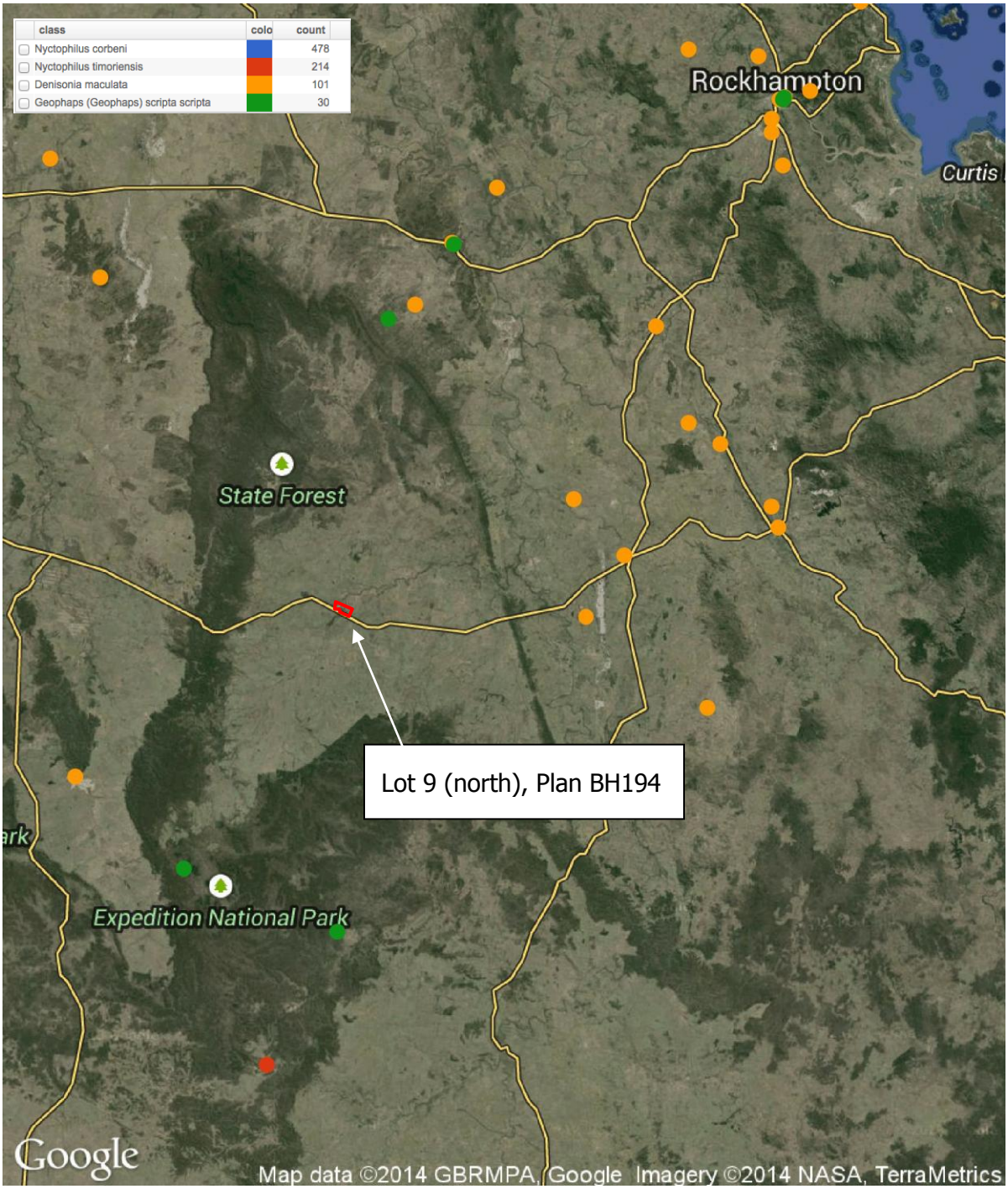

Figure 3-8 Fauna Records for Lot 9 (north) from Atlas of Living Australia

3.6.3. Lot 5, Plan KM135, Little Sorrel

This lot has been highlighted as supporting potentially suitable habitat for the ornamental snake. Review, as with previous lots, supports this conclusion even though a search of the Atlas of Living Australia did not identify any records for this species in close proximity (as can be seen in Figure 3-9). Database searches did identify records for the other two target species, squatter pigeon and south-eastern long-eared bat, within close proximity to the lot. As such, it is reasonable to conclude that, as the lot may potentially support suitable habitat for these species, that it may also be earmarked as a suitable offset for these two species.

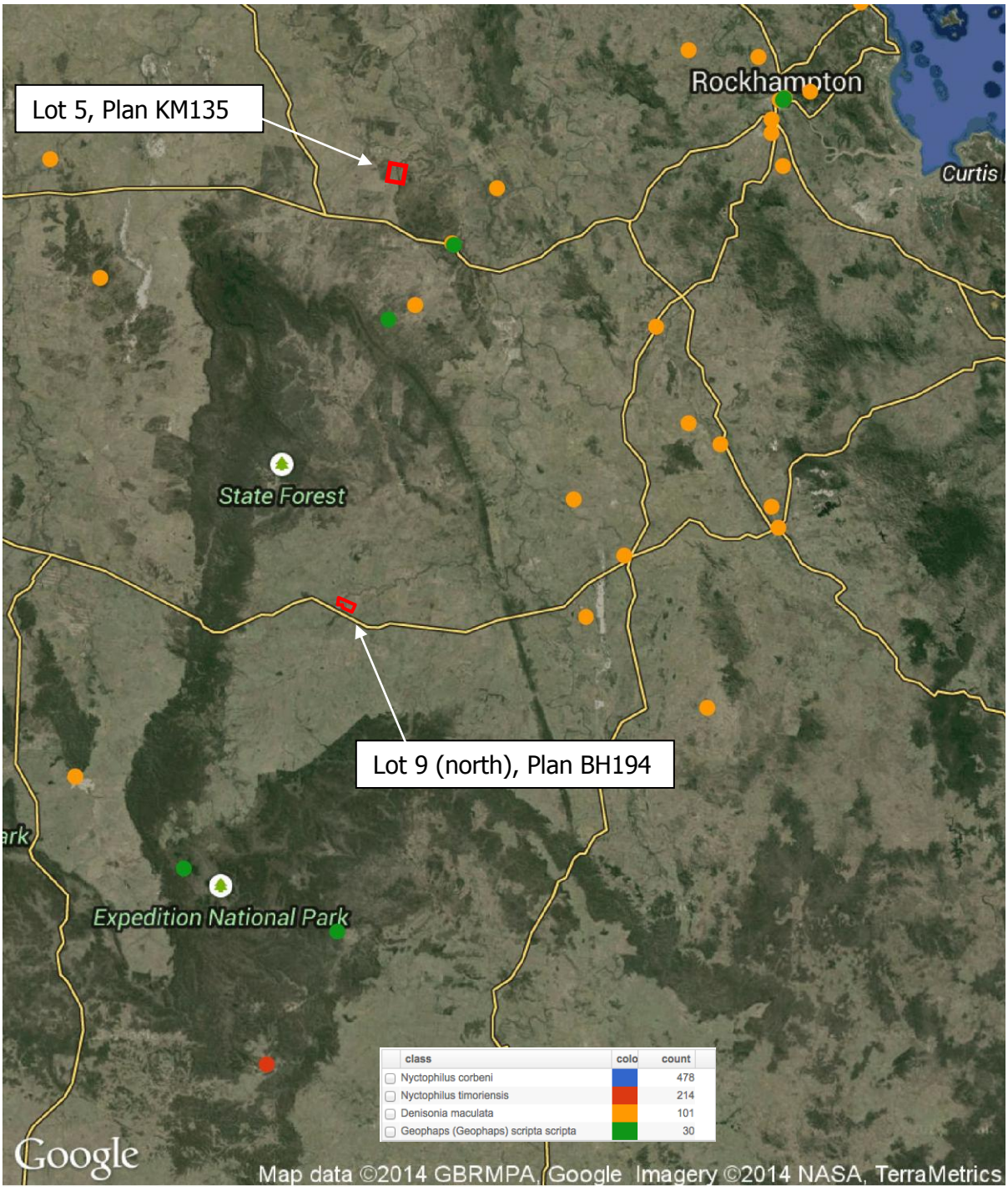

Figure 3-9 Fauna Records for Lot 5 from Atlas of Living Australia

Details of the database source and the type of records contained therein, the REs mapped that potentially support suitable habitat for each target species per lot and an assessment of the likelihood of occurrence for each target species is presented in Table 3-5 below.

Table 3-5 Summary of Target Fauna Species, Potential Habitat and Occurrence Assessment

	Species	1	2	3	4	5
Lot 5, KM135, Little Sorrel	Ornamental snake	✓	11.4.3/ 11.4.8, Cleared	×	Near	Possible/potential habitat present. Field validation required to assess presence/quality of gilgai habitats
	Squatter pigeon	✓	11.5.9, 11.7.2, 11.4.3/ 11.4.8, Cleared	×	Near	Possible/potential habitat present
	South-eastern long-eared bat	✓		×	×	Possible/potential habitat present. Field validation required to assess presence/quality of woodland condition, presence of roosting/foraging resources
Lot 9 (north) BH194, Zamia	Ornamental snake	✓	11.3.3/ 11.3.4, regrowth 11.4.9/ 11.4.8, 11.9.5, Cleared	×	Near	Possible/potential habitat present. Field validation required to assess presence/quality of gilgai habitats
	Squatter pigeon	✓	As above		Near	Possible/potential habitat present
	South-eastern long-eared bat	✓	11.3.3/ 11.3.4, Cleared		×	Possible/potential habitat present. Field validation required to assess presence/quality of woodland condition, presence of roosting/foraging resources
Lot 21&22, Plan AU37, Bushblock	Squatter pigeon	✓	11.7.4/ 11.7.7/ 11.7.5/ 11.7.2	✓	Near	Possible/potential habitat present
	South-eastern long-eared bat	✓	11.7.4/ 11.7.7/ 11.7.5/ 11.7.2	✓	Near	Possible/potential habitat present. Field validation required to assess presence/quality of woodland condition, presence of roosting/foraging resources

Table Key:
1 = Environment Protection and Biodiversity Conservation Act Protected Matters Search Tool;
2 = REs supported on each lot considered likely to support potentially suitable target species habitat;
3 = Wildlife database search;
4 = Atlas of Living Australia database search;
5 = Assessment of potential likelihood of target species/habitat occurrence.
✓ = database potential habitat; ✓= database record; × = not recorded; Near = ALA record in local region.

NB: Species in grey shading are offset target species considered likely to occur in these proposed offset areas, though not indicated by Cockatoo Coal in the Scope of Works as requiring investigation.

4. FLORA HABITAT ASSESSMENTS AND DETAILED SURVEYS

The following section discusses the findings of the flora habitat assessments and detailed surveys, undertaken by QTree Vegetation Assessment, to assess the suitability of the properties potentially useful for Environmental Offsets under Queensland Government policy. These field surveys follow on from the Stage 1 desktop assessment for habitat suitability and likelihood of occurrence of several target flora species, which have now been revised to the following species, all of which are from a group broadly referred to as "nightshades":

- *Solanum elachophyllum*.
- *Solanum johnsonianum*.

Both species are listed as Endangered under the *Queensland Nature Conservation Act 1992*, but are not listed under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999*.

The three potential offset areas which were surveyed were:

- Lot 9 Plan BH194 (northern parcel) - ("Zamia").
- Lot 5 Plan KM135 ("Little Sorrel").
- Lots 21 & 22 Plan AU37 ("Bushblock"). This area was considered unlikely, so was only briefly surveyed.

4.1. Field Survey

Field survey was undertaken using Queensland Herbarium mapping methodology (DSITIA 2012). Threatened flora species survey was also undertaken with methods by DSITIA (2012), and incorporated methods required by DEHP (2014c).

Sampling sites during reconnaissance are referred to as Brief – only the dominant and indicator plant species present on-site are recorded. This type of site is consistent with a Queensland Herbarium Quaternary site using Queensland Herbarium mapping methodology (DSITIA 2012). Brief sites are surveyed to confirm current vegetation mapping, and get an overview of the study area.

Detailed sites were used to assess suitability of habitat for target threatened flora species. Data were collected to satisfy BioCondition sites (DERM 2011a), which are required as the supporting component of Ecological Equivalence Methodology (DERM 2011b). This is used to compare the impacted project areas and the proposed offset areas. If necessary, when vegetation structure and floristics are complex, these site data are supported by further detailed data in the form of Queensland Herbarium Secondary sites (DSITIA 2012). Threatened species and significant weeds are searched for during the entire course of survey work.

Photographs are taken at each site to illustrate dominant species and vegetation structure, and the position is recorded with a hand-held GPS. Flora species unable to be identified in the field are collected for later identification, with appropriate permits in place if required. Individual unknown plants are not collected if whole plant removal is required, and instead, close-up photographs and descriptions are taken, along with highly specific location information for return to site if necessary.

Survey was undertaken from 8-11 October 2014, with the caveat that there were seasonal limitations for detecting the target flora species, which were expected to have largely died back at this time, due to a preceding dry period of several weeks.

4.2. Existing Information

4.2.1. Lot 5 Plan KM135, Little Sorrel

4.2.1.1. Regional Ecosystem Mapping

Current Regional Ecosystem mapping (DEHP 2014d) covering the study area is shown in Figure 4-1.

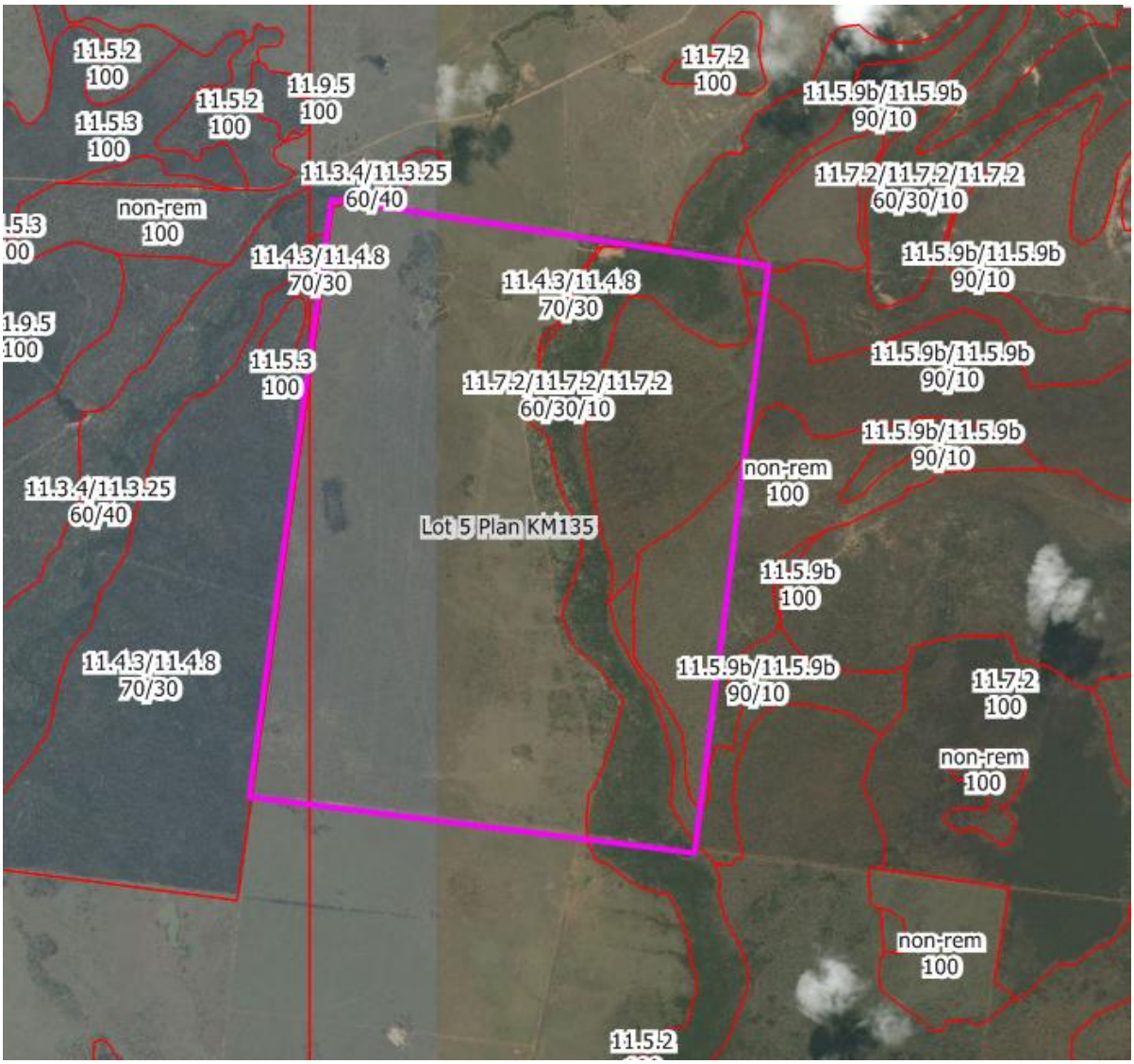

Figure 4-1 Little Sorrel - Current RE Mapping

Red = polygons with RE codes, Purple = study area.

Distance along southern boundary is approximately 3.3 km.

Image from Visual Earth (2014).

Regional Ecosystems from RE mapping in Figure 4-1 are summarised in Table 4-1.

Table 4-1 Little Sorrel - Remnant RE Mapped by DEHP

Regional Ecosystem Code	Description (DEHP 2014a)	Common Names	VM Act Status	Biodiversity Status
11.4.3	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open-forest on Cainozoic clay plains.	brigalow-belah	Endangered	Endangered
11.4.8	*Eucalyptus cambageana* woodland to open-forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains.	blackbutt-brigalow	Endangered	Endangered
11.5.9b	*E. crebra, E. tenuipes, Lysicarpus angustifolius* +/- *Corymbia* spp. woodland.	ironbark, narrow-leafed white mahogany, budgeroo +/- bloodwoods	Least Concern	No Concern at Present
11.7.2	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	wattles on jump-ups	Least Concern	No Concern at Present

The EPBC Protected Matters Search Tool (DOTE 2014a) lists the following Threatened Ecological Communities as potentially occurring within the study area:

- Brigalow (*Acacia harpophylla* dominant and codominant).
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions.
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin.
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions.
- Weeping Myall Woodlands.

Of these, Brigalow is mapped within the study area by DEHP (2014c). Semi-evergreen vine thicket may occur, but Natural Grasslands and Weeping Myall are considered less likely to occur.

4.2.1.2. Threatened Plant Species

Threatened flora listed under the EPBC Act Protected Matters search, potentially occurring within the Study Area (DOTE 2014a), based on a search radius of 10 km, are shown in Table 4-2.

Table 4-2 Little Sorrel - EPBC Act Threatened Flora Potential Species

Botanical Name	Common Name	EPBC Act*	Likelihood of Occurrence
Cadellia pentastylis	ooline	V	Unlikely. Outside known distribution.
Cycas ophiolitica	a cycad	E	Unlikely. Outside known distribution.

* CE=Critically Endangered, E=Endangered, V=Vulnerable, NT=Near-Threatened

There were no NC Act or EPBC Act Threatened flora species listed as potentially occurring within 10 km of the study area by DEHP (2014e). A blank Table 4-3 is retained to maintain consistency with other sections in this report.

Table 4-3 Little Sorrel - NC Act Threatened Flora Potential Species

Botanical Name	Common Name	EPBC Act*	NC Act*	Likelihood of Occurrence
none recorded				

*underlined and in bold if listed on database

CE=Critically Endangered, E=Endangered, V=Vulnerable, NT=Near-Threatened

Although the presence of *Cadellia pentastylis* or *Cycas ophiolitica* is considered unlikely on Lot 5 ("Little Sorrel"), they would add value to the offset area, in case of the need to offset these species due to any future projects.

4.2.1.3. Weeds

The presence of significant weed infestations may make land management difficult or uneconomic.

EPBC Act Significant weed species listed as potentially occurring within the study area by DOTE (2014a), based on the 10 km search radius, are shown in Table 4-4. These species are from the list of Weeds of National Significance (WoNS), by Thorp and Lynch (2000), and the list of Declared Plants under the LP Act. If a Declared Plant, then this is indicated in the table. Likelihood of occurrence is based on actual species distributions and habitat suitability These are based on Wildlife Online records (DEHP 2014e), known distributions (CHAH 2014) and RE mapping (DEHP 2014d).

Table 4-4 Little Sorrel - EPBC Act Significant Weeds Potential Species

Botanical Name	Common Name	Declared Class under LP Act (if applicable)	Likelihood of Occurrence
Acacia nilotica subsp. indica *(also listed as Vachellia nilotica)*	prickly acacia	2	Unlikely.
Cryptostegia grandiflora	rubber vine	2	Possible.
Hymenachne amplexicaulis	hymenachne	2	Unlikely.
Jatropha gossypifolia	bellyache bush	2	Possible.
Lantana camara	lantana	3	Possible.
Opuntia spp.	prickly pear	2	Highly likely.
Parkinsonia aculeata	parkinsonia	2	Unlikely.
Parthenium hysterophorus	parthenium	2	Possible.
Salvinia molesta	salvinia	2	Unlikely.

The presence of *Opuntia* spp. (prickly pear or tree pear) on Lot 5 ("Little Sorrel") is considered highly likely due to distribution and topography. The presence of several other

weed species (*Cryptostegia grandiflora, Jatropha gossypifolia, Lantana camara* and *Parthenium hysterophorus*) is also considered possible, and field survey will help determine the extent and severity of these weed species.

4.2.2. Lot 9 Plan BH194 (north), Zamia

4.2.2.1. Regional Ecosystem Mapping

Current Regional Ecosystem mapping (DEHP 2014d) covering the study area is shown in Figure 4-2.

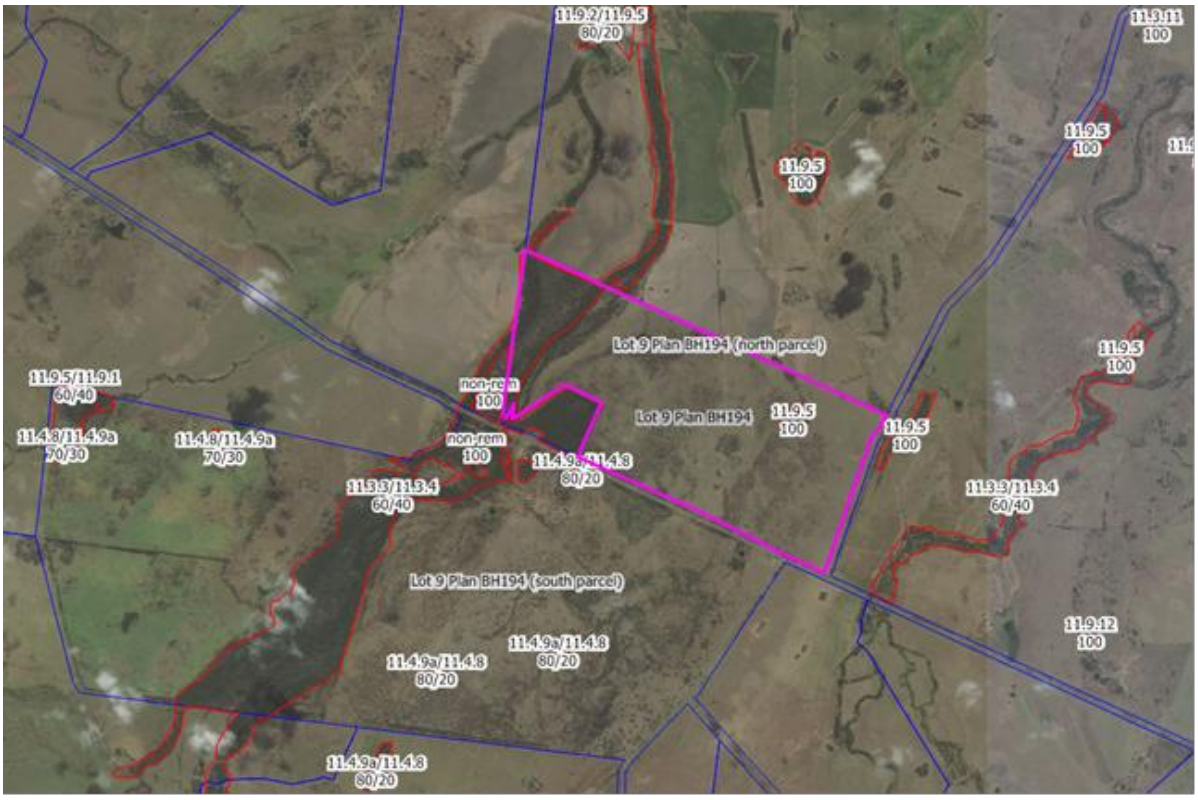

Figure 4-2 Zamia - Current RE Mapping

Red = polygons with RE codes, Purple = study area.

Distance along southern boundary of northern parcel is approximately 4 km including Zamia Creek.

Image from Visual Earth (2014).

Regional Ecosystems from RE mapping in Figure 4-2 are summarised in Table 4-5.

Table 4-5 Zamia (north parcel) - Remnant RE Mapped by DEHP

Regional Ecosystem Code	Description (DEHP 2014a)	Common names	VM Act Status	Biodiversity Status
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains.	floodplain coolabah	Of Concern	Of Concern
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains.	floodplain eucalypts (including blue gum, carbeen etc)	Of Concern	Of Concern
11.4.8	*Eucalyptus cambageana* woodland to open-forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains.	blackbutt-brigalow	Endangered	Endangered
11.4.9a	*Acacia harpophylla, Lysiphyllum carronii* +/- *Casuarina cristata* open-forest to woodland.	brigalow and bauhinia	Endangered	Endangered
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open-forest on fine-grained sedimentary rocks.	brigalow and/or belah	Endangered	Endangered

The EPBC Protected Matters Search Tool (DOTE 2014a) lists the following Threatened Ecological Communities as potentially occurring within the study area:

- Brigalow (*Acacia harpophylla* dominant and codominant).
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions.
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions.
- Weeping Myall Woodlands.

Of these, Brigalow and Coolibah are mapped within the study area by DEHP (2014d). Semi-evergreen vine thicket may occur, but Weeping Myall is considered less likely to occur.

4.2.2.2. Threatened Plant Species

Threatened flora listed under the EPBC Act Protected Matters search, potentially occurring within the Study Area (DOTE 2014a), based on a search radius of 10 km, are shown in Table 4-6.

Table 4-6 Zamia (north parcel) - EPBC Act Threatened Flora Potential Species

Botanical Name	Common Name	EPBC Act*	Likelihood of Occurrence
Cadellia pentastylis	ooline	V	Possible.
Dichanthium queenslandicum	king bluegrass	E	Possible.

* CE=Critically Endangered, E=Endangered, V=Vulnerable, NT=Near-Threatened

NC Act Threatened flora species listed as potentially occurring within 10 km of the study area by DEHP (2014c), are shown in Table 4-7. The only species listed is *Solanum elachophyllum*. Notably, the record for this species occurs within Zamia Creek Conservation Park, which is immediately adjacent to the study area. This was spatially confirmed by the *Protected Plants Flora Survey Trigger Map* (DEHP 2014f). There were no EPBC Act Threatened flora species listed as potentially occurring in the study area (DEHP 2014e).

Table 4-7 Zamia (north parcel) - NC Act Threatened Flora Potential Species

Botanical Name	Common Name	EPBC Act*	NC Act*	Likelihood of Occurrence
Solanum elachophyllum	none		**E**	Highly likely if remnant vegetation is present.

*underlined and in bold if listed on database

CE=Critically Endangered, E=Endangered, V=Vulnerable, NT=Near-Threatened

The known occurrence of *Solanum elachophyllum* in close proximity to Lot 9 North ("Zamia") is enough to recommend the use of this land as an offset for the species, provided the condition of the land is sufficiently good enough to support the species. The focus of the field survey in this case needs to be on the following:

- Ability of the native vegetation habitat to recover once grazing is excluded.
- Presence of any unmapped habitat of remnant or near-remnant status.
- An absence of significant weed infestations.

The presence of *Cadellia pentastylis* or *Dichanthium queenslandicum* would add value to the offset area, in case of the need to offset these species due to any future projects.

4.2.2.3. Weeds

The presence of significant weed infestations may make land management difficult or uneconomic.

EPBC Act Significant weed species listed as potentially occurring within the study area by DOTE (2014a), based on the 10 km search radius, are shown in Table 4-8. These species are from the list of Weeds of National Significance (WoNS), by Thorp and Lynch (2000), and the list of Declared Plants under the LP Act. If a Declared Plant, then this is indicated in the table. Likelihood of occurrence is based on actual species distributions and habitat suitability. These are based on Wildlife Online records (DEHP 2014e), known distributions (CHAH 2014) and RE mapping (DEHP 2014d).

Table 4-8 Zamia (north parcel) - EPBC Act Significant Weeds Potential Species

Botanical Name	Common Name	Declared Class under LP Act (if applicable)	Likelihood of Occurrence
Acacia nilotica subsp. indica *(also listed as Vachellia nilotica)*	prickly acacia	2	Unlikely.
Dolichandra unguis-cati	cat's-claw creeper	3	Unlikely.
Parkinsonia aculeata	parkinsonia	2	Unlikely.

Botanical Name	Common Name	Declared Class under LP Act (if applicable)	Likelihood of Occurrence
Parthenium hysterophorus	parthenium	2	Highly likely.

The presence of *Parthenium hysterophorus* on Lot 9 North ("Zamia") is considered highly likely due to distribution and soil type (clay). Field survey will help determine the extent and severity of this weed species.

4.2.3. Lots 21 & 22 Plan AU37, Bushblock

4.2.3.1. Regional Ecosystem Mapping

Current Regional Ecosystem mapping (DEHP 2014d) covering the study area is shown in Figure 4-3.

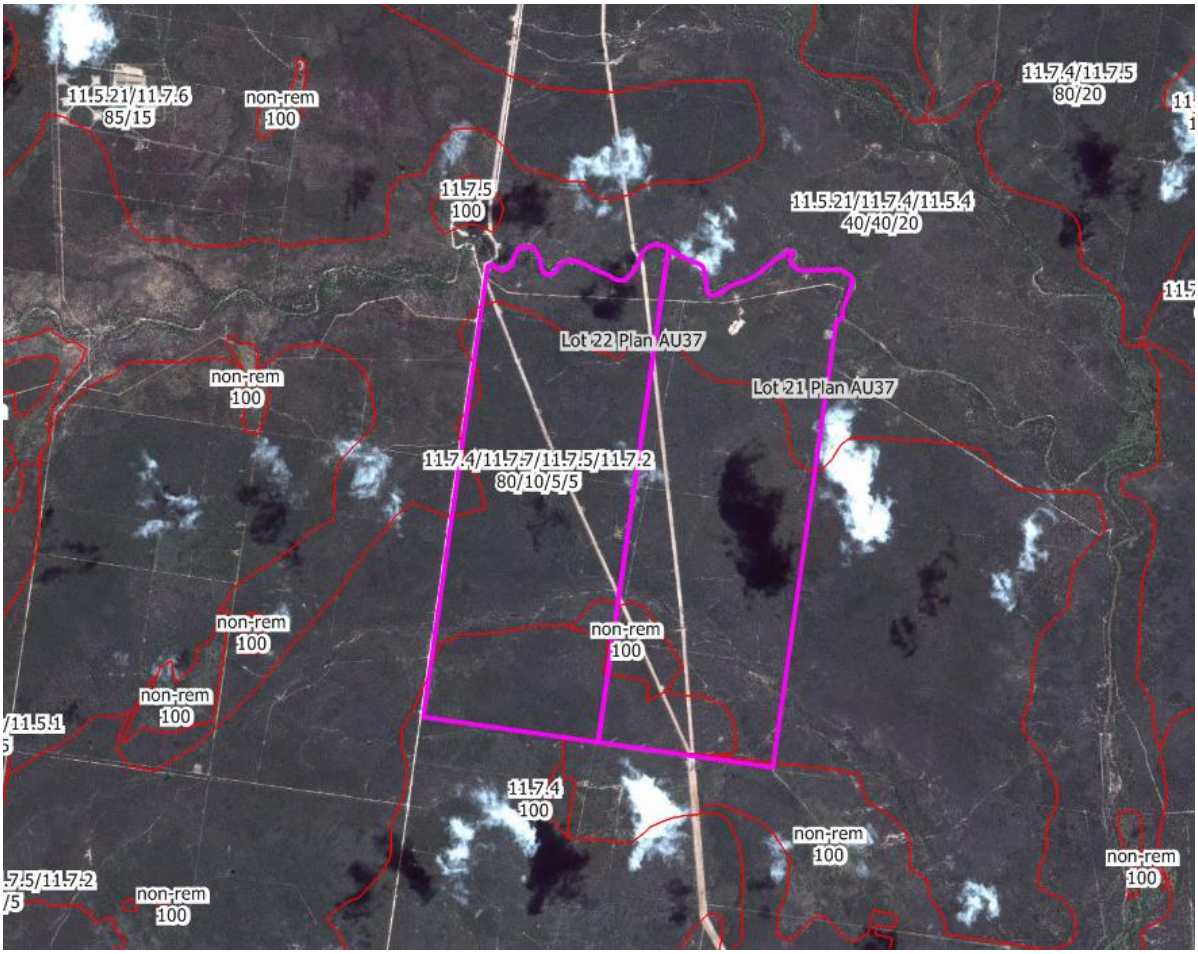

Figure 4-3 Bushblock - Current RE Mapping

Red = polygons with RE codes, Purple = study area.

Distance along southern boundary of both blocks combined is approximately 3.7 km.

Image from Visual Earth (2014).

Regional Ecosystems from RE mapping in Figure 4-3 are summarised in **Error! Not a valid bookmark self-reference.**.

Table 4-9 Bushblock - Remnant RE Mapped by DEHP

Regional Ecosystem Code	Description (DEHP 2014a)	Common names	VM Act Status	Biodiversity Status
11.5.4	*Eucalyptus crebra, Callitris glaucophylla, C. endlicheri, E. chloroclada, Angophora leiocarpa* on Cainozoic sandplains/remnant surfaces. Deep sands.	ironbark, cypress and gums on deep sand	Least Concern	No Concern at Present
11.5.21	*Corymbia bloxsomei +/- Callitris glaucophylla +/- Eucalyptus crebra +/- Angophora leiocarpa* woodland on Cainozoic sandplains/remnant surfaces.	yellow bloodwood +/- others including cypress, ironbark, smooth-barked apple	Least Concern	No Concern at Present
11.7.2	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	wattles on jump-ups	Least Concern	No Concern at Present
11.7.4	*Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp., *Lysicarpus angustifolius* on Cainozoic lateritic duricrust.	gum-topped ironbark and/or eucalypts, with bloodwoods, wattles, budgeroo	Least Concern	No Concern at Present
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks.	shrubland on natural scalds	Least Concern	No Concern at Present
11.7.7	*Eucalyptus fibrosa* subsp. *nubila* +/- *Corymbia* spp. +/- *Eucalyptus* spp. on Cainozoic lateritic duricrust.	broad-leafed ironbark +/- bloodwoods and eucalypts	Least Concern	No Concern at Present

The EPBC Protected Matters Search Tool (DOTE 2014a) lists the following Threatened Ecological Communities as potentially occurring within the study area:

- Brigalow (*Acacia harpophylla* dominant and codominant).
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions.
- Weeping Myall Woodlands.

None of these communities (TECs) are mapped within the study area by DEHP (2014e) due to the significant difference between the soil requirements of these TECs (clay soils) and the mapped REs (sandy soils).

4.2.4. Threatened Plant Species

Threatened flora listed under the EPBC Act Protected Matters search, potentially occurring within the Study Area (DOTE 2014a), based on a search radius of 10 km, are shown in Table 4-10.

Table 4-10 Bushblock - EPBC Act Threatened Flora Potential Species

Botanical Name	Common Name	EPBC Act*	Likelihood of Occurrence
Cadellia pentastylis	ooline	V	Possible.
Calytrix gurulmundensis	none	V	Possible.
Homopholis belsonii	Belson's panic	V	Unlikely. Prefers brigalow.
Homoranthus decumbens	none	E	Possible.

* CE=Critically Endangered, E=Endangered, V=Vulnerable, NT=Near-Threatened

NC Act Threatened flora species listed as potentially occurring within 10 km of the study area by DEHP (2014e), are shown in Table 4-11. One species from this table, *Calytrix gurulmundensis*, is also recorded in the EPBC Protected Matters search (previous table). It is listed as Vulnerable under both the EPBC and NC Acts.

Table 4-11 Bushblock - NC Act Threatened Flora Potential Species

Botanical Name	Common Name	EPBC Act*	NC Act*	Likelihood of Occurrence
Calytrix gurulmundensis	none	V	**V**	Possible.
Cryptandra ciliata	none		**NT**	Possible.
Aphyllorchis anomala	none - an orchid		**NT**	Unlikely. Outside main distributions.
Eremochloa muricata	none - a grass	E	**E**	Unknown. Level of assessment needed is high and not warranted for the purposes of this study.

*underlined and in bold if listed on database

CE=Critically Endangered, E=Endangered, V=Vulnerable, NT=Near-Threatened

The presence of *Calytrix gurulmundensis* or *Cryptandra ciliata* on Lots 21 & 22 ("Bushblock") would add value to the offset area, in case of the need to offset these species due to any future projects. The presence of *Cadellia pentastylis* and *Homoranthus decumbens* are considered less likely to occur, but are nonetheless of potential value. The other species listed are considered unlikely to occur and do not need to be targeted in field survey.

4.2.4.1. Weeds

The presence of significant weed infestations may make land management difficult or uneconomic.

EPBC Act Significant weed species listed as potentially occurring within the study area by DOTE (2014a), based on the 10 km search radius, are shown in Table 4-12. These species are from the list of Weeds of National Significance (WoNS), by Thorp and Lynch (2000), and the list of Declared Plants under the LP Act. If a Declared Plant, then this is indicated in the table. Likelihood of occurrence is based on actual species distributions and habitat suitability. These are based on Wildlife Online records (DEHP 2014e), known distributions (CHAH 2014) and RE mapping (DEHP 2014d).

Table 4-12 Bushblock - EPBC Act Significant Weeds Potential Species

Botanical Name	Common Name	Declared Class under LP Act (if applicable)	Likelihood of Occurrence
Eichhornia crassipes	water hyacinth	2	Unlikely.
Hymenachne amplexicaulis	hymenachne	2	Unlikely.
Opuntia spp.	prickly pear	2	Highly likely.
Parkinsonia aculeata	parkinsonia	2	Unlikely.
Parthenium hysterophorus	parthenium	2	Unlikely.
Salvinia molesta	salvinia	2	Unlikely.

Aerial imagery and RE mapping indicate a lack of water bodies, wet areas and clay plains on Lots 21 & 22 ("Bushblock"), and hence the only weed species listed that is of concern is *Opuntia* spp. (prickly pear or tree pear).

4.3. Field Observation

4.3.1. Lot 5 KM135, Little Sorrel

4.3.1.1. Observation Sites

An aerial image of the study area, with sites overlaid, is shown in Figure 4-4. Site observations are shown in Table 4-13.

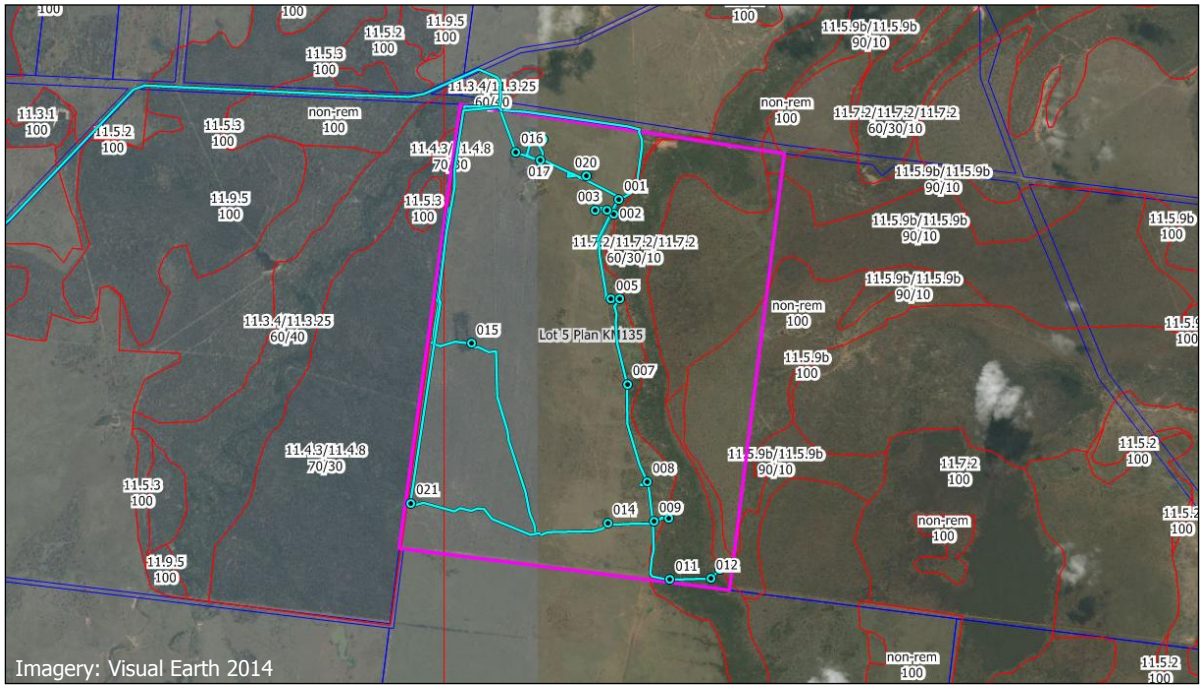

Figure 4-4 Little Sorrel - Observation Sites

Blue dots=observation sites in study area, with GPS tracks. Red = mapped remnant Regional Ecosystems.

Distance along southern boundary is approximately 3.3 km.

Table 4-13 Little Sorrel - Site Observations

Observation site	Easting (Zone 55 GDA94)	Northing (Zone 55 GDA94)	Vegetation description*	Comments
001	756977	7395431	Colluvial outwash of orange sand. Narrow thin trees forming woodland 10-12m tall, 60% cover. Eucalyptus sp. (probably *E.tenuipes*), *Acacia shirleyi*. Sparse shrub layer with *Flindersia dissosperma* et al. Ground layer of buffel grass and *Carissa ovata*. Edge of remnant has 1 *Eucalyptus populnea*, 1 *E.cambageana*, indicating soil change and preferential clearing downslope. Soil changes downslope to cleared paddock of black soil (clay).	Edge of remnant at foot of slope. RE 11.5.9.
002	756932	7395298	As above for site 1, but only about 30% cover, with taller trees upslope. Other species include *Erythroxylum australe, Aristida ramosa*.	RE 11.5.9.
003	756864	7395337	Small patch of brigalow regrowth 1-7m tall, patchy 20-90% cover.	Downslope. Regrowth of RE 11.4.9.
004	756759	7395332	Small slight terrace of disturbed *Acacia rhodoxylon*, *Acacia shirleyi*, 1 *Santalum lanceolatum*, 1 medium *Eucalyptus cambageana* at edge. To west is extensive lower plain of clearing and brigalow regrowth.	Further downslope - RE 11.7.2. Then to west is non-remnant and regrowth 11.4.8, 11.4.9 or 11.9.5.
005	756887	7394517	Large continuous patch of regrowth of various stages, 5-14m tall, of *Eucalyptus cambageana*, brigalow, *Alphitonia excelsa*, cover highly variable 10-60%. Shrub layer mainly *Alectryon diversifolius* to 2m tall, with *Carissa ovata*, *Diospyros humilis*. RE 11.4.8. Uphill is *Acacia shirleyi* on laterite slope. RE 11.7.2.	Regrowth of RE 11.4.8 on lower slope. RE 11.7.2 on upper slope. Contiguousness of 11.4.8 regrowth with 11.7.2 remnant increases ecological value of 11.4.8 regrowth.
006	756970	7394518	Laterite slope with *Acacia shirleyi* 7m tall, with dying emergents 12m tall. Also *Alphitonia excelsa*, *Aristida ramosa*.	Base of laterite scarp. RE 11.7.2.
007	757026	7393735	Small spur of *Acacia shirleyi*.	RE 11.7.2.
008	757196	7392835	As for site 5 - extensive area on footslope of variable-aged regrowth of RE 11.4.8, with *Eucalyptus cambageana*, brigalow, occasional scrub species. Downhill on flat area to south is extensive area of low brigalow regrowth to 3m tall, about 30-40% cover. No gilgai in this area.	Regrowth of RE 11.4.8, with lower regrowth of 11.4.9 downhill.

Observation site	Easting (Zone 55 GDA94)	Northing (Zone 55 GDA94)	Vegetation description*	Comments
009	757250	7392473	200m west - isolated patch of *Eucalyptus cambageana* about 0.5 Ha. 100m north - southern edge of extensive brigalow regrowth. 50m east - woodland of *Eucalyptus crebra* 12m tall, 40% cover. On site - cleared, non-remnant.	W - 11.4.8. N - regrowth 11.4.9. E - 11.9.9.
010	757393	7392495	Woodland 12-14m tall, 50% cover, *Eucalyptus crebra*, *E.cambageana*, *Acacia shirleyi*. Sparse shrub layer of *Erythroxylum australe*. Ground layer sparse but diverse, including *Aristida caput-medusae, Ancistrachne uncinulata*, *Alternanthera* sp., *Sida* sp., *Poaceae indet*.	RE 11.5.9. Serves as a more valuable buffer than 11.7.2 for the RE 11.4.8 described site 5.
011	757392	7391932	Lower slope of *Acacia shirleyi* on laterite, with *Eucalyptus crebra*, *Erythroxylum australe* (RE 11.7.2). Lower down slope is *Eucalyptus cambageana*, *E.crebra* (REs 11.4.8, 11.5.9).	Southern boundary. RE 11.7.2. Severe erosion along fenceline on neighbouring property.
012	757766	7391938	*Acacia shirleyi* only. Edge of patch of *Cerbera dumicola* (NT under NC Act). Associated small tree species TBI.	RE 11.7.2. Near Threatened species present.
013	757857	7392020	Very open woodland of *Corymbia clarksoniana*, with some *Eucalyptus crebra, E.tenuipes*. Grassy understorey with *Aristida caput-medusae*.	Top of plateau, about 30m from edge. RE 11.5.9.
014	756823	7392461	South-east corner of isolated patch of woodland of *Eucalyptus cambageana* with occasional brigalow.	RE 11.4.8. Adjacent to dam and heavily used by cattle for shade and camp. Strongly undulating, no gilgai. Occurrence of target EVNT Solanum spp. very unlikely.
015	755587	7394133	Near SE corner of patch of woodland of *Eucalyptus thozetiana* 14m tall, 50% cover. Some brigalow 3-5m tall. Sparse shrub layer of *Eremophila* sp. (probably *E.deserti*). *Carissa ovata*. Surrounding landscape is extensive very open brigalow regrowth.	RE 11.7.1 is only option to cover dominant species, but there is no laterite and land zone is probably 5 (hard sand).

Observation site	Easting (Zone 55 GDA94)	Northing (Zone 55 GDA94)	Vegetation description*	Comments
016	756031	7395884	Near SW corner of woodland of *Eucalyptus cambageana* on distinct dome compared to surrounding area (different patch of woodland to site 15). Tree height variable - a clump of relict trees 12-16m tall, with the rest to N, E, S as advanced regrowth 8-12m tall including *E.crebra*, *E.populnea*, *Acacia catenulata*, *Acacia rhodoxylon*, *Alectryon oleifolius*. Sparse ground layer mostly grazed buffel grass.	Shed and new cattle yards 100m SE. RE 11.4.9 grading upslope to RE 11.5.9.
017	756255	7395811	South-east part of large domed orange-sand area with some scalded areas north of cattle yards. Mostly very open woodland of *Eucalyptus crebra* 12-18m tall. Shrub layer of *Acacia rhodoxylon*, *Petalostigma pubescens*, *Alstonia constricta*, *Carissa ovata*. Ground layer with *Sida* sp., *Dianella* sp., **Melinis repens*, *Heteropogon contortus*. 50m south - small patch of woodland of *Eucalyptus cambageana* about 50m x 50m in size. 200m south - large patch of advanced brigalow regrowth with dam in centre. Heavily impacted by cattle.	RE 11.5.9, with small patch of 11.4.8 to south. further south is advanced regrowth of 11.4.9.
018	756289	7395995	Eastern edge of woodland from site 17, of *Eucalyptus crebra*. Shrub layer of *Petalostigma pubescens*, *Alectryon oleifolius*, *Acacia rhodoxylon*, *Alstonia constricta*, *Erythroxylum australe*. Ground layer mostly *Aristida* sp. Orange clayey sand as for site 17. To east - patchy low open brigalow regrowth past edge of dead trees.	RE 11.5.9. To east is regrowth 114.9.
019	756209	7395978	Change from *Eucalyptus crebra* (RE 11.5.9) to *E.populnea* (RE 11.5.3) to north-west. Both on orange sand with similar understorey.	RE 11.5.9 with 11.5.3 to NW.
020	756683	7395652	Centre of small patch of advanced regrowth of two types: To south - regrowth of *Eucalyptus cambageana* 10-14m tall (RE 11.4.8), with *Carissa ovata*, *Citrus glauca.* To north - regrowth of brigalow 8-10m tall (RE 11.4.9), with bare understorey and ground layer, and slight depression (possibly gilgai).	Advanced regrowth of RE 11.4.8 and 11.4.9.
021	755002	7392677	Non-remnant, completely cleared. Buffel grass. Occasional slight gilgai. To west - neighbouring property has remnant brigalow, *Eucalyptus thozetiana*, *Casuarina cristata*, *Terminalia oblongata*, *Eremophila* sp. (probably *E.deserti*).	Western boundary, near southern boundary. Old broken dam. Non-remnant. To west in neighbouring property is RE 11.4.3.

* naturalised (weed or exotic) species indicated by *

Brigalow = *Acacia harpophylla*, buffel = *Pennisetum ciliare*.

TBI = to be identified.

4.3.1.2. Regional Ecosystems

Additional, unmapped REs observed from field survey are shown in Table 4-14.

Table 4-14 Little Sorrel - Unmapped Regional Ecosystems Observed

Regional Ecosystem Code	Description (DEHP 2014a)	Common names	VM Act Status	Biodiversity Status
11.7.1	*Acacia harpophylla* and/or *Casuarina cristata* and *Eucalyptus thozetiana* or *E.microcarpa* woodland on lower scarp slopes on Cainozoic lateritic duricrust.	Brigalow and/or belah and napunyah or grey box.	Least Concern	Of Concern

The RE mapping for the study area was generally correct, but some map revision is necessary to at least remove the sliver of the RE mosaic 11.4.3/11.4.8, as shown in Figure 4-1. These two REs represent brigalow-belah and brigalow-blackbutt respectively, but neither were observed to occur as remnants in that area (sites 1 & 2). Instead, this area was observed as RE 11.5.9, and was locally dominated by small-leafed white mahogany (*Eucalyptus tenuipes*), which has presumably produced a dark aerial imagery signature similar to that of brigalow. Alternatively, the pre-clearing mapping by DEHP was used to produce the remnant mapping, and the deletion of the RE mosaic 11.4.3/11.4.8 polygon has left a sliver at the edge of the remaining remnant.

The low escarpment running down the mid-east part of the study area is mapped as the RE mosaic 11.7.2/11.7.2/11.7.2, which can be amalgamated into a single code of 11.7.2. The multiple codes have originated from more locally detailed floristic codes which are not relevant to this study. This RE has been confirmed on site as dominated by lancewood (*Acacia shirleyi*) (see sites 6,7,11,12). The plateau was of limited interest in terms of target Threatened flora and fauna species, so was briefly confirmed at site 13.

The footslopes of the low escarpment have relatively extensive areas of regrowth blackbutt, brigalow and occasional scrub species (sites 5 & 8). These areas need to be mapped as regrowth RE 11.4.8, as they are considered to be capable of regenerating to remnant structure and condition, and may provide future habitat for the target Threatened flora species.

The unmapped, relatively pure stand of napunyah (*Eucalyptus thozetiana*) in the mid-west of the study area (site 15) is best classified by RE 11.7.1, but there is no laterite visible in this area and topographic relief is minimal. However, this RE will be used for practical purposes to highlight the difference in dominant trees, as the alternative REs describe it very poorly and there is some confusion as to their descriptions. RE 11.4.9b describes it as "*Acacia harpophylla, Eucalyptus thozetiana*" which is a partly correct description, but then the comments in that section of REDD indicate that it has been reclassified as RE 11.4.8a, which is described as "palustrine wetland". This is completely inapplicable to the *Eucalyptus thozetiana* community observed on site.

There is an unmapped remnant consisting of several REs in the north-west of the study area (sites 16-19) which occurs mostly on a sandy dome which was presumably not cleared due to soil type (it is surrounded by clay soils). This sandier area is mostly RE 11.5.9 (ironbark dominated) with some 11.5.3 (poplar box dominated), but also has smaller areas of REs 11.4.9 (brigalow) and 11.4.8 (blackbutt-brigalow). It is these brigalow (and blackbutt-brigalow) areas that are of interest for potential Threatened flora and fauna target species habitat, and as such need to be mapped in order to calculate areas and assess value.

There is a small unmapped remnant with one half consisting of blackbutt, and the other half of brigalow, at site 20. This remnant is in fair condition, but is considered too small to be viable as habitat for the target Threatened flora species, due to edge effects. It may be of value as a cumulative area if sufficient other areas are also set aside as offsets, but it is not contiguous with these areas.

There is an unmapped remnant of blackbutt at site 14, adjacent to a dam. The soil has been compacted severely by cattle at this site and it is considered unlikely that the soil structure would recover sufficiently to provide suitable habitat for the target Threatened flora species. The small size of this remnant, in conjunction with its poor condition, do not make it worthwhile to recognise on revised mapping.

There is an unmapped remnant of brigalow about 200m south of site 17. This was seen to be intensively used by cattle and the small size of this remnant, in conjunction with its anticipated poor condition, do not make it worthwhile to recognise on revised mapping.

Extensive areas of brigalow regrowth were observed in the study area but almost none had gilgai ("melonholes"). The general domination of the ground layer by buffel grass (*Pennisetum ciliare*) determined that doing a detailed BioCondition site was of no benefit. Some of the denser areas of brigalow regrowth are considered to be capable of regenerating to remnant structure and condition, and may provide future habitat for the target Threatened flora species. These areas can be added to revised mapping.

A revised RE map is shown in Figure 4-5 (figure is split into two parts). Red lines are DEHP RE mapping, green lines are the revised RE polygon mapping.

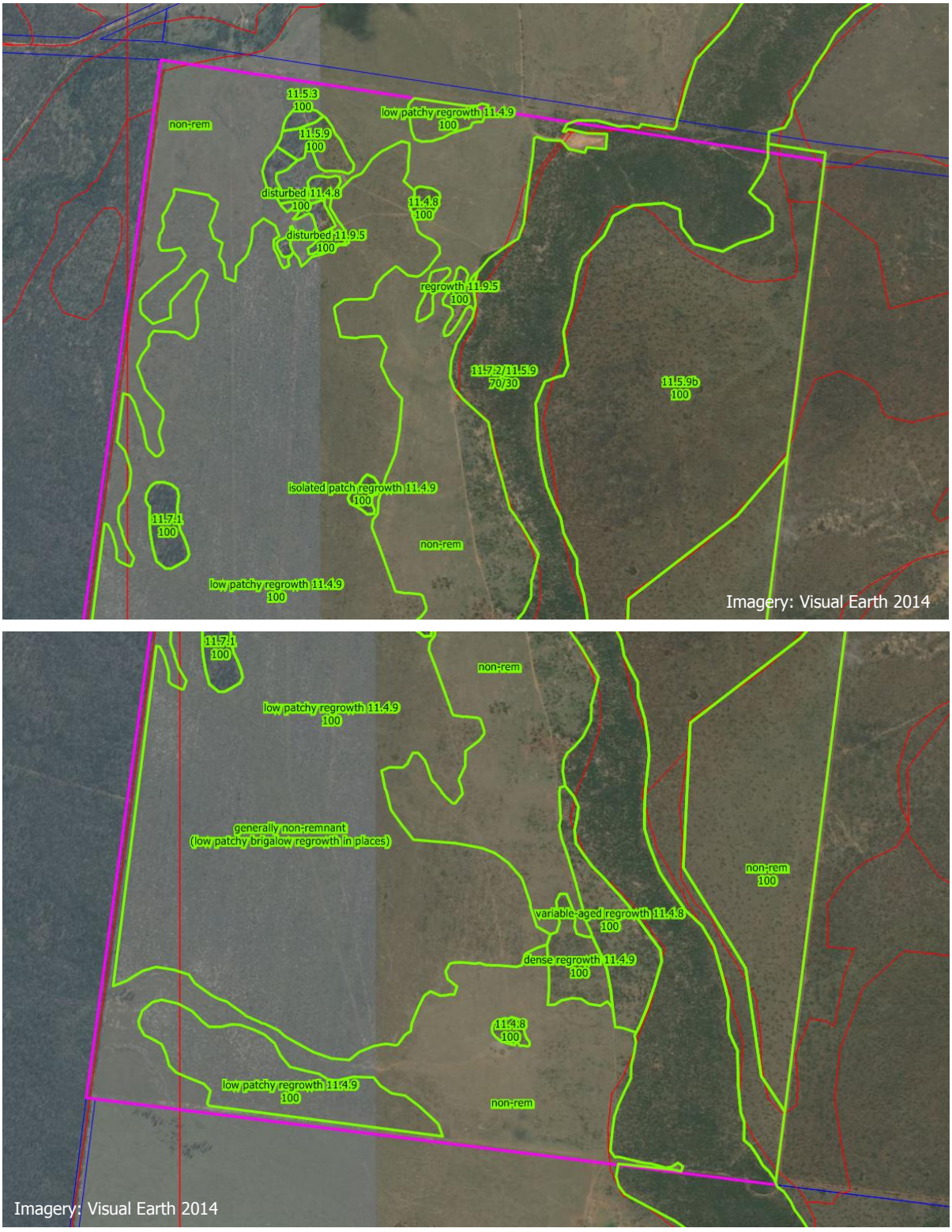

Figure 4-5 Revised RE Map for Little Sorrel

4.3.1.3. Threatened Plant Species

No suitable habitat was found in the study area for the target Threatened flora species (*S.elachophyllum, S.johnsonianum*). However, the extensive areas of brigalow regrowth, and particularly the blackbutt-brigalow regrowth on the footslopes of the low escarpment, may be suitable as future habitat, provided grazing is excluded.

It is possible that habitat for the Threatened flora species may be provided by the unmapped remnants at sites such as 17, but the lack of nearby records of occurrence of these species suggest that this would be unlikely, particularly when compared with more favourable areas such as Zamia (north).

A small patch of native frangipani (*Cerbera dumicola*) was seen at site 12, towards the top of the slope of the low escarpment near the southern boundary of the study area. This species is Near Threatened under the NC Act, and may be of offset value for future projects.

4.3.1.4. Weeds

Much of the study area was extensively dominated by buffel grass (*Pennisetum ciliare*). In areas not dominated by buffel grass, there were some minor weeds observed, but these were not serious. These weed species include occasional tree pear (*Opuntia tomentosa*). Tree pear is a Class 2 Declared Plant under the LP Act and efforts to control it are required.

4.3.2. Lot 9 Plan BH194 north parcel ("Zamia")

4.3.2.1. Observation Sites

An aerial image of the study area, with sites overlaid, is shown in Figure 4-6. Site observations are shown in Table 4-15. Note that observation site numbers may not start at "1" due to other Lots surveyed as part of this study.

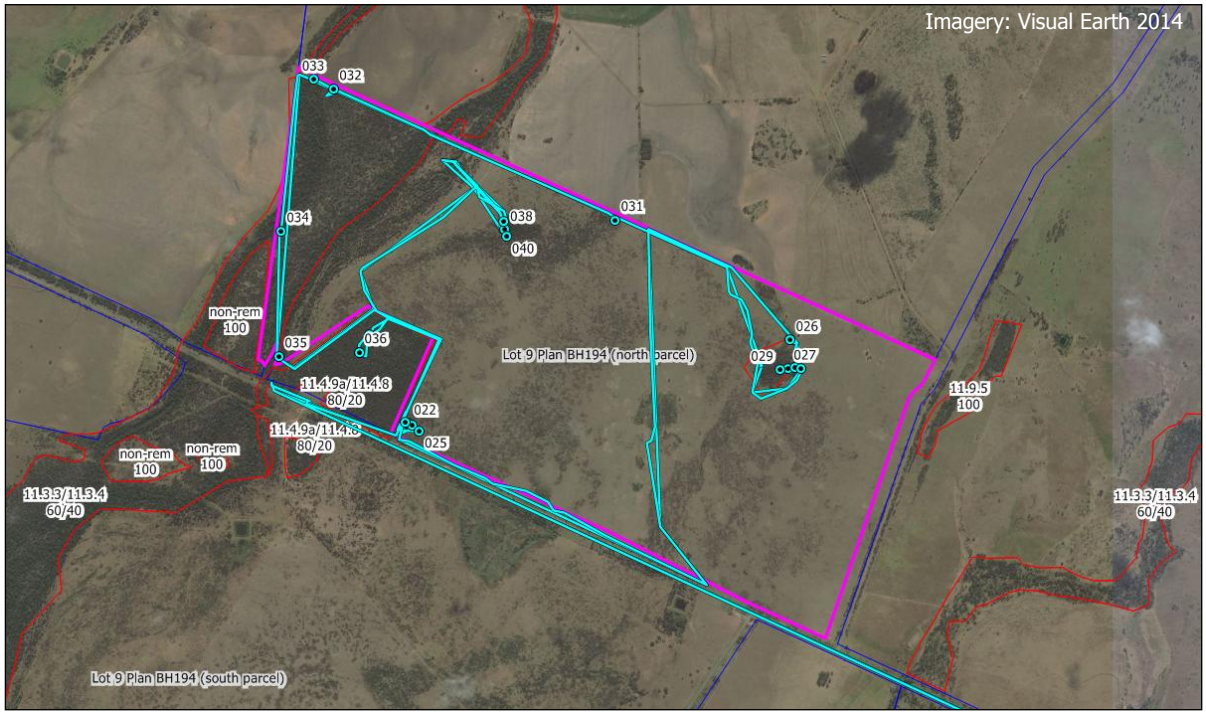

Figure 4-6 Zamia (northern portion) - Observation Sites

Blue dots=observation sites in study area, with GPS tracks. Red = mapped remnant Regional Ecosystems.

Distance along southern boundary of northern parcel is approximately 4 km including Zamia Creek.

Table 4-15 Zamia (northern portion) - Site Observations

Observation site	Easting (Zone 55 GDA94)	Northing (Zone 55 GDA94)	Vegetation description*	Comments
022	740753	7276065	Brigalow regrowth 1-3m tall (avg. 2m) on moderate gilgai. Ground layer sparse in dips. Mostly buffel on higher areas (rims) and in small flat cleared areas. *Leptochloa digitata* in larger depression here on site. *Enchylaena tomentosa*, occasional small **Parthenium hysterophorus*. Small open area has **Oxalis corniculata*, *Atalaya hemiglauca*, *Apophyllum anomalum*, *Portulaca oleracea*, *Eriachne* sp., *Terminalia oblongata*, *Evolvulus alsinoides*, *Capparis lasiantha*, *Glycine* sp., *Enteropogon* sp., *Sporobolus caroli*, *Citrus glauca*, *Solanum* sp.(possibly *S.johnsonianum*).	Near SE corner of Zamia Creek Conservation Park.
023	740775	7276052	As above - brigalow regrowth 1-3m tall (avg. 2m) on moderate gilgai. Patchy cover to 40%.	BioCondition site1. Site centre - 50m mark.
024	740735	7276073	As above.	BioCondition site1. 0m mark.
025	740817	7276019	As above.	BioCondition site1. 100m mark.
026	743066	7276526	Brigalow regrowth to 3m (avg. 2m) 20% cover. Buffel grass 50% cover. Also *Leptochloa digitata*, *Eriachne* sp., *Enteropogon acicularis*, *Sporobolus caroli*. Note: loose head of *Homopholis belsonii* - possibly from adjacent conservation park. *Enchylaena tomentosa*, *Atalaya hemiglauca*, *Apophyllum anomalum*, *Terminalia oblongata*, *Evolvulus alsinoides*, *Capparis lasiantha*, *Glycine* sp., *Citrus glauca*, *Solanum* sp. (possibly *S.johnsonianum*) **Pennisetum ciliare*, **Oxalis corniculatum*, *Parthenium hysterophorus*.	Gentle drainage depression with pale sandy clay. Ex 11.3.1 or 11.4.9. Two possible Threatened species.

Observation site	Easting (Zone 55 GDA94)	Northing (Zone 55 GDA94)	Vegetation description*	Comments
027	743050	7276355	Patch of disturbed mapped remnant brigalow-belah about 16m tall with about 30% canopy cover, and 30% partly-overlapping sub-canopy cover. Large logs. Disturbed by grazing. T1-EDL (upper) 16-18m tall, 10% cover - *Eucalyptus cambageana*, *Casuarina cristata*. T2-Sub (mid) 8-12m tall, 50% cover - *Acacia harpophylla*, *Brachychiton rupestris*, *Geijera salicifolia*. S1 (tall shrub) 2-8m tall, 40% cover - *Geijera parviflora*, *Citrus glauca, Alectryon diversifolius, Everistia vacciniifolia, Alectryon oleifolius, Amyema* sp. S2 (lower shrub) 1-2m tall, 10% cover - *Casuarina cristata, Citrus glauca, Acacia harpophylla, Carissa ovata, Lysiphyllum carronii, Terminalia oblongata, Apophyllum anomalum.* G (ground) - *Enteropogon acicularis, Sporobolus caroli, Capparis lasiantha, Apophyllum anomalum, Cissus opaca, Sida* sp., *Maireana microphylla, *Pennisetum ciliare, *Opuntia tomentosa.*	BioCondition site2. Site centre - 50m mark.
028	743091	7276360	As above.	BioCondition site2. 0m mark.
029	743001	7276348	As above.	BioCondition site2. 100m mark.
030	743129	7276354	Eastern edge of remnant patch of brigalow-belah with *Eucalyptus cambageana*. To east: extensive cleared area with no gilgai. Soil has top sandy layer, dominated by buffel grass. Note: ridge line several hundred metres west defines eastern edge of gilgai to west.	
031	742023	7277263	Distinct sudden change from orange sandy-covered soil to east, and typical black soil with cracking and gilgai to west. Western area supports brigalow regrowth 1.5 - 4m tall.	
032	740339	7278079	Typical sample of wedge of dryland vegetation in between anabranches of Zamia Creek. Tall open woodland of brigalow 18-20m tall, 10% cover, with variable height understorey to 10m tall (avg. 5m) consisting of brigalow, belah, *Lysiphyllum hookeri*, *Eremophila mitchellii, Geijera parviflora*, 1 *Capparis arborea, Amyema* sp. on brigalow, buffel grass, *Enchylaena tomentosa*.	Remnant RE 11.9.5. No gilgai.

Observation site	Easting (Zone 55 GDA94)	Northing (Zone 55 GDA94)	Vegetation description*	Comments
033	740219	7278138	One of several channels comprising western (or NW) branch of fork of creeks surrounding wedge of dryland vegetation (as per site 32). Tall brigalow, with *Melaleuca bracteata* and *Eucalyptus coolabah*. Ground layer and water impacted by cattle.	Zamia Creek, NW anabranch. RE 11.3.1, with 11.3.37.
034	740005	7277232	Further downstream - generally mostly *E.coolabah* along creek from site 33 to here, but with component of brigalow approximately 10%. Also some brigalow on floodplain on western side of creek, but too narrow to be of offset value (cleared to west), and mostly *E.coolabah*.	Traverse down western boundary of creek, mostly RE 11.3.37 and 11.3.3. Further survey needed to determine amount of brigalow 11.3.1.
035	739981	7276481	Further downstream - *E.coolabah, Melaleuca trichostachya. Terminalia oblongata* up on terrace, with *Brachychiton rupestris* and brigalow.	Creek. RE 11.3.37 and 11.3.3.
036	740463	7276497	Remnant brigalow-belah in good condition. T1 (upper) 12-14m tall, 30% cover - brigalow 15%, belah 15%. Most larger trees 15-20cm DBH, but all under BioCondition threshold of 32cm. T2 (mid) 7-10m tall, 20% cover - brigalow, belah, *Citrus glauca, Flindersia dissosperma*. S1 (shrub) 1.5-4m tall, 15% cover - *Geijera parviflora*, brigalow, belah. S2 (shrub) 0.5-1.5m tall, 30% cover - *Paspalidium* sp., *Enchylaena tomentosa, Capparis lasiantha, Chenopodiaceae, Acanthaceae, *Opuntia tomentosa, Cissus opaca, Sida* sp. Litter 30%, bare 30%, logs 10%.	Inspection of site record location for *Solanum elachophyllum* in Zamia Creek Conservation Park. No sign of target species due to dry conditions. RE 11.4.3.
037	740528	7276602	*Senna* sp. collected TBI.	Also in Zamia Creek Conservation Park, near site 36.

Observation site	Easting (Zone 55 GDA94)	Northing (Zone 55 GDA94)	Vegetation description*	Comments
038	741355	7277216	Patch of disturbed mapped remnant brigalow-belah about 14m tall with about 10% canopy cover, and 70% partly-overlapping sub-canopy cover. Large logs. Disturbed by grazing. T1-EDL (upper) 12-16m (avg.14m), 10% cover - *Casuarina cristata* (dominant), *Acacia harpophylla*. T2-Sub (mid) 2-12m (avg.9m), 60% cover - *Casuarina cristata, Acacia harpophylla, Lysiphyllum carronii, Alectryon diversifolius, Terminalia oblongata*. S1 (shrub) 1-2m, 5% cover - *Acacia harpophylla, Casuarina cristata, Geijera parviflora, Terminalia oblongata, Alectryon diversifolius, Carissa ovata*. G (ground) *Ancistrachne uncinulata*, thin-leafed grass grazed (possibly *Enteropogon acicularis*), *Cissus opaca*, *Jasminum didymum* subsp. *lineare*, *Enchylaena tomentosa, Capparis lasiantha*, probably *Sida* sp., **Bryophyllum* sp., **Opuntia tomentosa*.	BioCondition site3. Site centre - 50m mark.
039	741347	7277265	As above.	BioCondition site3. 0m mark.
040	741364	7277175	As above.	BioCondition site3. 100m mark.

* naturalised (weed or exotic) species indicated by *

Brigalow = *Acacia harpophylla*, belah = *Casuarina cristata*, buffel = *Pennisetum ciliare*.

4.3.2.2. Regional Ecosystems

Additional, unmapped REs observed from field survey are shown in Table 4-16.

Table 4-16 Zamia (northern portion) - Unmapped Regional Ecosystems Observed

Regional Ecosystem Code	**Description (DEHP 2014a)**	**Common names**	**VM Act Status**	**Biodiversity Status**
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open-forest on alluvial plains.	brigalow and/or belah on alluvium	Endangered	Endangered
11.3.37	*Eucalyptus coolabah* fringing woodland on alluvial plains.	coolabah on channels	Least Concern	No Concern at Present

The RE mapping for the study area was generally correct, with the western remnant area surrounding and between Zamia Creek and its anabranch as eucalypt floodplain REs 11.3.3 (coolabah) and 11.3.4 (blue gum and/or other floodplain eucalypts). However, there is a large wedge of brigalow and belah, sampled at site 32, between the anabranches, which is mappable as RE 11.4.3 (or possibly 11.9.5 depending on soil type and geology mapping).

The large remnant of Zamia Creek Conservation Park, which is immediately adjacent to the study area, is generally correctly mapped as a mosaic of two brigalow REs (11.4.9a and 11.4.8). It was observed to be RE 11.4.3 in places such as site 36 due to the presence of belah (*Casuarina cristata*), but it is beyond the scope of this study to revise the mapping in this external area. It is also largely unnecessary since all three afore-mentioned REs are generally brigalow dominated or co-dominated, and are hence similar.

The isolated patch of brigalow in the north-east part of the study area is also mapped correctly, as RE 11.9.5, sampled at site 27 (BioCondition site 2). However there is also a similar-sized remnant patch of brigalow-belah which has not been mapped, and is sampled at site 38 (BioCondition site 3).

Extensive areas of brigalow regrowth were observed in the study area and a significant proportion of this had gilgai ("melonholes"). This regrowth with gilgai was sampled near the south-east corner of Zamia Creek Conservation Park, at site 23 (BioCondition site 1). The regrowth over gilgai is most likely from RE 11.4.9. Most of the area without gilgai, especially if undulating, is likely to be from RE 11.9.5.

More minor additions to the RE mapping entail adding riparian forest communities for Zamia Creek, as there are currently only floodplain communities mapped. RE 11.3.37 (fringing coolabah) needs to be added, and also RE 11.3.1 (brigalow on alluvium). These two REs can only be currently mapped as a mosaic, as further survey would be needed to differentiate them along the watercourses.

A revised RE map is shown in Figure 4-7 (figure is split into two parts). Red lines are DEHP RE mapping. Note that "disturbed" vegetation has a mature structure but the understorey is missing, therefore it is classified as regrowth.

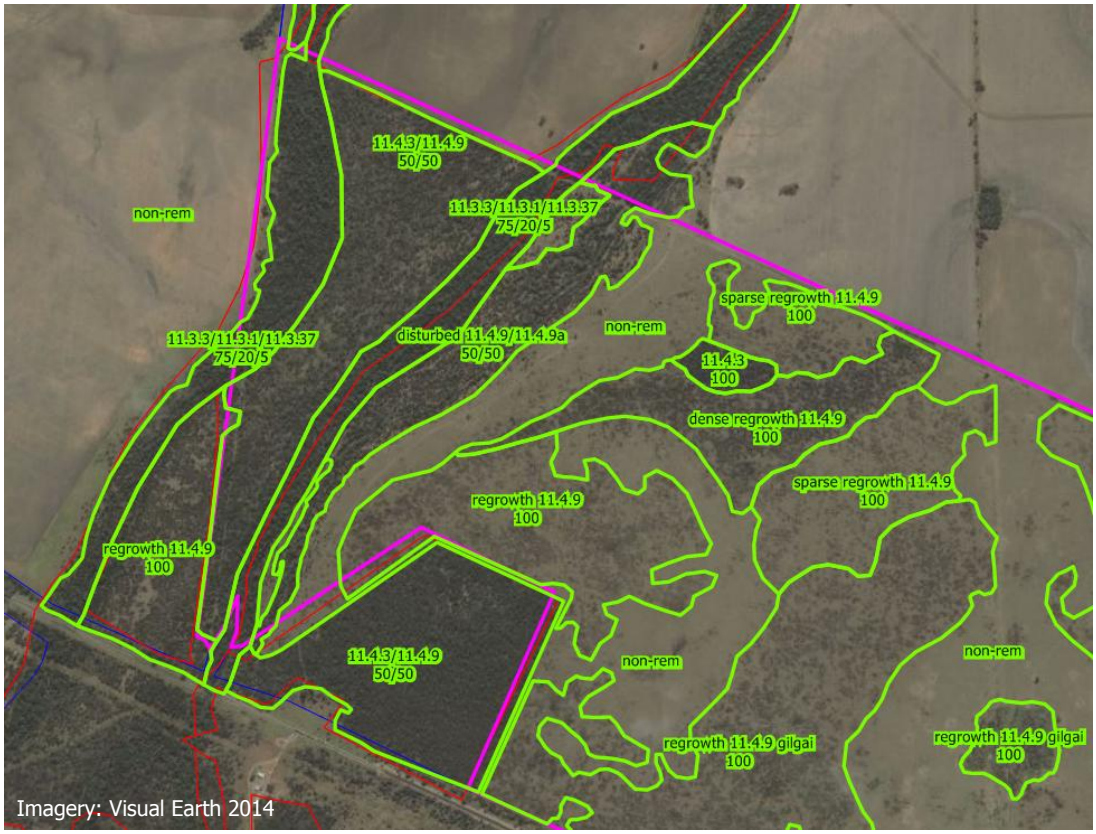

Figure 4-7 Revised RE Map for Zamia (northern portion)

4.3.2.3. Threatened Plant Species

A seedling resembling one of the target Threatened species, *Solanum johnsonianum*, was found at site 22. A photograph was taken *in situ*.

A Quaternary sample site (site 36) was done in remnant vegetation in the adjacent Zamia Creek Conservation Park, at a known location of one of the target Threatened species, *Solanum elachophyllum*. The dry seasonal conditions made it unlikely to find the species, but it gave a good indication of suitable habitat. On this basis it was decided that an unmapped remnant of similar structure and floristics to the north may also provide suitable habitat, albeit in poorer condition due to grazing disturbance. A BioCondition site (BioCondition site 3) was done at this location (also marked as Quaternary site 38). Similar habitat was also observed to occur within the large wedge-shaped remnant in between the anabranches of Zamia Creek. This was sampled at Quaternary site 32.

In general, some potentially suitable habitat was found in the study area for the target Threatened flora species (*Solanum elachophyllum, S.johnsonianum*). The areas with the greatest potential are the following:

- The wedge of brigalow and belah, sampled at site 32, in between the anabranches of Zamia Creek. This is the largest remnant in the study area and is improved in value because it is contiguous with the creek. It is currently mapped as a mosaic of REs 11.3.3/11.3.4, but should be mapped as 11.4.3 or 11.9.5 depending on soil type and geology mapping.
- The isolated patch of brigalow in the north-east part of the study area is mapped correctly, as RE 11.9.5, sampled at site 27 (BioCondition site 2).
- There is also a similar-sized remnant patch of brigalow-belah which has not been mapped, and is sampled at site 38 (BioCondition site 3).
- The extensive areas of brigalow regrowth mainly in the western half of the study area, and in particular, those areas with gilgai near the south-east corner of Zamia Creek Conservation Park, sampled at site 23 (BioCondition site 1). These areas are not currently suitable habitat due to lack of shade, but are considered to be capable of regenerating to remnant structure and condition, and may provide future habitat for the target Threatened flora species. These areas can also be added to revised mapping.

4.3.2.4. Weeds

Some parts of the study area were extensively dominated by buffel grass (*Pennisetum ciliare*). In areas not dominated by buffel grass, there were some minor weeds observed, but these were not serious. These weed species include tree pear (*Opuntia tomentosa*). Tree pear is a Class 2 Declared Plant under the LP Act and efforts to control it are required.

4.3.3. Lots 21 & 22 Plan AU37, Bushblock

4.3.3.1. Observation Sites

An aerial image of the study area, with sites overlaid, is shown in Figure 4-8. Site observations are shown in Table 4-17. Note that observation site numbers may not start at "1" due to other Lots surveyed as part of this study.

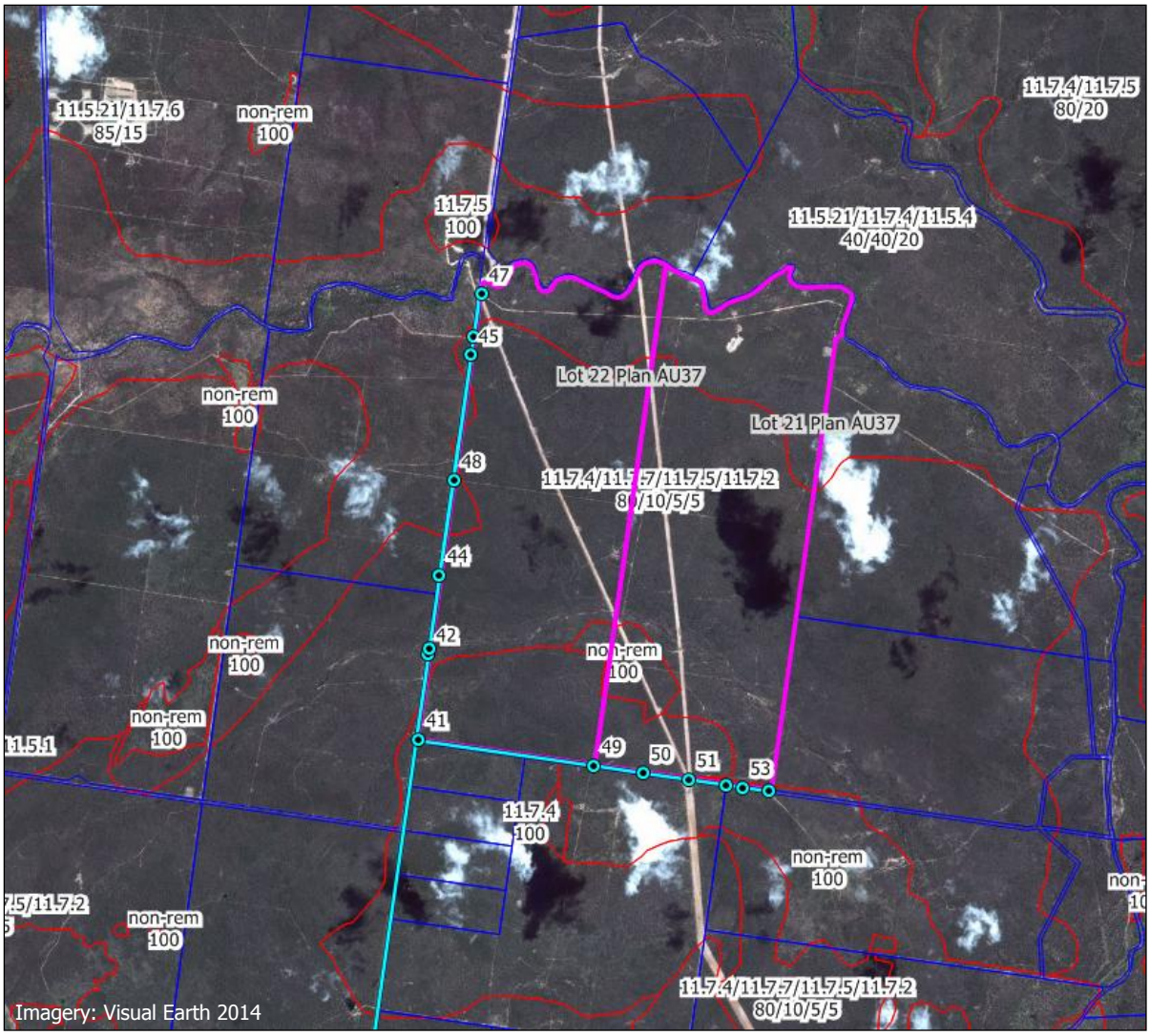

Figure 4-8 Bushblock - Observation Sites

Blue dots=observation sites in study area, with GPS tracks. Red = mapped remnant Regional Ecosystems.

Distance along southern boundary of both blocks combined is approximately 3.7 km.

Table 4-17 Bushblock - Site Observations

Observation site	Easting (Zone 56# GDA94)	Northing (Zone 56# GDA94)	Vegetation description*	Comments
41	218764	7069749	Tall open forest of *Eucalyptus crebra* 20-25m tall, with dense lower layer of *Callitris glaucophylla* to 16m tall.	NE corner of L Tree Rd and Warramoo Rd. RE 11.5.1.
42	218836	7070534	Drainage depression. As above for site 41, but also with *Eucalyptus chloroclada*.	Minor drainage depression, but no channel.
43	218842	7070583	As above for site 42, but with channel in drainage depression.	Minor drainage depression with channel.

Observation site	Easting (Zone 56# GDA94)	Northing (Zone 56# GDA94)	Vegetation description*	Comments
44	218924	7071265	Another drainage depression. As for site 42.	Drainage depression.
45	219169	7073290	As for site 41, but also with *Melaleuca decora*.	Probably a slightly wetter area.
46	219190	7073457	*Eucalyptus crebra, Angophora leiocarpa, Callitris glaucophylla.*	Grid on L Tree Rd, and gate to Lot. No east-west fence east of grid, but there is one to the west.
47	219251	7073852	*Eucalyptus crebra, Callitris glaucophylla, Corymbia* sp. (probably *C.watsoniana*).	NW corner of Lot. Good access along both boundaries and along pipeline easement running ESE.
48	219036	7072135	As for site 41.	Gate. Minor track access to east.
49	220387	7069545	*Eucalyptus crebra, Callitris glaucophylla, Eucalyptus populnea.*	Gate on Warramoo Rd. Minor track access to north between Lot 21 & Lot 22. RE 11.5.1 with minor 11.5.1a.
50	220842	7069489	*Eucalyptus crebra, Callitris glaucophylla, Allocasuarina luehmannii*. Shrub layer of *Acacia* spp.	
51	221269	7069437	Mainly *Eucalyptus crebra, Allocasuarina luehmannii*.	Start of fork into two gas pipeline easements to NNW.
52	221615	7069396	*Eucalyptus crebra, Corymbia* sp. (probably *C.watsoniana*), *Acacia* spp., minor *Callitris glaucophylla.*	Drainage depression, but no channel.
53	221766	7069375	Semi-advanced regrowth, or possibly stunted, *Eucalyptus* sp. (probably *E.tenuipes*), *Callitris glaucophylla, Acacia* spp., *Corymbia* sp. (probably *C.watsoniana*), *Eucalyptus crebra.*	
54	222013	7069346	Shrubland of *Acacia aprepta* for last 100m of road. 1 large *Eucalyptus populnea* in corner of Lot 21 but no others.	East end of Warramoo Rd, with gate SE to Warramoo. Also gate to NE property. No track to Lot 21 but fenceline is cleared.

* naturalised (weed or exotic) species indicated by *

note that this site (Bushblock) is further east than the other two sites (Little Sorrel and Zamia) and is in MGA Zone 56 (and not 55).

4.3.3.2. Regional Ecosystems

Based on existing RE mapping and general familiarity with the study area, Lots 21 & 22 ("Bushblock") were not considered suitable habitat for the targeted offset species (*Solanum elachophyllum & S.johnsonianum*). For this reason only a brief roadside survey was undertaken to ensure that the RE mapping was broadly correct, and this was found to be the case.

4.3.3.3. Threatened Plant Species

It is possible, but considered unlikely, that there are minor areas of suitable habitat for the targeted offset species (*Solanum elachophyllum & S.johnsonianum*) within Lots 21 & 22 ("Bushblock"). Detailed survey similar to the other sites (Lot 9 (north) "Zamia " and Lot 5 "Little Sorrel") may be of benefit in order to assess habitat and search for other target flora species that may become relevant offset species due to future projects.

4.3.3.4. Weeds

Roadside survey found that weed infestation was relatively minor, but a more thorough survey would be necessary to make a complete assessment, particularly since the woody vegetation is relatively dense and visibility is limited. It is expected that there would be at least occasional localised infestations of *Opuntia* spp. (prickly pear or tree pear). Significant clearing for high pressure gas pipelines has been done, and these areas may pose a significant future risk for weed invasion.

4.4. BioCondition Assessments

4.4.1. Calculation Requirements

4.4.1.1. State Requirements and Methodology

Clearing of vegetation in Queensland often requires the use of offsets once measures to avoid and mitigate impacts have been implemented. Offsets are currently required under the *Queensland Environmental Offsets Policy (Version 1.0)* (DEHP 2014b). The policy applies to matters of state environmental significance listed in Schedule 2 of the *Environmental Offsets Regulation 2014*. This framework replaces the Queensland Biodiversity Offset Policy (DERM 2011c). Although the policy framework has changed, the methodology for assessing the ecological condition of vegetation remains the same.

BioCondition assessment (DERM 2011a) is a field assessment used to evaluate the ecological condition of vegetation to be cleared, and compare it with the condition of vegetation proposed as offset. With these data, the two areas of vegetation are compared using Ecological Equivalence Methodology (DERM 2011b).

Condition indicators are based on Tables 2 & 4 in the EEM, shown in Table 4-18. Scores are calculated for each indicator, so that clearing and offset areas can be compared.

Table 4-18 State Offset Condition Indicators

	Condition indicator (from Tables 2 & 4 in the Ecological Equivalence Methodology, DEHP 2011b)
1	Recruitment of woody perennial species.
2	Native plant species richness
	Trees
	Shrubs
	Grasses
	Forbs
3	Tree canopy height.
4	Tree canopy cover.
5	Shrub canopy cover.
6	Native perennial grass cover.
7	Organic litter.
8	Large trees.
9	Coarse woody debris.
10	Weed cover.
11	Size of patch (Fragmented).
12	Connectivity (Fragmented).
13	Context (Fragmented).
14	Distance from water (Intact).
	Sum of score:
	Area (Ha).
	Sum of scores x area / 100 = Ecological equivalence score for ecological condition

The calculations in this report will be completed by using a benchmark RE for comparison, in order to assess offset feasibility based on absolute environmental values. The same method of calculation will be necessary to compare the study area with the intended areas of clearing. The clearing area is compared with the offset area, using the following calculation:

- Sum of scores x area / 100 = Ecological equivalence score for ecological condition.

BioCondition benchmarks were developed by the Queensland Herbarium (2012) based on CORVEG vegetation mapping site data, and are periodically updated. These provide standardised average data (*e.g.* heights, cover, floristic diversity) on selected REs in good condition.

Wherever possible, BioCondition data collected from the EIS is used if deemed to be reliable, but may need to be supplemented with additional BioCondition site data to enable calculations to satisfy DEHP requirements. The main reasons for additional data collection will depend on Condition Indicators 11-14 as seen in the preceding table, which requires knowledge of the following:

- Size of patch (Fragmented).
- Connectivity (Fragmented).
- Context (Fragmented).
- Distance from water (Intact).

Further calculations may be necessary to compare the study area with the intended areas of clearing depending on any *special features* which may be present in the clearing area, based on Tables 7 & 8 in the Ecological Equivalence Methodology (DERM 2011b). These special features are mapped in an Offsets Special Features GIS layer available from DEHP. Recent changes in DEHP offset policy may affect the need or use of this dataset. The special features are shown in Table 4-19. Scores are calculated for each feature.

Table 4-19 State Offset Special Feature Indicators

	Special Feature Indicator (from Tables 7 & 8 in the Ecological Equivalence Methodology, DEHP 2011b)
	Indicators which require adjacency calculation:
1	Centres of endemism.
2	Wildlife refugia.
3	Areas with concentrations of disjunct populations.
4	Areas with taxa at limits of geographic range.
5	Areas with high species richness.
6	Areas considered to be important for maintaining populations of ancient and primitive taxa.
7	Areas containing regional ecosystems with distinct variation in taxa composition associated with geomorphology and other environmental variables.
8	Artificially created waterbodies of ecological significance.
9	Areas considered to be important because of high relative density of hollow-bearing trees.
10	Breeding or roosting sites used by a significant number of individuals.
12 (sic)	Priority species.
	Indicators where adjacency is not applicable:
11 (sic)	Ecological corridors.
13	Significance of patch within a 1 kilometre buffer.
14	Protected area estate buffer.

4.4.1.2. Commonwealth Requirements and Methodology

Vegetation clearing offsets are also required under Commonwealth policy. The policy was last updated in October 2012: *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DOTE 2014b). The policy applies to Threatened

Ecological Communities and Threatened species (and their habitat) as defined under the EPBC Act, and therefore has some overlap with the Queensland policy.

An offsets calculator is supplied by DOTE in the form of an Excel spreadsheet, which is a different method to the DEHP EEM. The collection of field data is still done primarily using the State-derived BioCondition methodology (DERM 2011a).

The Commonwealth policy is not applicable to the two NC Act target Threatened species in this report (*Solanum elachophyllum & S.johnsonianum*), as they are not listed as Threatened species under the EPBC Act. It will still be applicable to the clearing of any Threatened Ecological Communities (*e.g.* brigalow).

4.4.2. Site Selection

4.4.2.1. Lot 5 KM135, Little Sorrel

The Little Sorrel site had limited areas of vegetation suitable for BioCondition assessment, on the basis of:

- Limited areas of the same remnant REs suitable for offset.
- No records of nearby occurrence of target Threatened species (*Solanum elachophyllum & S.johnsonianum*).
- High impact by cattle grazing and trampling, based on brief observations recorded during Quaternary site data survey.

4.4.2.2. Lot 9 Plan BH194 (north), Zamia

The Zamia (north) site had several areas of vegetation suitable for BioCondition assessment, on the basis of:

- Target REs in relatively good condition for the region, based on brief observations recorded during Quaternary site data survey.
- Known nearby occurrence of target Threatened species (*Solanum elachophyllum & S.johnsonianum*).
- Proximity to remnant brigalow in good condition in Zamia Creek Conservation Park, and Zamia Creek.

Three different representative sites were selected for BioCondition assessment. These were:

- Regrowth brigalow on gilgai. This would originally have been RE 11.4.9. This site was BioCondition site 1 (Quaternary site 23), near the south-east corner of the brigalow remnant of Zamia Creek Conservation Park. This remnant is adjacent to the regrowth area, and has a recorded occurrence of *Solanum elachophyllum*.
- Blackbutt-belah. This is RE 11.4.8. This site was BioCondition site 2 (Quaternary site 27), an isolated mapped remnant in the east of the study area.
- Brigalow-belah. This is RE 11.4.3. This site was BioCondition site 3 (Quaternary site 38), an isolated *unmapped* remnant in the mid-north of the study area. It could potentially be joined to Zamia Creek Conservation Park by brigalow regrowth in between the two areas.

4.4.2.3. Lots 21 & 22 Plan AU37, Bushblock

The Bushblock site had no areas of vegetation suitable for BioCondition assessment, on the basis of:

- No mapped areas of the same remnant REs suitable for offset. Only brief survey along two boundaries of the site (on public roads) were necessary to confirm that the site was not a suitable offset.
- No records of nearby occurrence of target Threatened species (*Solanum elachophyllum & S.johnsonianum*).

4.4.3. BioCondition Calculations - Zamia (north) Sites

4.4.3.1. Regrowth Brigalow RE 11.4.9 on Gilgai

BioCondition assessment of regrowth brigalow on gilgai was done at BioCondition site 1 (Quaternary site 23). This would originally have been RE 11.4.9. Calculations are shown in Table 4-20, which is based on the sample table in Appendix E of the EEM. A relatively low score is expected for this site because it is regrowth, but calculations are done nonetheless for consistency with the other remnant offset sites, and to help assess the overall value of the site. There is currently no BioCondition benchmark (Queensland Herbarium, 2012) available for RE 11.4.9, so a benchmark for a similar RE was selected - RE 11.9.5. Ideally a Best On Offer site of the same RE is assessed and a temporary benchmark established, but this was beyond the scope of this study. It would however be required in subsequent work if comparing clearing and offset areas using EEM.

Table 4-20 BioCondition Scoring - Regrowth Brigalow RE 11.4.9 on Gilgai

	Field-based Condition Indicators	Benchmark RE* (11.9.5 west as surrogate)	Offset study area	Comparison %	Benchmark Score	Offset score
1	Recruitment of woody perennial species (%). Offset must score >=3.	100	100	100	5	5
2	Native plant species richness.					
	Trees.	4	1	25	5	2.5
	Shrubs.	5	1	20	5	0
	Grasses.	5	4	80	5	2.5
	Forbs.	10	9	90	5	2.5
3	Tree canopy height.	15	2	13	5	0
4	Tree canopy cover. Offset must score >=2.	32	2.5 (30 avg)	8 (94 avg)	5	0 (5 avg)
5	Shrub canopy cover.	19	5.5	30	5	3
6	Native perennial grass cover.	30	5	17	5	1
7	Organic litter.	49	40	82	5	5

	Field-based Condition Indicators	Benchmark RE* (11.9.5 west as surrogate)	Offset study area	Comparison %	Benchmark Score	Offset score
8	Large trees (Ha).	10	0	0	10	0
9	Coarse woody debris (m/Ha).	688	0	0	5	0
10	Weed cover.	0	<1	>	10	10
	Total of Field Indicators:				**75**	**24 (or 29)**
	GIS/map-based Indicators					
11	Size of patch (Ha - include adjoining woody).	No data	~430			10
12	Connectivity (length adjacent woody boundary %).	No data	~5%			0
13	Context (% woody within 1km).	No data	~50%			2 (TBC)
14	Distance from water (intact bioregions only).	N/A for B.Belt	n/a			n/a
	Sum of All Indicators:					
	Area (Ha).	applies to clearing areas				
	Sum of scores x area / 100 = Ecological equivalence score for ecological condition					

* Benchmarks from Queensland Herbarium (2012). In this case a surrogate RE 11.9.5 needed to be used as RE 11.4.9 was unavailable. Site is in sub-region 21, Dawson River Downs, therefore western benchmark of 11.9.5 needs to be used.

This site has a BioCondition score of between 24 and 29 based solely on field condition indicators. This indicates that that its ecological condition is not as high as the benchmark RE (score 75). However, this is to be expected since this potential offset community is regrowth. The GIS-based indicators would improve its score, due to its patch size, particularly when joined to the adjacent Zamia Creek Conservation Park remnant. Its connectivity is also high, as it joins the Park along the Park's entire eastern boundary of approximately 400m, and another nearby patch of regrowth joins for approximately 800m. Furthermore, the Park is in turn joined to the remnant vegetation of Zamia Creek, which extends considerably further. This would produce a high *context* score. *(Note: a vehicle track runs along the perimeter of the Park but this can be decommissioned, or preferably retained as a firebreak).*

Tree canopy cover was measured by running the measuring tape through open areas due to difficulty with access through (and over) dense young brigalow regrowth. This tended to under-represent the amount of cover, and a higher estimate of cover is proposed as an alternative in the above table. Also, most of the brigalow was slightly under 2m tall, and hence missed out on being counted as tree cover.

The EEM allows for exclusion of some indicators if they are not naturally present in a particular type of community. In the case of this shrubland, it might be possible to exclude large tree counts, which would improve the relative score of the offset area. Section B.2, Box B.4 of the EEM demonstrates this.

The size of this patch of regrowth (with gilgai) is approximately 85 ha. The total area of brigalow regrowth in the study area (with or without gilgai) is approximately 280 Ha, based on revised RE mapping using field survey data. This area is then used in future calculations when comparing with clearing areas (refer to last two rows of above table). Regrowth areas will be worth *less* than remnant areas. The proximity to Zamia Creek Conservation Park, and a known occurrence of one of the target threatened flora species, adds ecological value to these regrowth areas.

4.4.3.2. Blackbutt-Belah RE 11.4.8

BioCondition assessment of blackbutt-belah was done at BioCondition site 2 (Quaternary site 27). This is RE 11.4.8. Calculations are shown in Table 4-20. There is currently no BioCondition benchmark (Queensland Herbarium, 2012) published for RE 11.4.8, but a draft benchmark was available from the Queensland Herbarium.

Table 4-21 BioCondition Scoring - Blackbutt-Belah RE 11.4.8

	Field-based Condition Indicators	Benchmark RE* (11.9.5 west as surrogate)	Offset study area	Comparison %	Benchmark Score	Offset score
1	Recruitment of woody perennial species (%). Offset must score >=3.	50**	50	100	3	3
2	Native plant species richness.					
	Trees.	4	9	225	5	5
	Shrubs.	7	7	100	5	5
	Grasses.	10	2	20	5	0
	Forbs.	14	5	36	5	2.5
3	Tree canopy height.	16	15	94	5	5
4	Tree canopy cover. Offset must score >=2.	32	34.5	108	5	5
5	Shrub canopy cover.	15	5	33	5	3
6	Native perennial grass cover.	10	0.6	6	1	0
7	Organic litter.	75	53.4	71	5	5
8	Large trees (Ha).	115	26	23	10	5
9	Coarse woody debris (m/Ha).	800	291	36	5	2
10	Weed cover.	0	20	>	10	5
	Total of Field Indicators:				**69**	**45.5**
	GIS/map-based Indicators					
11	Size of patch (Ha - include adjoining woody).	No data	5.8			2
12	Connectivity (length adjacent woody boundary %).	No data	~50%			0
13	Context (% woody within 1km).	No data	~50%			2 (TBC)

14	Distance from water (intact bioregions only).	N/A for B.Belt	n/a			n/a
	Sum of All Indicators:					
	Area (Ha).	applies to clearing areas				
	Sum of scores x area / 100 = Ecological equivalence score for ecological condition					

* Benchmarks from Queensland Herbarium (2012). In this case a draft benchmark from Queensland Herbarium was used as the RE 11.4.8 benchmark has not yet been published.

** Recruitment of woody perennial species - benchmark has no Eucalyptus cambageana recruitment, but has brigalow. Offset study area has no Eucalyptus cambageana recruitment either, but also has no brigalow in the tree layer, instead it is belah. It also has belah recruitment so it is also regarded as 50%.

This site has a BioCondition score of 45.5 based solely on field condition indicators. This indicates that that its ecological condition is not as high as the benchmark RE (score 69). The main factors that lower the score are lack of large trees, and lack of native grass cover. This mapped remnant is actually advanced regrowth and therefore has the potential to produce large trees in the future. Grazing has depleted native grass cover, which would return if grazing was excluded.

Coarse woody debris rules produced inaccurate results, as, for example, one particularly large hollow log spanned a gully and was not recordable since it was elevated.

This patch of remnant is isolated, so therefore the GIS-based indicators of *patch size* and *connectivity* will not improve scoring. However, the patch is near other remnants, and could be connected to them in future by brigalow regrowth if grazing was excluded. It would then connect to Zamia Creek Conservation Park, and in turn the more extensive remnant vegetation of Zamia Creek. The presence of the Park and Zamia Creek would currently produce a high *context* score.

The size of this patch of blackbutt-belah remnant is approximately 5.8 Ha, and is the total extent of this community in the study area. This area is then used in future calculations when comparing with clearing areas (refer to last two rows of above table). Although much smaller in total area than the brigalow regrowth, it has greater ecological offset value under State policy.

4.4.3.3. Brigalow-Belah RE 11.4.3

BioCondition assessment of brigalow-belah was done at BioCondition site 3 (Quaternary site 38). This regrowth is RE 11.4.3. Calculations are shown in Table 4-20.

Table 4-22 BioCondition Scoring - Brigalow-Belah RE 11.4.3

	Field-based Condition Indicators	Benchmark RE* (11.9.5 west as surrogate)	Offset study area	Comparison %	Benchmark Score	Offset score
1	Recruitment of woody perennial species (%). Offset must score >=3.	100	100	100	5	5
2	Native plant species richness.					
	Trees.	2	5	250	5	5
	Shrubs.	10	6	60	5	5
	Grasses.	4	2	50	5	5

	Forbs.	13	5	38	5	5
3	Tree canopy height.	24	14	58	5	3
4	Tree canopy cover. Offset must score >=2.	70	7 (+68 sub)	0.1 (or 107 with sub)	5	0 (or 5 with sub)
5	Shrub canopy cover.	48	5	10.4 (10 scores 0)	5	2
6	Native perennial grass cover.	6	1.4	23	5	1
7	Organic litter.	75	81.8	109	5	5
8	Large trees (Ha).	80 (DBH>32)	0 (or 200 for DBH 10-15)	0 (or 250 for smaller DBH)	10	0 (or 15 for smaller DBH)
9	Coarse woody debris (m/Ha).	1752	250	14	5	2
10	Weed cover.	0	10	>	10	5
	Total of Field Indicators:				**75**	**43 (or 63)**
	GIS/map-based Indicators					
11	Size of patch (Ha - include adjoining woody).	No data	~430			10
12	Connectivity (length adjacent woody boundary %).	No data	~50%			0
13	Context (% woody within 1km).	No data	~50%			2 (TBC)
14	Distance from water (intact bioregions only).	N/A for B.Belt	n/a			n/a
	Sum of All Indicators:					
	Area (Ha).	applies to clearing areas				
	Sum of scores x area / 100 = Ecological equivalence score for ecological condition					

* Benchmarks from Queensland Herbarium (2012).

This site has a BioCondition score of 43 (or as high as 63) based solely on field condition indicators. This indicates that that its ecological condition is not as high as the benchmark RE (score 75), but with the higher possible score of 63, this patch of remnant is a potential offset with ecological condition which is almost as high as the benchmark.

All trees in this patch were advanced regrowth, and hence the DBH ranged from 10-15 cm, therefore no trees were able to be included in the *large tree count*, due to the higher threshold DHB of 32 cm. This produced an inaccurate assessment of the patch, and an alternative score is included which takes these smaller trees into account.

The assessment of tree *cover* was inaccurate because most of the trees were in the sub-canopy, and had to be ignored in the scoring process, even though they comprised most of the overstorey, with a relatively small number of taller, narrow-crowned trees forming the Ecologically Dominant Layer. If the trees from the sub-layer are included in the EDL, a much higher and more appropriate cover is calculated.

This *unmapped* remnant is actually advanced regrowth and therefore has the potential to produce large trees in the future. Grazing has depleted native grass cover, which would return if grazing was excluded.

This patch of remnant is isolated, so therefore the GIS-based indicators of *patch size* and *connectivity* will not improve scoring. However, the patch is near other remnants, and could be connected to them in future by brigalow regrowth if grazing was excluded. It would then connect to Zamia Creek Conservation Park, and in turn the more extensive remnant vegetation of Zamia Creek. The presence of the Park and Zamia Creek would currently produce a high *context* score.

The size of this patch of brigalow-belah remnant is approximately 3.6 Ha. The total area of this community in the study area is far greater, but cannot be accurately estimated without further field survey. It is considered to form at least 50%, and possibly as much as 100%, of the wedge of brigalow (with or without belah) in between the two anabranches of Zamia Creek within the study area. This wedge is up to approximately 55 Ha of remnant, and appears to be in good condition. Some of it may be in condition equal to that of Zamia Creek Conservation Park. Some of this area may also be coolabah floodplain (RE 11.3.3), but may also be brigalow on alluvium (RE 11.3.1). Once confirmed, this area of brigalow (with or without belah) is then used in future calculations when comparing with clearing areas (refer to last two rows of above table). Although much smaller in total area than the brigalow regrowth, it has greater ecological offset value under State policy.

5. THREATENED FAUNA SPECIES TARGETED SURVEYS

5.1. Habitat Assessments

Field investigations and assessments of the fauna habitats supported on each property and their potential suitability to support the target threatened species undertaken as part of Stage 2, identified potentially suitable habitats for the target species on each of the proposed lots as detailed in Section 3.6. Consequent of these assessments, a field survey program was designed and implemented to undertake targeted surveys for these threatened species on each property as described in Table 5-1 below.

Table 5-1 Summary of Target Fauna Species, Potential Habitat, Occurrence Assessment and Survey Recommendations

	Species	1	2	3	4	5	6
Lot 5, KM135, Little Sorrel	Ornamental snake	✓	11.4.3/ 11.4.8, Cleared	×	Near	Possible/potential habitat present. Field validation required to assess presence/quality of gilgai habitats	Y
	Squatter pigeon	✓	11.5.9, 11.7.2, 11.4.3/ 11.4.8, Cleared	×	Near	Possible/potential habitat present	Y
	South-eastern long-eared bat	✓		×	×	Possible/potential habitat present. Field validation required to assess presence/quality of woodland condition, presence of roosting/foraging resources	y m
Lot 9 (north) BH194, Zamia	Ornamental snake	✓	11.3.3/ 11.3.4, regrowth 11.4.9/ 11.4.8, 11.9.5, Cleared	×	Near	Possible/potential habitat present. Field validation required to assess presence/quality of gilgai habitats	Y
	Squatter pigeon	✓	As above		Near	Possible/potential habitat present	Y
	South-eastern long-eared bat	✓	11.3.3/ 11.3.4, Cleared		×	Possible/potential habitat present. Field validation required to assess presence/quality of woodland condition, presence of roosting/foraging resources	y m
Lot 21/22, Plan AU37, Bushblock	Squatter pigeon	✓	11.7.4/ 11.7.7/ 11.7.5/ 11.7.2	✓	Near	Possible/potential habitat present	Y
	South-eastern long-eared bat	✓	11.7.4/ 11.7.7/ 11.7.5/ 11.7.2	✓	Near	Possible/potential habitat present. Field validation required to assess presence/quality of woodland condition, presence of roosting/foraging resources	Y

Table Key:
1 = Environment Protection and Biodiversity Conservation Act Protected Matters Search Tool; 2 = REs supported on each lot considered likely to support potentially suitable target species habitat; 3 = Wildlife database search; 4 = Atlas of Living Australia database search; 5 = Assessment of potential likelihood of target species/habitat occurrence; 6 = Targeted field surveys.
✓ = database potential habitat; ✓= database record; × = not recorded; Near = ALA record in local region;
Y = undertake targeted surveys; ym = undertake modified targeted surveys .

NB: Species in grey shading are offset target species considered likely to occur in these proposed offset areas, though not indicated by Cockatoo Coal in the Scope of Works as requiring investigation.

5.2. Methodology

5.2.1. Search Area Location and Selection

Search areas were selected on the basis that they contained suitable habitat values and structural composition likely to support the threatened fauna species targeted for the assessment. Each search area was selected to provide good geographical spread and representation of vegetation communities and landscapes across the study area.

5.2.2. Fauna Survey Methodologies and Effort

As a minimum requirement of the SoW, survey methodologies used to undertake this assessment were based on the individual significant species survey guidelines recommended by the Federal Government. These survey guidelines stipulate a variety of methods for targeted surveying of threatened species which can be summarised by the following:

- diurnal bird census and flushing surveys – squatter pigeon (*Geophaps scripta scripta*);
- active diurnal and nocturnal ground searching – ornamental snake (*Denisonia maculata*); and
- harp trapping and trip lining – south-eastern long-eared bat (*Nyctophilus corbeni/timoriensis*).

The following table details the threatened species considered for this assessment, the applicable survey methods as dictated by the Commonwealth threatened species survey guidelines and the level of survey effort required.

Table 5-2 Conservation Significant Species, Survey Methods & Efforts Matrix

Zoological Name	Survey Timing	Methods	Effort*
REPTILES			
Denisonia maculata ornamental snake	Nocturnal	Area Searches	1.5 hours/Ha over 3 nights
BIRDS			
Geophaps scripta scripta squatter pigeon	Diurnal	Census/Area Searches	15 hours/area, 10 hours flushing,<50Ha, 3 days
BATS			
Nyctophilus corbeni south eastern long-eared bat	Nocturnal	Harp/Anabat	Min 5 nights, 20 trap nights, areas <50Ha

* Effort as indicated in relevant Commonwealth Survey Guidelines.

The survey program comprised a range of survey techniques, utilised where applicable, at each search area. The methods applied are discussed in the following sections.

The survey methodologies employed for these assessments are based upon, conform to, if not exceed, current recommended methodologies (e.g. McFarland *et al.* 1999, Commonwealth survey guidelines for threatened species).

5.2.2.1. Diurnal Bird Surveys

Diurnal birds were surveyed using area searches that were comprised of early morning censuses, transect and flushing survey methods. In addition, surveys of water bodies supported within each property were conducted pre and post dusk and dawn. Area searches were conducted at search areas and at other selected locations where suitable

habitat for target species was supported. Census surveys were undertaken within four hours of sunrise and sunset. Birds were identified from either direct observations and/or their call vocalisations.

5.2.2.2. Nocturnal Herpetofauna Ground Searches

Dedicated active ground searches were conducted at each of the search areas and at other selected locations where suitable habitat for target species was supported. Surveys were conducted on each of the survey days to locate active/inactive reptiles and inactive frogs. Total search effort for each of the targeted species was dictated by the recommended Commonwealth survey guideline methodology applicable. This method involved:

- rolling logs and rocks;
- raking soil at the base of trees and shrubs and examination under debris; and
- searching under decorticating/exfoliating bark on logs and standing dead or live trees.

Spotlighting searches were undertaken on foot using hand-held spotlights and headlamps. These were conducted at selected search areas and at other selected locations where suitable habitat for target species was supported. Searches were conducted for a minimum of 60 minutes per area and replicated as dictated by survey requirements for the threatened species of interest.

5.2.2.3. Insectivorous Microbat Surveys

The survey program for insectivorous bat fauna was undertaken using harp traps and trip lining methods. With regards the *Nyctophilus* genus of microbats, it is impossible to differentiate between the calls of the species within this genus. Consequently, Anabat detection for specific identification of individual species' of *Nyctophilus* genus is useless. However, Anabat detection methods, as they can identify the genus, are useful in establishing whether a particular area supports the genus, and therefore, suitable habitat for the genus. This data can then be used to indicate whether *N. corbeni*, or other *Nyctophilus* spp., are present in a particular area, for which targeted trapping methods can then be employed.

Anabat detection involved both remote and active detection techniques with Anabat II detectors, used to record the ultrasonic signals of active bats. Remote detection (*i.e.* equipment programmed for unattended, fixed point, overnight detection of microbat calls, was employed during nocturnal spotlighting surveys.

Ultrasonic bat calls and locality details were recorded during the survey and subsequently analysed by Greg Ford, Balance Environmental, for species identification.

5.2.2.4. Targeted Area Searches

A series of rapid biodiversity assessments and target species surveys were undertaken in a range of representative and/or distinctive habitat types throughout the study site.

For diurnal activities, each search area, nominally comprised of up to four hectares, was surveyed for up to one person hour. At each selected search area, a combination of active diurnal ground searches, primarily for reptiles, and bird surveys were undertaken. For nocturnal assessments, an area of approximately two hectares was surveyed for a minimum of one survey person hour where spotlighting searches on foot were undertaken using 30-watt spotlights and headlamps.

Targeted area searches were also undertaken for specific species, such as ornamental snake, in specific habitat types, such as brigalow gilgai associations.

5.2.2.5. Driving Transects

Driving diurnal and nocturnal transect searches (driver plus one observer with a 100-watt spotlight) were undertaken from a 4WD along the road/track network within the study site primarily to survey for squatter pigeons.

5.3. Threatened Species, Survey Methodology and Effort

5.4. Threatened Species Profiles

The following section provides threatened species profiles for each of the conservation significant species surveyed.

5.4.1. Ornamental Snake

The ornamental snake (see photographs in Figure 5-1) is listed as vulnerable under the provisions of both the NC Act and EPBC Act and is one of several key threatened terrestrial fauna species that have been recorded on mining leases throughout the geographic extent of the Bowen Basin (*pers. obs*. A. Veary 1998 - 2012). It has a small, well-defined distribution range, located only in mid-eastern Queensland, and confined to the Brigalow Belt, primarily within the Fitzroy River drainage system (McDonald *et al*. 1991; Cogger *et al.* 1993; Cogger 2000). In the main, the biology and ecology of the ornamental snake is considered to be poorly known (Cogger *et al.* 1993; *pers. comm*. R. Shine, Sydney University 2005) however, the recently completed ACARP research project by the author has provided insight into the biology and movement patterns of this cryptic species (Footprints Environmental Consultants 2011).

Within the drainage system of the Fitzroy and Dawson Rivers, the ornamental snake is known to primarily inhabit brigalow (*Acacia harpophylla*) forest growing on grey cracking clays supporting gilgai formations (Footprints Environmental Consultants 2011). This habitat preference is believed to reflect the relative abundance of its food source, which is principally a diet of frogs (Cogger 2000, Wilson and Swan 2003). This cryptic snake is regarded as a specialist predator of native frogs (Shine 1983; Cogger 2000). At a brigalow woodland site near Nebo, snakes were only found in the vicinity of a complex of flooded gilgai, where there was an abundance of frog prey, however snakes were not found in nearby riparian and floodplain woodland vegetation (Melzer 2001 in DEWR 2007). Surveys conducted over the last 11 years have only recorded ornamental snakes within grey cracking clay soils supporting gilgai formations (*pers. obs.* A. Veary) and ecological modelling has identified that grey cracking clays in REs 11.4.8 and 11.4.9 appear to be the primary habitat type for the ornamental snake (Footprints Environmental Consultants 2011).

Activity levels, and hence highest potential for ornamental snake detection, are typically restricted to periods following suitable summer rainfall events which create optimum conditions for its favoured prey to be most active and concentrated around its breeding sites (Footprints Environmental Consultants 2011, *pers. obs*. A. Veary 1998 - 2012; *pers. comm.* R. Shine, Sydney University 2005). Thus, the opportunity to detect the ornamental snake is highly constrained.

During dry periods when gilgai formations do not support water and the soil has shrunk to form large ground cracks, the snakes seek refuge in these ground cracks. Once the soils are wet and cracks have closed up, the snakes seek refuge in dense tussock grass clumps

and in log piles where available (Footprints Environmental Consultants 2011). The snake also shelters under litter and fallen timber (Cogger 2000), becoming active only at night (Shine 1983, Footprints Environmental Consultants 2011). This suggests that vegetation groundcover characteristics may also be an important component of good quality ornamental snake habitat.

Current ecological knowledge (*pers. comm*. A. Veary 2011) suggests ornamental snake habitat requires soil landscapes that have the capacity:

- to pond shallow surface water for extended periods; and
- to provide a nutrient rich, seasonal wetland environment capable of supporting amphibious prey habitat; and also
- to dry and crack extensively on a regular basis to provide dry season snake refugia via surface cracks and sub-surface voids.

Figure 5-1 Photographs of Ornamental Snakes

5.4.2. Squatter Pigeon

The southern subspecies of the squatter pigeon (Figure 5-2 and Figure 5-3) is listed as vulnerable under both the NC Act and the EPBC Act. Squatter pigeons are small yet robust, ground dwelling, seed-eating birds with a preference for eucalypt woodland with a sparse native grass cover within close proximity to permanent water in tropical and subtropical eucalypt woodland (Frith 1982, Higgins 1996, Garnett & Crowley 2000).

The ecology of *Geophaps scripta* is poorly known and no populations estimates are given for the species (Higgins 1996). It is known that they nest on the ground; roost in low trees at night; forage on the ground, amongst sparse low grass and in improved pasture; are always near permanent water; and formally hunted and considered excellent eating (Higgins 1996). Very little is known about their breeding biology with only eight records available (Higgins 1996).

Key threatening processes detailed in Higgins (1996) note that much of their original habitat has been replaced with improved pasture for cattle grazing. However, this may be not as destructive as grazing by sheep. Improved pastures may supply an important food source.

Figure 5-2 Photograph of Squatter Pigeon

Figure 5-3 Squatter Pigeons Resting on Cattle Pad

5.4.3. South Eastern Long-Eared Bat

The south eastern long-eared bat (Figure 5-4) is listed as vulnerable under both the NC Act and EPBC Act and vulnerable by Duncan, Baker & Montgomery (1999).

This microbat inhabits southern central Queensland, central western New South Wales, north-western Victoria and South Australia (Parnaby 1995) and is considered scattered through the remainder of Queensland (Turbill and Ellis 2006) though surveys for this species through much of western Queensland have not been undertaken (C. Clague, unpubl. in SEWPaC Survey Guidelines).

The species also occurs in a range of habitat s from Buloke/belah woodlands to brigalow woodlands to a variety of eucalypt and bloodwood forest/woodlands, riparian zones to dry sclerophyll forest.

Mixed eucalypt and bloodwood woodlands/forests are dominant within this species habitat throughout inland Queensland, with it being most abundant in vegetation with a distinct canopy and a dense cluttered shrub layer (Dominelli 2000; Ellis et al. 1999; Koehler 2006; Lumsden 1994; McFarland et al. 1999; Parnaby 1995; Turbill & Ellis 2006).

This species is generally found in river red gum forest, savannahs and semi-arid woodlands. It also occur in ironbark/box/*Callitris* open forests and Buloke woodland (Duncan, Baker & Montgomery 1999). It roosts in tree hollows and under loose bark (Parnaby 1995a).

Extensive loss of habitat, clearing for agriculture, timber harvesting, grazing and inappropriate fire regimes (Parnaby 1995, Duncan, Baker & Montgomery 1999) are considered threatening process for this species.

Figure 5-4 South Eastern Long-eared Bat

5.5. Results and Discussion

The results of the habitat assessments and targeted field surveys for each of the respective lots proposed for potential offsets are detailed in the following sections.

5.5.1. Survey Timing and Personnel

Initial site reconnaissance and habitat assessments (Stage 2) were undertaken from the 7th to the 11th October 2013, inclusive. From these site assessments, detailed, targeted field surveys (Stage 3) were undertaken as follows (dates inclusive):

- Lot 5 – 28th – 31st October.
- Lot 9 – 1st – 4th November.
- Lots 21/22 – 8th – 13 November.

The principal investigator was Andrew Veary (BSc (Hons)) with assistance in the field from Elle Veary (BAppSc). Greg Ford (BAppSc, Grad Dip Resource Management) of Balance Environmental, was commissioned by Footprints Environmental Consultants to undertake the Anabat microchiropteran bat call recording analysis.

5.5.2. Field Survey Conditions

Excellent rainfall in the preceding summer seasons and the good rainfall in the local district over several years had recharged the waterbodies and creeks in the local area and promoted good vegetative growth, particularly in relation to the diversity and biomass of grasses.

Very little rain was recorded during the 2014 winter and immediately preceding and during the survey period.

Climatic condition leading up to the survey were characterised by hot (high 30's to low 40's °C), partly cloudy to fine days with warm (mid to low 20's °C), humid nocturnal conditions.

Environmental conditions immediately prior to undertaking the surveys for squatter pigeons and south-eastern long-eared bats were considered to be optimal for a targeted fauna survey for these species. For the ornamental snake however, environmental conditions were considered not to be optimal due to the lack of sufficient rainfall prior to or during the survey period. This meant that the gilgais did not support water and there was no observed frog activity within gilgai habitats. This would have resulted in no ornamental snake activity in potentially suitable habitats, if they are present within suitable habitats supported within the study site.

5.5.3. Lot 5, Little Sorrel

Detailed vegetation community descriptions and floristic structure and composition for this site are presented in Sections 4.2.1 and 4.3.1 above.

This site consisted of a mosaic of cleared/pastorally improved areas, remnant/regrowth patches of mixed eucalypt woodlands and extensive areas of regrowth brigalow on grey cracking clays.

The majority of this site has been cleared as part of pastoral improvement practises, which have been focused on the grey cracking clay soils. The north – south ridge line located in the central portion of the site supported a mosaic of lancewood woodlands on the ridge slopes with a ground cover of mixed native grasses. Dawson gum/brigalow and ironbark

woodland mosaics were located on mid-slope benches to the west, with dense ground cover dominated by buffel grass and blackcurrant bush. Above the ridge line and to the east on flat plains, ironbark/acacia open woodlands were supported with sparse cover of native grasses and chenopods.

At the toe of the ridge line and to the west, a mosaic of brigalow regrowth and buffel grass dominated the landscape. Several drainage lines were observed within the landscape. There were areas of weakly formed gilgais, observed within portions of this habitat type and grey cracking clays were present in these areas. There was some evidence of historically ponded water within a few of the larger gilgai formations.

There was an area of remnant vegetation associated with cattle yards and a farm dam in the northern central part of the site, situated on a slight hill. In addition, in the western central area, a small remnant of mountain yapunyah and brigalow persisted. In the central south, a copse of Dawson gum with some brigalow was associated with another farm dam. In the areas associated with the farm dams, there was little to no shrub nor ground layers present, consequent of the apparent use of the areas as cattle camps.

5.5.3.1. Ornamental Snake

Review of pre-clearing and remnant RE mapping and historical aerial photography (Google Earth) identified the possible presence of several areas of gilgai formations within Lot 5.

Field surveys were undertaken across the site to indentify, validate and map areas of gilgai formations and assess and evaluate the potential suitability of those habitats to support population/s of ornamental snake. As part of the field surveys, gilgai formations were identified within an area in the central part of the site (see Figure 5-7). This area supported regrowth brigalow to 5 m on cracking clays, where significant cracks and crevices were observed (Figure 5-5). The gilgai were considered to be poorly formed, represented by very shallow depressions and low mounds (Figure 5-6). Given the historical land management practises evident on site, the lack of distinct gilgai structure is considered to be most likely attributed to clearing and blade ploughing of the area for pastoral improvement. Consequently, it is considered that this area supports very low to no habitat value for ornamental snakes.

Figure 5-5 Photograph of Cracks and Crevices, Lot 5

Figure 5-6 Photograph of Gilgai Formation, Lot 5

5.5.3.2. Squatter Pigeon

Targeted field surveys identified two squatter pigeons in the south east corner of the property (Figure 5-7). These birds were observed as part of transect surveys, resting on the ground in the shade within ironbark open woodland with a native grass ground cover. Assessment of the habitats supported across the property and the confirmation of the species on site indicates that the site supports suitable habitat for squatter pigeon.

5.5.3.3. South-eastern Long-eared Bat

Anabat detection surveys were undertaken at specific locations that supported potentially suitable habitat for *Nyctophilus* species. These locations are presented in Figure 5-7. The dam locations were selected as they provided the opportunity to survey the microbat population of the local area as they congregate and utilise the dam to drink on dusk before embarking on foraging for the night.

Results of Anabat data collected from these surveys confirmed the presence of 12 microbat species from Lot 5. These species were:

- *Chalinolobus gouldii*
- *Chalinolobus morio*
- *Chalinolobus picatus* (NT – NC Act)
- *Nyctophilus* sp.
- *Scotorepens balstoni*
- *Scotorepens greyii*
- *Vespadelus baverstocki*
- *Chaerephon jobensis*
- *Mormopterus beccarii*
- *Mormopterus ridei*
- *Saccolaimus flaviventris*
- *Taphozous troughtoni*

Of note, is that the Anabat surveys recorded little pied bat (*Chalinolobus picatus*) which is listed as *Near Threatened* under the *NC Act*.

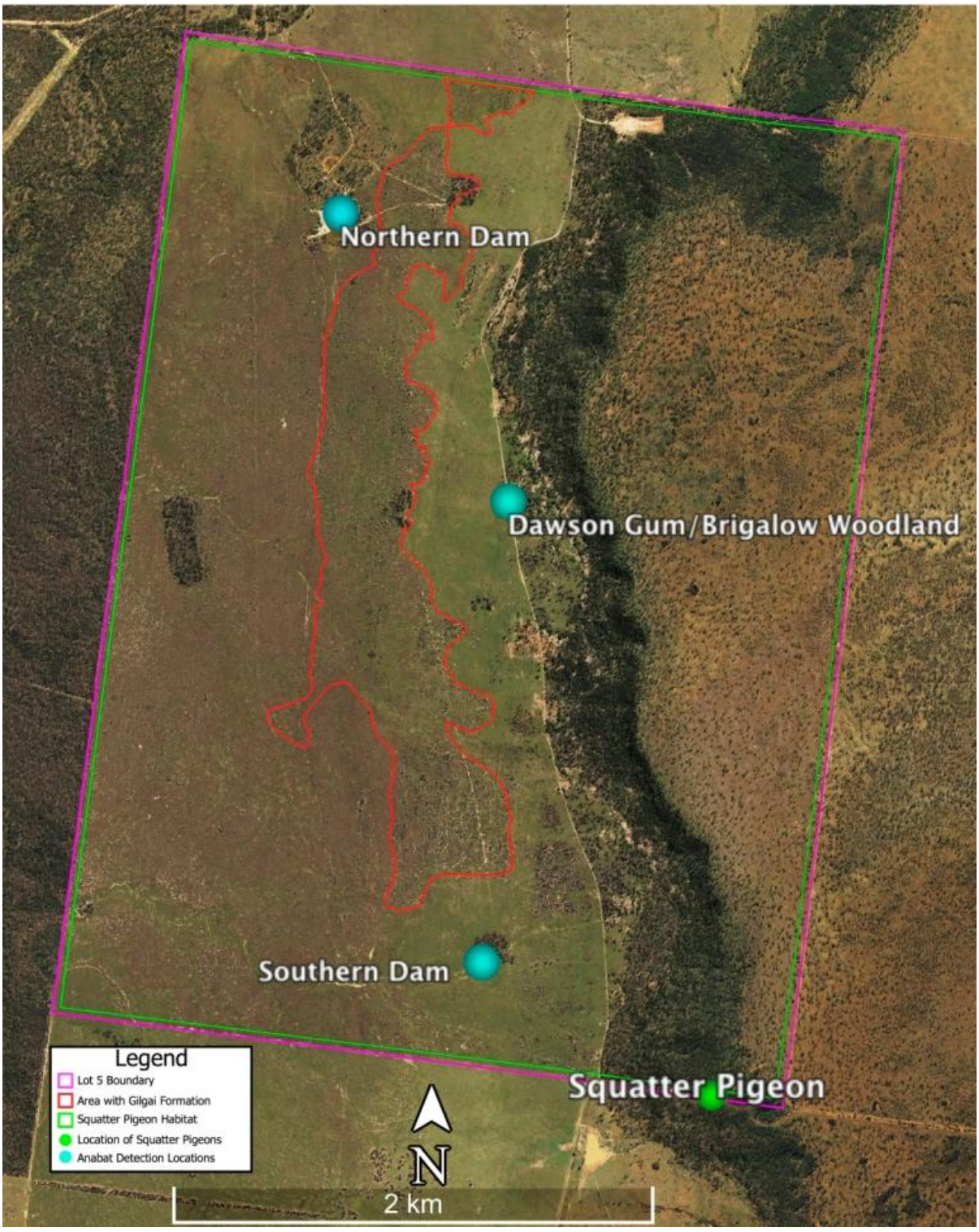

Figure 5-7 Lot 5 - Location of Habitat Features and Observed Target Species

5.5.1. Lot 9 (north), Zamia

Detailed vegetation community descriptions and floristic structure and composition for this site are presented in Sections 4.2.2 and 4.3.2 above.

This site consisted of a mosaic of cleared/pastorally improved areas, remnant/regrowth patches of mixed eucalypt woodlands and extensive areas of regrowth brigalow on grey cracking clays.

As with Lot 5, the majority of the site had been cleared for pastoral improvement. A small remnant patch of Dawson gum/brigalow and brigalow/belah woodlands remained which supported a relatively diverse shrub layer and a ground cover that included native and pastoral grasses.

Zamia Creek passed through the western portion of the site which consisted of several distinct channels within the high banks of the creek. Riparian vegetation consisted of coolabah woodlands fringing the creek channels, giving rise to mountain yapunyah/brigalow, brigalow/belah and brigalow woodlands on higher ground. This riparian zone supported a complex understorey mosaic of shrubs and ground cover, which included dense thickets of brigalow, mixed Acacia species, native grasses and blackcurrant bush. The eastern margins of the riparian zone were highly impacted by cattle, where, in some areas, there was little to no understorey and no ground cover.

5.5.1.1. Ornamental Snake

Review of pre-clearing and remnant RE mapping and historical aerial photography (Google Earth) identified the possible presence of several areas of gilgai formations within Lot 9 (north).

Identification, validation and mapping of areas of gilgai formations was undertaken across the site during field surveys to assess and evaluate the potential suitability of those habitats to support population/s of ornamental snake. As part of the field surveys, gilgai formations were identified within an area in the central western portion of the site (see Figure 5-10). These areas supported dense regrowth brigalow to 5 m on deep cracking clays, where significant cracks, crevices and sink holes were observed (Figure 5-8). The gilgai were considered to be well defined and formed, consisting of a mosaic of depressions and mounds and they supported vegetation characteristic of wetland habitats (see Figure 5-9). Given the diverse characteristics of the gilgai identified within the areas identified, it is considered likely that these habitat areas potentially support population/s of ornamental snakes.

Figure 5-8 Photograph of Cracks and Crevices, Lot 9

Figure 5-9 Photograph of Gilgai Formations with Sink Holes, Lot 9

5.5.1.2. Squatter Pigeon

Targeted field surveys identified a squatter pigeon in the north west corner of the property (Figure 5-10). This bird was observed as part of transect surveys, resting on the ground in the shade of dense regrowth brigalow on the fringe of a large remnant area of RE 11.4.3/11.4.9. Assessment of the habitats supported across the property and the confirmation of the species on site indicates that suitable habitat for squatter pigeon is supported across the whole site.

5.5.1.3. South-eastern Long-eared Bat

Anabat detection surveys were undertaken at four specific locations in the western half of Lot 9 (north) that supported potentially suitable habitat for *Nyctophilus* species collecting data for a total of 16 nights. These locations are presented in Figure 5-10. These locations were selected as they supported potentially suitable habitat, a structurally and floristically diverse mosaic complex of a tall canopy of mixed eucalypts and a dense, multi-layered shrubby understorey. Specifically, the riparian zone of Zamia Creek was targeted as this area forms part of an extensive riparian corridor of Zamia Creek that extends further to the north and east, draining into Mimosa Creek, ultimately into the Dawson River. The riparian

zones of these creeks appeared relatively intact and potentially forms an important movement corridor in a landscape that has been significantly altered for cropping and pastoral activities.

Nyctophilus species calls were recorded during most detector-nights across the study site, however, it is not possible to reliably differentiate these calls to species level. Two species are likely to be common at Lot 9 (north): *N. geoffroyi* and *N. gouldi*. *N. corbeni* (Vulnerable; *EPBC Act*) – also possibly occurs in the Moura study area (*pers.comm.* G. Ford).

The south eastern long-eared bat (*N. corbeni*) is generally only encountered in relatively large, more-or-less intact tracts of dry sclerophyll forest (e.g. ironbark-cypress-bulloak), but may forage in smaller forest remnants (e.g. roadside or riparian corridors) that are connected to larger tracts. It should, therefore, be considered as probably present where *Nyctophilus* species calls were recorded in larger forest tracts (*pers.comm.* G. Ford).

The only way of confirming the presence of *N. corbeni* in any study area is to undertake an extensive, systematic trapping survey using harp traps (Reardon 2010).

Results of Anabat data collected from these surveys confirmed the presence of 15 microbat species from Lot 9. These species were:

- *Chalinolobus gouldii*
- *Chalinolobus morio*
- *Chalinolobus picatus* (NT – NC Act)
- *Nyctophilus* sp.
- *Scotorepens balstoni*
- *Scotorepens greyii*
- *Vespadelus baverstocki*
- *Vespadelus vulturnus*
- *Miniopterus orianae oceanensis*
- *Austronomus australis*
- *Chaerephon jobensis*
- *Mormopterus beccarii*
- *Mormopterus ridei*
- *Saccolaimus flaviventris*
- *Taphozous troughtoni*

Of note, is that the Anabat surveys recorded little pied bat (*Chalinolobus picatus*) from all recording locations across the sites. This species is listed as *Near Threatened* under the *NC Act*.

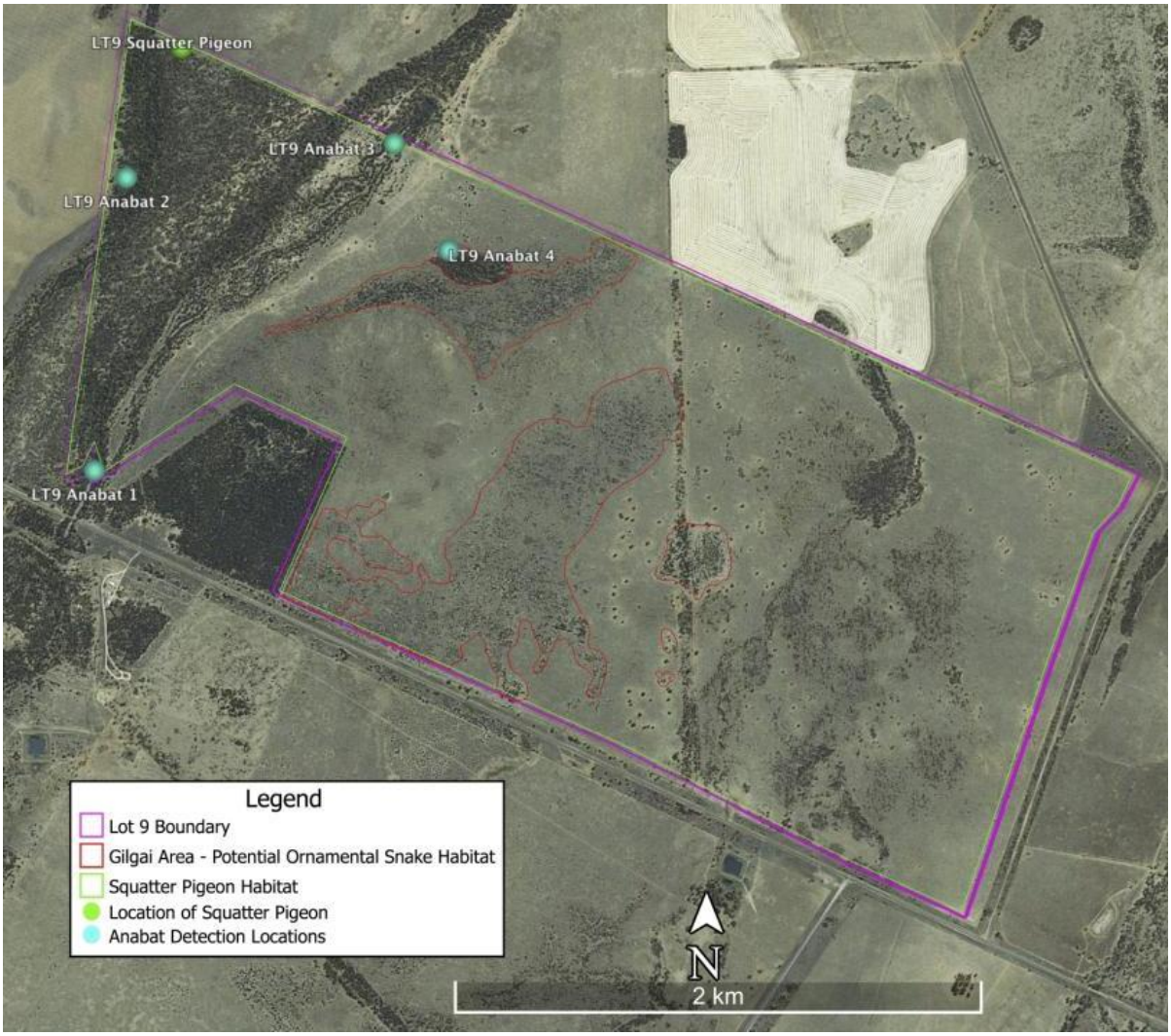

Figure 5-10 Lot 9 (north) – Location of Habitat Features and Target Species

5.5.2. Lots 21 & 22, Bushblock

Detailed vegetation community descriptions and floristic structure and composition for this site are presented in Sections 4.2.3 and 4.3.3.

The sites are located within a very large area of remnant vegetation and are located 3 km to the west of the Barakula State Forest. Historically, these sites have been selectively logged as part of the regional timber harvesting industry. Consequently, whilst there were old growth trees present on site, they were considered rare and sparsely distributed within the landscape.

The sites supported a floristically diverse and structurally complex mosaic of communities. Communities included: ironbark open woodlands with low shrub layer; mixed eucalypt woodlands with dense, diverse shrub layers; dense calitris closed woodlands; low, open eucalypt woodlands with low, very dense heath shrubland layers; riparian woodlands; buloke woodlands; stringybark woodlands; and cleared corridors for LNG high pressure gas pipelines. Ground cover in all areas (except cleared pipeline corridors) was dominated by native tussock grasses and low shrubs.

The northern boundary of the sites was formed by Tin Hut Creek which supported significant pools of water at the time of the survey. Tin Hut Creek flows to the east, draining into Bottletree Creek, which then flows into Dogwood Creek. Several drainage lines

traverse the site, with standing pools of water, whilst rare, being observed during the survey. A farm dam was located within a stand of stringybarks in the north western quadrant of the sites.

Habitat resource preferences for the south eastern long-eared bat were well represented on site including abundant tree hollows, decorticating bark, water courses with potentially semi-permanent water, a dam and well structured vegetation communities with tall canopy layer and sub-canopy and shrub layers from sparse to very dense.

5.5.2.1. Squatter Pigeon

Targeted field surveys completed a total of 289 km of transect surveys (both on ATV and walking) in addition to flushing surveys at 45 locations in approximately four hectare areas and dusk and dawn observations at water bodies at three locations. This survey effort failed to produce any records for squatter pigeon within the various habitats supported on these sites.

Review of historical databases, Atlas of Living Australia and Wildlife Online, identified one record for squatter pigeon approximately 8.5 kilometres to the north west of the sites, however this historical record is from 1997.

As a consequence of the assessment of the habitats supported across the sites, the survey effort expended and together with the authors extensive experience in surveying for and identifying squatter pigeons and their habitats, it is considered highly unlikely that the sites support squatter pigeons and consequently, should not be considered as suitable offset areas for this species.

5.5.2.2. South-eastern Long-eared Bat

Habitat assessments identified that the sites supported potentially suitable habitats to support south eastern long-eared bats. To that end, detailed targeted fauna surveys were implemented across the sites which included harp trapping, trip lining and Anabat remote detection (to collect additional background data on microbat population composition should the trapping program fail to capture *Nyctophilus* microbats).

Anabat detection surveys were undertaken at eight specific locations across the sites that supported potentially suitable habitat for *Nyctophilus* species. These locations are presented in Figure 5-11. These locations were chosen as they supported potentially suitable habitat, a structurally and diverse mosaic complex of a tall canopy of mixed eucalypts and a dense, multi-layered shrubby understorey. Anabat detection surveys provided 23 recording nights.

Nyctophilus species calls were recorded during most detector-nights across the study site, however, it is not possible to reliably differentiate these calls to species level. Two species are considered common (through the trapping program) within Lots 21 & 22: *N. geoffroyi* and *N. gouldi*. *N. corbeni* (Vulnerable; *EPBC Act*) – also potentially occurs in the Miles study area (*pers.comm.* G. Ford).

The south eastern long-eared bat (*N. corbeni*) is generally only encountered in relatively large, more-or-less intact tracts of dry sclerophyll forest (e.g. ironbark-cypress-bulloak), but may forage in smaller forest remnants (e.g. roadside or riparian corridors) that are connected to larger tracts. It should, therefore, be considered as probably present where *Nyctophilus* species calls were recorded in larger forest tracts (*pers.comm.* G. Ford).

The only way of confirming the presence of *N. corbeni* in any study area is to undertake an extensive, systematic trapping survey using harp traps (Reardon 2010) as was undertaken for this study.

Results of Anabat data collected from these surveys confirmed the presence of 13 microbat species from Lots 21/22. These species were:

- *Chalinolobus gouldii*
- *Chalinolobus morio*
- *Chalinolobus picatus* (NT – NC Act)
- *Nyctophilus* sp.
- *Scotorepens balstoni*
- *Scotorepens greyii*
- *Vespadelus baverstocki*
- *Vespadelus vulturnus*
- *Vespadelus troughtoni*
- *Austronomus australis*
- *Mormopterus beccarii*
- *Mormopterus ridei*
- *Saccolaimus flaviventris*

Of note, is that the Anabat surveys recorded little pied bat (*Chalinolobus picatus*) from all recording locations across the sites. This species is listed as *Near Threatened* under the *NC Act*.

Harp traps were deployed in nine locations within the most suitable habitats supported on site. The locations of these traps are depicted in Figure 5-11 below. A brief habitat description and accompanying photograph of each harp trap location is provided in Table 5-3 below. Further photographs of each trap location are presented in APPENDIX E. Harp traps were "open" for five nights, providing for 45 trap nights for the survey.

Table 5-3 Harp Trap Brief Habitat Descriptions of Harp Trap Locations

Trap Site #	Habitat Description	Photograph
1	Tin Hut Creek, located on rock outcrop within creek over large water pool. Old growth *E. tereticornis* common with numerous hollows and decorticating bark. Riparian vegetation tall eucalypt woodland with complex shrubby understorey including dense copse of calitris. Well developed ground cover of native grasses and thick leaf litter layer.	

Trap Site #	Habitat Description	Photograph
2	Situated within mixed eucalypt closed woodland within deeply incised gully, downstream from large rock overhang, adjacent to Tin Hut Creek. Complex, dense shrubby understorey with dense ground cover of native grasses and thick leaf litter layer.	
3	Buloke open woodland with ironbark emergents, sparse ground cover of native grasses, copses of buloke regrowth formed shrub layer copses and sparse leaf litter layer.	
4	Situated over a drainage channel with fringing melaleucas within a larger area of dense calitris forest. Ground cover patchy, native grasses and thick leaf litter layer.	

Trap Site #	Habitat Description	Photograph
5	Positioned on a rock bar within stream channel, immediately upstream of ponded water. Fringing vegetation included forest redgum, calitris copses, acacia understorey with dense ground cover of native grasses with a thick leaf litter layer.	
6	Ironbark open woodland with patchy acacia understorey with sparse native grass ground cover and a sparse leaf litter layer with abundant fallen timber.	
7	Mixed open woodland of eucalypts, acacia, calitris and buloke. Thick shrub layer of acacias and buloke with a sparse native grass ground cover.	

Trap Site #	Habitat Description	Photograph
8	Tall open ironbark woodland with tall open shrub layer of acacias and sparse native grass ground layer and leaf litter layer.	
9	Dense copse of calitris with dense native grass ground cover, abundant fallen timber and leaf litter layer.	
Trip Lining	Small farm dam, bare earthen banks as a result of dropping water levels and cattle access. Fringing vegetation dominated by stringybarks, calitris and acacia understorey. Sparse leaf litter, except under stringybarks, and ground cover layers.	

Trip lining surveys were undertaken on the farm dam over two nights from dusk until approximately 2100 hrs.

A total of 100 microbats, comprised of three genus and five species were captured and identified through the combined methods of harp trapping and trip lining. The five species were:

- *Nyctophilus geoffroyi*, lesser long-eared bat;
- *Nyctophilus gouldi*, Gould's long-eared bat;
- *Scotorepens balstoni*, inland broad-nosed bat;
- *Scotorepens greyii*, little broad-nosed bat; and
- *Mormopterus beccarii*, Beccari's freetail bat.

The details of the trapping program are presented in Table 5-4.

Table 5-4 Results of Microbat Trapping Program

Harp Trap Site #	*N. geoffroyi*	*N. gouldi*	*S. balstoni*	*S. greyii*	*M. beccarii*	Totals
1			4		2	6
2			1			1
3	3	2	1			6
4	1	2				3
5	3	14	13	1		31
6			1			1
7						
8		2	1			3
9	2	1		1		4
Trip Lining		1	32		10	43
Totals	9	22*	53	2	12	**98***

NB: * Total capture = 100 bats as one *N. gouldi* female was captured carrying two young.

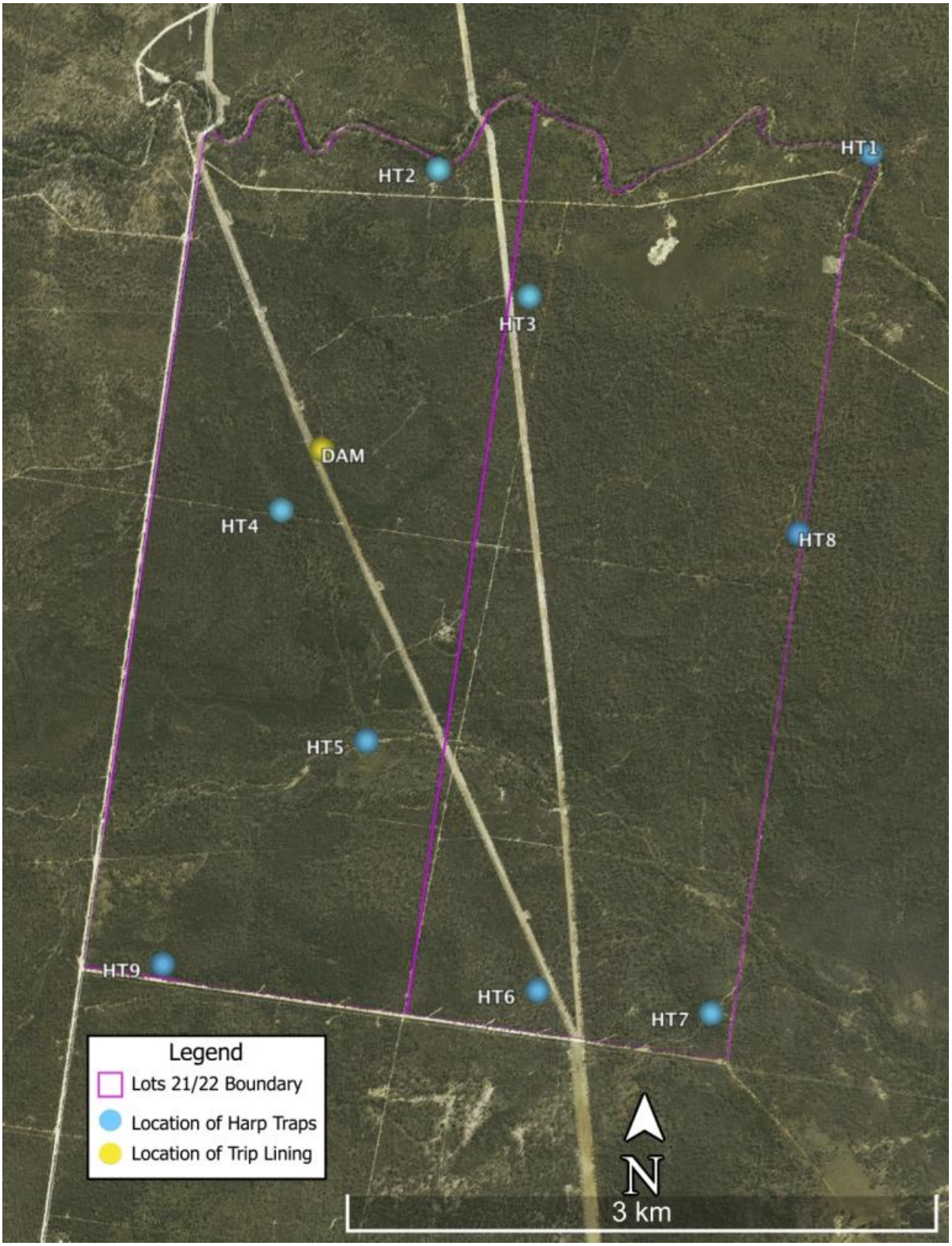

Figure 5-11 Lots 21 & 22 - Location of Habitat Features and Trap Sites

6. CONCLUSIONS AND RECOMMENDATIONS

In summary, the lots that have been identified to provide offsets for the Baralaba North Continued Operations Project, the Train Load Out facility, the Dawson Highway re-alignment and upgrade and the Coal Haulage Route upgrade are considered to potentially support suitable habitat for the six threatened target species and one target threatened community. Field surveys were undertaken to ascertain that extent, nature, condition and values of those suitable habitats for each of the target species/communities. In addition, targeted threatened species surveys were also completed to provide sufficient data to inform the assessment of the offset/s suitability as per the three offsets policies (Commonwealth and State – both superseded and current).

6.1. Flora

Lot 9 BH194 north parcel ("Zamia") is the preferred property of the three surveyed, to be used as a source of ecological offset areas for the target threatened flora species (*Solanum elachophyllum & S.johnsonianum*). Its key features that make it the preferred option are:

- Known occurrence of *Solanum elachophyllum* in the adjacent Zamia Creek Conservation Park.
- Up to approximately 55 Ha of brigalow (with or without belah) in between the two anabranches of Zamia Creek within the study area, with connectivity to the creek, and with structure and condition probably as good as the adjacent Park in some places. Refinement of mapping will determine the balance of the two REs - brigalow 11.4.9, and brigalow-belah 11.4.3. There may also be some brigalow on alluvium RE 11.3.1.
- Two additional small patches of suitable remnant belah. One patch is with blackbutt - approximately 5.8 Ha of RE 11.4.8, one patch is with brigalow - approximately 3.6 Ha of RE 11.4.3).
- Up to approximately 85 Ha of brigalow regrowth on gilgai, which may not be as useful for flora species offsets, but may be of high value for fauna species offsets (*e.g*. Ornamental Snake).
- Up to approximately 200 Ha of additional brigalow regrowth without gilgai. Although this may be of limited offset value, it functions as connective vegetation and improves the value of other preferred offset vegetation.
- Up to 65 Ha of remnant brigalow and up to 285 Ha of regrowth brigalow in various stages of regeneration are available as potential offsets for the brigalow TEC.

There are some limited offset values at Lot 5 KM135 ("Little Sorrel"). This property has an area of approximately 20 Ha of blackbutt regrowth (RE 11.4.8) on the footslopes of the low escarpment which runs through the entire property from north to south. The regrowth is characterised by a variety of tree and shrub heights, and a variety of species. Its connection to the scarp vegetation improves its ecological value. However, there are no nearby records of target Threatened flora species as there are for the Zamia north site.

No suitable Regional Ecosystems or target flora habitats were observed at Lots 21 & 21 AU37 ("Bushblock").

6.2. Fauna

As with the flora assessment, Lot 9 (north) Zamia Creek supports the best biodiversity habitat values to be used as ecological offsets for the ornamental snake and the squatter pigeon. Key features that make this property the preferred option are:

- Current surveys have confirmed the presence of squatter pigeon on site and habitat assessments have identified that the entire site supports suitable habitat, approximately 670 ha, for this species.
- Approximately 100 ha of gilgai habitat, that is considered potentially suitable for the ornamental snake, is supported within the property boundaries.
- Approximately 105 ha of potential habitat for south-eastern long-eared bat associated with the riparian vegetation and immediate surrounds of Zamia Creek.

However, with regard to the occurrence of the ornamental snake on site, which was not sufficiently assessed due to the very dry environmental conditions that prevailed during the assessments, additional targeted surveys under optimal environmental conditions, i.e. flooded gilgai, must be undertaken before this site may be considered suitable as an offset for ornamental snake habitat.

Whilst Lot 5 did support approximately 1242 Ha of suitable habitat for squatter pigeon, Lot 5 is unsuitable for other offset purposes. Unless this site is desired as solely a squatter pigeon offset area, greater ecological gains can likely be obtained by grouping and managing consolidated offset areas for multiple species and communities.

The surveys and assessments of Lots 21 and 22 have identified that these sites support suitable habitat for the *Nyctophilus* microbats, recording two species through targeted surveys. Whilst *N. corbeni* was not captured during the surveys, it is considered highly likely that, given the extent, nature and condition of the suitable habitats supported on the sites, approximately 1431 Ha (1469 Ha – 38 Ha of cleared LNG pipeline corridors), and that searches of databases identified a record of the species 4.5 km to the west in 2002 along Tin Hut Creek, that there is a very high probability that the site does support this threatened microbat. *N. corbeni* is particularly difficult to trap, by virtue of the fact that it is vulnerable (and hence, represented only in low numbers in a wider population of microbats). Absence of capture results should not be taken as confirmation that *N. corbeni* is not present when other factors indicate a high likelihood of its presence.

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APPENDIX A BIOCONDITION SITE DATA

- Methodology is in accordance with Queensland Department of Environment and Heritage Protection (formerly Department of Environment and Resource Management) (2011). *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.1*.
- Default plot size, unless otherwise specified, is a set of nested quadrats. Simplified summary is: Trees 100 m x 50 m, Shrubs and ground layer 50 m x 10 m, Fallen timber 50 m x 20 m, Ground cover percent 5 x 1 m x 1 m quadrats on centre-line.
- Heights are in metres.
- Cover is based on projected crown cover (not projected foliage cover, unless specified).
- * denotes naturalised species (weed).
- DBH, stands for Diameter at Breast Height (diameter of tree trunk in cm, taken approximately 1.3 metres above ground level).
- TBI = to be identified, NFI = needs further identification, TBC = to be confirmed.

BioCondition Site no:	**1**			**Relevant quaternary site no. if applicable:**						**23**			
RE/landtype:	regrowth 11.4.9		Bioregion:	BB				Property: "Zamia North" (Lot 9 BH194 north)					
Date: 09/10/14			Photos:	N: ⬧		E: ⬧		S: ⬧		W: ⬧			
Landscape photos: ⬧			Spot photos:	1:		2:		3:		4:		5:	
Datum: WGS84/GDA94/specify if other:					Zone: 55			Transect bearing: W-E (90 deg)					
0m mark	E 740734			N 7276174				100m mark: E 740818 N 7276019					
50m mark	E 740774			N 7276052									
General description: Brigalow regrowth on gilgai.													
100m x 50m area:													
Eucalypt large tree DBH benchmark (cm):		n/a		Non-eucalypt large tree DBH benchmark (cm):						n/a			
Number of large eucalypt trees:		0		Number of large non-eucalypt trees:						0			
Total large trees:	0												
Tree canopy height (for EDL Ecologically Dominant Layer) (m):		2m		1-3m tall (avg. 2m) on moderate gilgai. Patchy cover to 40%.									
Subcanopy height (if present) (m):		-											
Emergent height (if present) (m):		-											
Proportion of dominant canopy species with evidence of recruitment (%):				100%									
Total tree species richness:		1		Includes all tree species in 100m x 50m, not just EDL. Trees are single-stemmed and over 2m tall.									
Tree species list:	Acacia harpophylla.												
50m x 10m area:													
Shrub species richness:		1		Defined as single-stemmed and below 2m tall, or multi-stemmed from base, or from below 20cm.									
Shrub species list:	Acacia harpophylla.												
Grass species richness:		4											
Grass species list:	Leptochloa digitata, Eriachne sp., Enteropogon acicularis, Sporobolus caroli. Note: loose head of Homopholis belsonii - possibly from adjacent conservation park, not counted.												
Forbs and others (non-grass ground) species richness:		9											
Forbs and other ground species:	Enchylaena tomentosa, Atalaya hemiglauca, Apophyllum anomalum, Terminalia oblongata, Evolvulus alsinoides, Capparis lasiantha, Glycine sp., Citrus glauca, Solanum sp. (possibly S.johnsonianum).												
Non-native plant cover (%):		30%		Species: Pennisetum ciliare, Oxalis corniculatum, (Parthenium hysterophorus <1%).									
50m x 20m area:													
Coarse woody debris (>10cm diameter, >0.5m long, measure to plot boundary). Total length (m):										0m			
Note: much woody debris but only up to 8cm diameter.													
Five 1m x 1m plots (ground cover %):													
Quadrat:				1		2		3		4		5	Mean
Native perennial "decreaser" grass:				n/r		n/r		n/r		n/r		n/r	n/r - see below

Native other grass cover:	0	0	0	25	0	5
Native forbs and other species:	0	0	0	1	0	0.2
Native shrubs (<1m tall):	0	0	5	0	0	1
Non-native grass:	0	35	20	3	35	22.6
Non-native forbs and shrubs:	0	0	0	<1	0	<1
Litter:	25	10	75	30	60	40
Rock:	0	0	0	0	0	0
Bare ground:	75	55	0	30	5	33
Cryptogams:	0	0	0	0	0	0
Total:	=100%	=100%	=100%	=100%	=100%	=100.8

100m transect:

Tree canopy cover: (Tree or Group code: C=canopy, S=subcanopy, E=emergent)

Total % canopy:	0	Total % subcanopy:	2.5	Total % emergent:	0	

Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total
S		2.5									

Shrub canopy cover: (indicate non-native with *)

Total % native:	5.5	Total % non-native:	0		

*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total
		1.5									
		3									
		0.5									
		0.5									

BioCondition Site no:	**2**	**Relevant quaternary site no. if applicable:**	**27**

RE/landtype:	11.4.8	Bioregion:	BB	Property: Lot 5 KM135 ("Little Sorrel")

Date:	Photos:	N:	E:	S:	W:	
Landscape photos:	Spot photos:	1:	2:	3:	4:	5:

Datum: WGS84/GDA94/specify if other:	Zone: 55	Transect bearing: E-W (270 deg)

0m mark	E 743049	N 7276355	100m mark: E 743001 N 7276347
50m mark	E 743092	N 7276361	

General description: Woodland (disturbed an open in places) of *Acacia harpophylla* with *Eucalyptus cambageana* and *Casuarina cristata*. Moderate shrub layer and numerous naturally fallen logs.

100m x 50m area:

Eucalypt large tree DBH benchmark (cm):	40cm(draft)	Non-eucalypt large tree DBH benchmark (cm):	27cm(draft)
Number of large eucalypt trees:	6	Number of large non-eucalypt trees:	7

Total large trees:	13	

Tree canopy height (for EDL Ecologically Dominant Layer) (m):	15m	T1 16-18m, 10% T2 8-12m, 50% S1 2-8m, 40%, S2 1-2m, 10%
Subcanopy height (if present) (m):	6m	
Emergent height (if present) (m):	-	

Proportion of dominant canopy species with evidence of recruitment (%):	50%	Casuarina only, no blackbutt

Total tree species richness:	9	Includes all tree species in 100m x 50m, not just EDL. Trees are single-stemmed and over 2m tall.

Tree species list:	[T1-EDL Eucalyptus cambageana, Casuarina cristata], [T2-Sub Acacia harpophylla, Brachychiton rupestris, Geijera salicifolia], [S1 Geijera parviflora, Citrus glauca, Alectryon diversifolius, Everistia vacciniifolia, Alectryon oleifolius]. (mistletoe not counted - Amyema sp.)

50m x 10m area:

Shrub species richness:	7	Defined as single-stemmed and below 2m tall, or multi-stemmed from base, or from below 20cm.

Shrub species list:	[S2 Casuarina cristata, Citrus glauca, Acacia harpophylla, Carissa ovata, Lysiphyllum carronii, Terminalia oblongata, Apophyllum anomalum].

Grass species richness:	2	

Grass species list:	Enteropogon acicularis (common), Sporobolus caroli (rare).

Forbs and others (non-grass ground) species richness:	5	

Forbs and other ground species:	Capparis lasiantha, Apophyllum anomalum, Cissus opaca, Sida sp., Maireana microphylla.		
Non-native plant cover (%):	20%	Species: Pennisetum ciliare (common), Opuntia tomentosa (rare).	

50m x 20m area:

Coarse woody debris (>10cm diameter, >0.5m long, measure to plot boundary). Total length (m):	145.5m

71													
74.5													

Five 1m x 1m plots (ground cover %):

Quadrat:	1	2	3	4	5	Mean
Native perennial "decreaser" grass:	n/r	n/r	n/r	n/r	n/r	n/r - see below
Native other grass cover:	1	1	1	0	0	0.6
Native forbs and other species:	1	5	0	0	0	1.2
Native shrubs (<1m tall):	0	5	0	0	70	15
Non-native grass:	0	20	2	10	10	8.4
Non-native forbs and shrubs:	0	0	0	0	0	0
Litter:	30	64	78	85	10	53.4
Rock:	0	0	0	0	0	0
Bare ground:	68	5	20	5	10	21.6
Cryptogams:	0	0	0	0	0	0
Total:	=100%	=100%	=100%	=100%	=100%	=100.2

100m transect:

Tree canopy cover: (Tree or Group code: C=canopy, S=subcanopy, E=emergent)

Total % canopy:	34.5	Total % subcanopy:	31.8	Total % emergent:	0

Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total
S		2	S		3						
C		7	S		6.3						
S		4.5	C		9						
C		5.5	S		2						

C		3									
S		3									
S		4									
C		10									
S		7									

Shrub canopy cover: (indicate non-native with *)				
Total % native:	5	Total % non-native:	0	

*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total
		2.5									
		2.5									

BioCondition Site no:	**3**		**Relevant quaternary site no. if applicable:**				**38**
RE/landtype:	11.4.3	Bioregion:	BB	Property: Lots 21 & 22 Plan AU37 ("Bushblock")			
Date: 10/10/14		Photos:	N: ♦	E: ♦	S: ♦	W: ♦	
Landscape photos: ♦		Spot photos:	1: ♦	2: ♦	3: ♦	4: ♦	5: ♦
Datum: WGS84/GDA94/specify if other:			Zone: 55	Transect bearing: W-E (90 deg)			
0m mark	E 741347	N 7277266	100m mark : E 741364 N 7277175				
50m mark	E 741355	N 7277217					
General description: Woodland of Acacia harpophylla and Casuarina cristata with moderate shrub layer of same, and sparse ground cover over minor gilgai.							
100m x 50m area:							
Eucalypt large tree DBH benchmark (cm):	n/a	Non-eucalypt large tree DBH benchmark (cm):	32cm				
Number of large eucalypt trees:	0	Number of large non-eucalypt trees:	0*				
Total large trees:	0*	*Note: most large trees were non-eucalypt 10-15cm DBH.					
Tree canopy height (for EDL Ecologically Dominant Layer) (m):	14m	T1 12-16m, 10% T2 2-12m, 60% S1 1-2m, 5%					
Subcanopy height (if present) (m):	9m						
Emergent height (if present) (m):	-						
Proportion of dominant canopy species with evidence of recruitment (%):	100%						
Total tree species richness:	5	Includes all tree species in 100m x 50m, not just EDL. Trees are single-stemmed and over 2m tall.					
Tree species list:	[T1-EDL Casuarina cristata (dominant), Acacia harpophylla], [T2-Sub Casuarina cristata, Acacia harpophylla, Lysiphyllum carronii, Alectryon diversifolius, Terminalia oblongata]						
50m x 10m area:							
Shrub species richness:	6	Defined as single-stemmed and below 2m tall, or multi-stemmed from base, or from below 20cm.					
Shrub species list:	Acacia harpophylla, Casuarina cristata, Geijera parviflora, Terminalia oblongata, Alectryon diversifolius, Carissa ovata.						
Grass species richness:	2						
Grass species list:	Ancistrachne uncinulata, thin-leafed grass grazed (possibly Enteropogon acicularis).						
Forbs and others (non-grass ground) species richness:	5						
Forbs and other ground species:	Cissus opaca, Jasminum didymum subsp. lineare, Enchylaena tomentosa, Capparis lasiantha, probably Sida sp.						

Non-native plant cover (%):	10%	Species: Bryophyllum sp. (common), Opuntia tomentosa (rare).

50m x 20m area:

Coarse woody debris (>10cm diameter, >0.5m long, measure to plot boundary). Total length (m):	

Five 1m x 1m plots (ground cover %):

Quadrat:	1	2	3	4	5	Mean
Native perennial "decreaser" grass:	n/r	n/r	n/r	n/r	n/r	n/r - see below
Native other grass cover:	0	5	0	2	<1	1.4
Native forbs and other species:	0	0	0	0	0	0
Native shrubs (<1m tall):	0	0	0	0	0	0
Non-native grass:	0	0	0	0	0	0
Non-native forbs and shrubs:	0	0	2	2	<1	0.8
Litter:	65	90	75	90	89	81.8
Rock:	0	0	0	0	0	0
Bare ground:	30	5	8	5	10	11.6
~~Cryptogams:~~ Logs (can add to litter):	5	0	15	1	0	4.2
Total:	=100%	=100%	=100%	=100%	=100%	=99.8

100m transect:

Tree canopy cover: (Tree or Group code: C=canopy, S=subcanopy, E=emergent)

Total % canopy:	7	Total % subcanopy:	68	Total % emergent:	0	

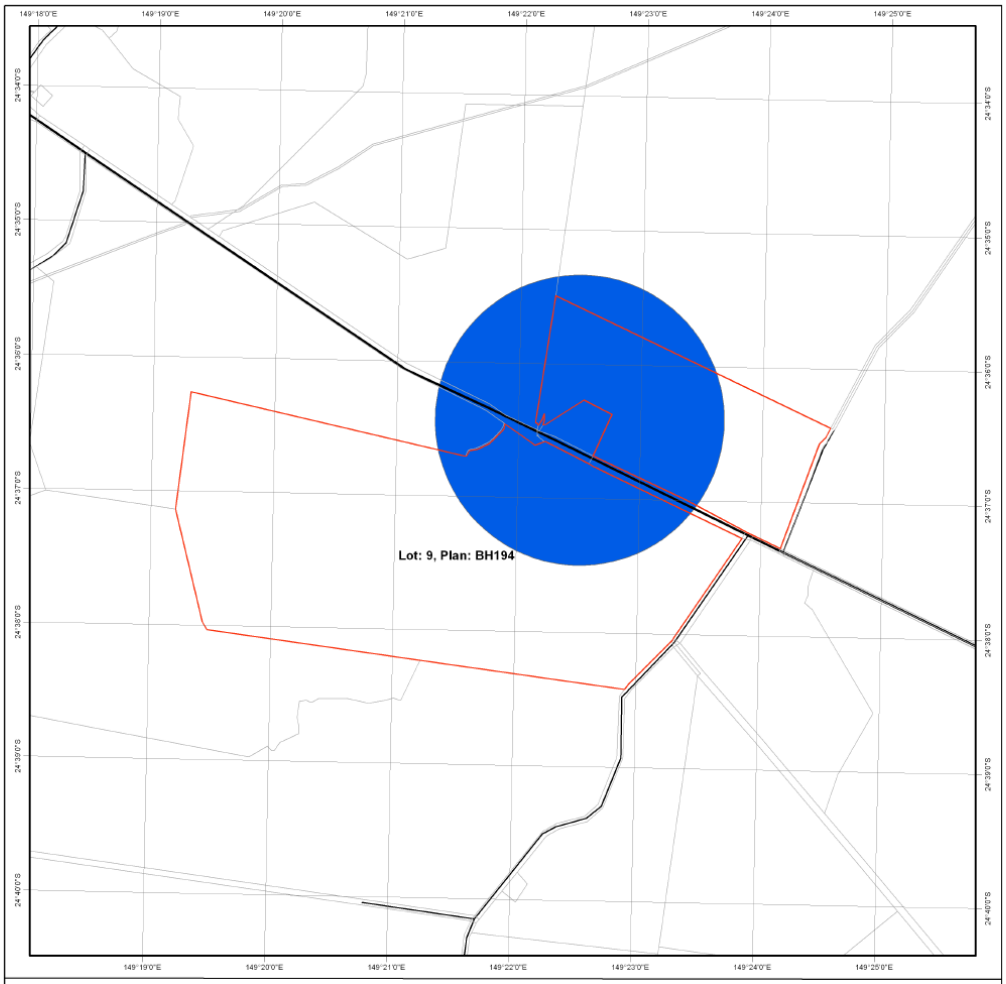
Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total
S	0-2	2	S	71.5-77	5.5						
C	2-5	3	S	81.5-82	0.5						
S	4-19	15	S	94-97	3						
S	23-25	2	S	98-100	2						
S	29-34	5									

S	36-41	5									
S	45-56	11									
C	59-63	4									
S	63-80	17									

Shrub canopy cover: (indicate non-native with *)											
Total % native:	5	Total % non-native:	0								
*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total
	2.5-3.5	1									
	9.5-10	0.5									
	12-14.5	2.5									
	26-26.5	0.5									
	34.5-35	0.5									

APPENDIX B DEHP PROTECTED PLANTS FLORA SURVEY TRIGGER MAP

24/09/2014 13:30:16
Lot: '9' Plan: 'BH194'



Protected Plants Flora Survey Trigger Map

Legend

- Lot and Plan
- High risk area
- Cadastral line
  Property boundaries shown are provided as a locational aid only
- Freeways / motorways / highways
- Secondary roads / streets

Queensland Government

LOCALITY DIAGRAM

N

0 490 980 1,470 1,960 2,450 m

This product is projected into:
GDA 1994 Queensland Albers

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of Environment and Heritage Protection at palm@ehp.qld.gov.au

Disclaimer:
While every care is taken to ensure the accuracy of the data used to generate this product, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damages) and costs which might be incurred as a consequence of reliance on the data, or as a result of the data being inaccurate or incomplete in any way and for any reason.

APPENDIX C FLORA PHOTOGRAPHS – POTENTIAL OFFSET AREAS

Zamia site 22 - regrowth brigalow with gilgai and canegrass

Zamia site 27 - blackbutt, belah, brigalow advanced regrowth (mapped remnant)

Zamia site 32 - wedge of brigalow between anabranches of Zamia Creek

Zamia site 36 - reference site only - previously recorded location of *S.elachophyllum* in adjacent Zamia Creek Conservation Park

Zamia site 38 - advanced regrowth of brigalow-belah (not mapped by DEHP)

Little Sorrel site 5 - variable-aged regrowth of brigalow-belah

Little Sorrel site 8 - variable-aged regrowth of brigalow-belah

Bushblock site 50 - ironbark-cypress-bulloak typical of general area

APPENDIX D REPRESENTIVE PHOTOGRAPHS OF FAUNA HABITAT SUPPORTED ON EACH LOT

Lot 5, Little Sorrel

Open Ironbark woodland, eastern portion of site, on top of ridge line.

View to the west from the toe of the ridge line

Poorly formed gilgai mound and depression with regrowth brigalow.

Lot 9 (north), Zamia

View from the eastern boundary to the west, dense brigalow regrowth mid-photo, Zamia Creek in background.

Well formed gilgai near Zamia Creek Conservation Park

Extensive cracking holes in grey cracking clays within potential ornamental snake habitat

Well formed gilgai with distinct mounds and basin shaped depressions

Remnant brigalow, complex shrub understorey and native grass cover

Water hole on Zamia Creek

Lots 21 and 22, Bushblock

Drainage line and riparian vegetation at Harp Trap Site 5

Ironbark open woodland with calitris understorey and complex shrub and ground layers

Buloke open woodland with regrowth understorey and sparse ground cover

Mixed eucalypt open woodland with heath shrub layer

Mixed eucalypt open woodland with calitris understorey, complex shrub and ground layers

Tin Hut Creek and associated riparian vegetation

Ironbark open woodland, calitris understorey, buloke shrub and grass/leaf litter layers

Ironbark woodland with acacia understorey, grass, leaf litter, fallen timber ground layers

Ironbark woodland with buloke understorey and sparse grass ground layer

APPENDIX E PHOTOGRAPHS OF MICROBAT SURVEY

Harp Trap Site 1

Harp Trap Site 2

Harp Trap Site 3

Harp Trap Site 4

Harp Trap Site 5

Harp Trap Site 6

Harp Trap Site 7

Harp Trap Site 8

Harp Trap Site 9

Trip Ling at Farm Dam