



Carmichael Coal Mine Ecological Equivalence Assessment

Stage 2

Prepared for
Adani Mining Pty Ltd

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Project Manager	Brad Dreis 07 3503 7195 51 Amelia St, Fortitude Valley, Qld 4006
Prepared by	Dr Alana Burley, Bruce Wilson
Reviewed by	Brad Dreis
Approved by	Brad Dreis
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Abbreviations

Abbreviation	Description
API	Aerial photographic interpretation
BRB	Brigalow Belt bioregion
BVG	Broad Vegetation Group
CCM	Carmichael Coal Mine
CWD	Coarse woody debris
DERM	Department of Environment and Resource Management (Queensland)
DEU	Desert Uplands bioregion
DoE	Department of Environment (Commonwealth)
EA	Environmental Authority
EEM	Ecological Equivalence Methodology
EHP	Department of Environment and Heritage Protection (Queensland)
EIS	Environmental Impact Statement
ELA	Eco Logical Australia
EP Act	<i>Environmental Protection Act 1994</i> (Queensland)
EPBC Act	<i>Environment Protection and Biodiversity Act 1999</i> (Commonwealth)
EPC	Exploration Permit for Coal
GIS	Geographic Information System
IBRA	Interim Biogeographic Regionalisation for Australia
ML	Mining Lease
MNES	Matters of National Environmental Significance
MR Act	<i>Mineral Resources Act 1989</i> (Queensland)
OAG	Offset Assessment Guide
PVMO	Policy for Vegetation Management Offsets (Queensland)
QBOP	Queensland Biodiversity Offset Policy

Abbreviation	Description
QGEOP	Queensland Government Environmental Offsets Policy
QGIS	Queensland Government Information System
RE	Regional Ecosystem
SDPWO Act	<i>State Development and Public Works Organisation Act 1971</i> (Queensland)
SSBV	State Significant Biodiversity Value
TEC	Threatened Ecological Community
VM Act	<i>Vegetation Management Act 1999</i> (Queensland)

1 Introduction

1.1 Project background

Adani Mining Pty Ltd (herein referred to as Adani) is developing the Carmichael Coal Mine (CCM) Project in the Galilee Basin, central Queensland. The proposed mine site is located about 170 km north-west of Clermont, which is approximately 100 km north of the regional centre of Emerald. The mine and supporting infrastructure for the CCM project will be located within the boundary of Exploration Permit for Coal (EPC) 1690 and the eastern part of EPC1080, a total area of approximately 45,048 ha. The CCM proposed mine site is located within two Bioregions, the Desert Uplands (DEU) in the western portion and the Brigalow Belt (BRB) to the east.

The proposed mine is expected to produce 60 million tonnes per annum of product coal at peak production. The project has a potential mine life of 60 years, including construction, operation and closure. It is expected that operations will be in six open cut pits and five underground pits. The overall workable length of the mine will be approximately 45 km. Export coal from this project will predominantly service the Indian market.

1.1.1 Need for assessment

In order to satisfy State and Commonwealth policy requirements, offsets will be necessary where unavoidable impacts to identified ecological values cannot be reasonably avoided or mitigated.

Adani currently holds EPC1690 under the *Mineral Resources Act 1989* (MR Act) and an associated Environmental Authority (EA). The eastern and northern portions of EPC1080, and its associated code of environmental compliance, are held by Waratah Coal, with whom Adani have an agreement to undertake exploration activities. One of the conditions listed in the EA for EPC1690 (permit no. EPPR00745013) is the identification of state significant biodiversity values (SSBV) and the completion of an ecological equivalence assessment for those values present on all sites to be impacted. Ecological equivalence must be demonstrated as it is a requirement for the identification of offset supply areas as stipulated in the EA issued for the proposed works under the Queensland Biodiversity Offsets Policy (QBOP). The requirement for 'obtaining ecological equivalence' is set out in Section 10, Part A Criteria of the QBOP.

It is anticipated that offsets will be required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) environmental approval conditions. The EPBC Act Environmental Offsets Policy (EPBC Act Offsets Policy) provides transparency around how the suitability of offsets is determined, based on the level of residual impact to a protected matter. Offset requirements under the EPBC Act are set out in Section 7 of the EPBC Act Offsets Policy. The suitability of a proposed offset is considered as part of the decision as to whether or not to approve a proposed action under the EPBC Act.

Adani applied for a Mining Lease application (ML) in July 2013 and has also sought a single EA for the mining project to cover the following activities:

- six open cut coal mining pits (Pits B to G) running from north to south
- five underground mining areas (Underground Mines 1 to 5) running from north to south
- haul roads and ramps
- mine stockpile and crushing areas
- rejects and 'dry' tailings dumping

- spoil dumps.

Once approved, these activities would be regulated by the ML issued under the MR Act and the EA issued under the *Environmental Protection Act 1994* (EP Act).

Prior to that approval, Adani still has an obligation to meet the conditions of the current EA for EPC1690 and comply with the standard code of compliance of the EA for EPC1080.

1.1.2 Offset policies

The Queensland Government Environmental Offsets Policy (QGEOP) establishes a framework for using environmental offsets in Queensland and came into effect on 1 July 2008. The QGEOP is based on seven principles that guide the use of offsets to achieve ecologically sustainable development:

- 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
- environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact
- offsets must achieve an equivalent or better outcome
- offsets must provide environmental values as similar as possible to those being lost
- offset provision should minimise lag time between the impact and the offset delivery
- offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values
- offsets must be legally secured for the duration of the offset requirement.

The Queensland Policy for Vegetation Management Offsets, Version 3, 2011 (PVMO) supports the *Vegetation Management Act 1999* (VM Act), which regulates vegetation clearing in Queensland. The VM Act is not applicable to Level 1 mining activities as Level 1 mining activities are defined as 'not assessable development' under the Sustainable Planning Regulation 2009. As such, the PVMO does not apply to project activities that are subject to a mining lease.

The Queensland Biodiversity Offset Policy, Version 1, 2011 (QBOP) does not expressly apply to projects declared as 'significant projects' under the *State Development and Public Works Organisation Act 1971* (SDPWO Act); however, the Coordinator-General may use discretionary powers to require compliance with the policy for approval. The QBOP's objective is to increase long-term protection and viability of SSBV by offsetting residual impacts from development. The current EA for EPC1690 requires offsets to be met in accordance with the QBOP. Although projects declared as significant projects under the SDPWO Act are not directly bound to the QBOP, an offset requirement is almost certain to form part of the approval conditions set by the Coordinator-General and QBOP is likely to be used as the basis for equitable offsets requirements.

Based on the results of the project's EIS assessment which identified significant impacts on three matters of environmental significance (MNES) listed under the EPBC Act, in addition to the various SSBVs, it is also assumed that offsets will be required under Commonwealth policy. The EPBC Act Environmental Offsets Policy, October 2012 (EPBC Act Offsets Policy) outlines the Australian Government's approach on the use of environmental offsets to compensate for the residual adverse impacts on MNES protected under the EPBC Act. The EPBC Act Offsets Policy is accompanied by the Offsets Assessment Guide (OAG) which uses a balance sheet approach to estimate impacts and offsets for MNES. Offsets seek to provide a net environmental gain through targeted actions (direct or

indirect) and do not necessarily facilitate onsite impact. Under the EPBC Act, environmental offsets can be used to maintain or enhance the health, diversity and productivity of the environment.

1.1.3 Environmental Offset Strategy

An Environmental Offset Strategy for the Carmichael Coal Mine and Rail Project was prepared by Ecofund Queensland Pty Ltd, part of CO2 Group (Ecofund) in November 2012 and submitted as a component of the EIS. An Environmental Offset Strategy for the Exploration Program on EPC1690 was also prepared by Ecofund in December 2012.

The Environmental Offset Package for the Carmichael Coal Mine and Rail Project was prepared by Ecofund as a second stage in the delivery of the project's offset plan in November 2013 and submitted as a component of the supplementary EIS. This package further refines and confirms the residual impacts of the project requiring offsets and outlines the approach for implementation and delivery of the offset package.

1.2 Project scope

Eco Logical Australia (ELA) was engaged by Adani to undertake an ecological equivalence assessment for the Carmichael Coal Mine. ELA has assumed that significant impacts will result from open cut mining. The Queensland Government's Ecological Equivalence Methodology (EEM) was used to undertake the assessment for the clearing areas (impact areas) that support SSBVs and hence trigger the requirements of the QBOP. For the purpose of the QBOP, state significant biodiversity values are those values listed in Appendix 1 of the QBOP and include regional ecosystems, essential habitat, wetlands, watercourses, connectivity and protected animals.

The assessment also included areas within the mine development footprint that support MNES and/or their habitat. There are six MNES protected under the EPBC Act of relevance to the project:

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- migratory species protected under international agreements
- a water resource, in relation to coal seam gas development and large coal mining development

In order to satisfy State environmental offsets policy requirements, offsets will be necessary where unavoidable or residual impacts to identified ecological values cannot be reasonably avoided or mitigated. As Adani is in the process of determining potential offset areas, the scope of the project did not include identifying or conducting ecological equivalence assessments on potential offset areas.

SSBVs and MNES identified across the Carmichael Coal Mine provide an indication of the likely offset liabilities for the CCM and the following have been assessed within this scope:

- Remnant Endangered REs
- Remnant Of Concern REs
- Brigalow TEC
- Wetlands
- Watercourses
- Threatened and migratory fauna species:
 - Squatter Pigeon (*Geophaps scripta scripta*)

- Black-throated Finch (southern) (*Poephila cincta cincta*)
- Black-necked Stork (*Ephippiorhynchus asiaticus*)
- Cotton Pygmy-goose (*Nettapus coromandelianus*)
- Little Pied Bat (*Chalinolobus picatus*)
- Koala (*Phascolarctos cinereus*)
- Ornamental Snake (*Denisonia maculata*)
- Yakka Skink (*Egernia rugosa*)
- Square-tailed Kite (*Lophoictinia isura*)
- Black-chinned Honeyeater (*Melithreptus gularis*)
- Threatened flora species, Waxy Cabbage Palm (*Livistona lanuginosa*)

Completion of the impact calculations as per the Commonwealth Department of Environment's (DoE) Offset Assessment Guide (OAG), which accompanies the EPBC Act Offsets Policy, is also included in this scope of works. The impact calculation of the OAG is the initial phase of determining the offset liabilities for MNES contained within the Carmichael Coal Mine footprint.

In response to the previous work prepared by ELA, the Department of Environment and Heritage Protection (EHP) also recommended the preparation of an RE Map Amendment to address the RE inaccuracies across site. The inaccuracies identified are predominantly associated with incorrect attribution of the RE type in the RE Mapping (version 8.0) provided by EHP. The RE Map Amendment will rectify these current errors through the provision of validated field data (refer to ELA 2014). In doing so, an accurate determination of SSBV and MNES such as threatened species habitat and threatened ecological communities across the Carmichael Coal Mine will be certified in the State Mapping database providing greater confidence in the project's offset liabilities for both the proponent and regulator.

The key objective for this scope of works is the delivery of an EEM report (this report) prepared in accordance with the Ecological Equivalence Methodology Guideline, Version 1 (DERM 2011) which includes survey methods, summary of results and ecological condition and special features scores for the clearing area.

1.3 Ecological equivalence method and criterion indicators

This section outlines the ecological equivalence assessment method set by DERM (2011). Usually offsets would be considered as part of this method. However, assessment of offsets was not part of ELA's scope for this report as offset areas are yet to be confirmed.

Ecological equivalence assessments are usually undertaken by assessing two ecological equivalence criteria on proposed clearing and offset areas. The first criterion, 'ecological condition', is assessed using a standard set of 14 indicators, including ten field-based and four GIS-based indicators (refer to **Appendix B**). The ten field-based indicators require the collection of a range of data characterising the structure and composition of plant assemblages. The four GIS-based indicators are assessed by undertaking spatial analyses on available spatial data layers and/or aerial imagery. Assessment of three of the GIS-based indicators is undertaken for sites in fragmented bioregions only and for one of the indicators in intact bioregions only.

The ten field-based indicators are assessed by following the method set out in the Ecological Equivalence Methodology Guideline, Version 1 (DERM 2011). Clearing sites and offset sites are initially stratified, where necessary, into homogeneous assessment units by identifying different REs and broad condition states (i.e. remnant, high value regrowth, low value regrowth and/or cleared areas).

A 100 m x 50 m nested sampling plot is then established and assessed within the assessment unit of focus, ensuring that the plot does not cross any environmental gradients. The plot is established in an area that is at least 50 m from a major disturbance (e.g. a road). The ten field-based indicators are all assessed within this plot.

The on-ground delineation of homogeneous assessment units can sometimes be problematic, especially in areas mapped as heterogeneous polygons (i.e. those polygons attributed with more than one RE). In these situations, areas within these polygons need to be ground truthed to ascertain the RE present within the clearing site. This task was undertaken by ELA for Adani in September 2013 with site stratification into assessment units and sampling sites based on site assessment. The site stratification for this report was approved by EHP on 28 October 2013.

The second criterion, 'special features', is assessed by undertaking a desktop spatial analysis using GIS data available from EHP. The relevant GIS layers required for assessment are downloaded from the Queensland Government Information System (QGIS).

2 Methods

2.1 Desktop review and analysis

Data reviewed at a desktop level, prior to field work, including the following documents and information sources:

- Carmichael Coal Mine Environmental Impact Statement (GHD 2012)
- Carmichael Coal Mine Supplementary Environmental Impact Statement (GHD 2013)
- Environmental Offset Strategy (Ecofund 2012)
- Environmental Offset Package (Ecofund 2013)
- Galilee Basin Offset Strategy (EHP 2013)
- Carmichael Coal Mine Exploration Sites Ecological Equivalence Assessment (ELA 2013)
- Carmichael Coal Mine Regional Ecosystem Map Amendment (ELA 2014)
- Relevant GIS layers
- BioCondition data and regional ecosystem technical descriptions
- Aerial imagery

Site stratification and the delineation of assessment units across the mining footprint was based on ground-truthed Regional Ecosystem (RE) mapping produced in ArcGIS from field data collected at sample sites across the mining footprint, and from aerial photographic interpretation (API) of high resolution 2012 imagery of the Moray Downs property.

2.1.1 Results of stage 1 RE ground-truthing

RE's that were the focus of the ground-truthed mapping included those that were found to correspond to a SSBV (**Table 1**). The Interim Biogeographic Regionalisation for Australia (IBRA) bioregion boundaries version 7.0 was used to determine REs from the Desert Uplands and Brigalow Belt bioregion across the mining footprint.

As per the EEM Guideline, delineation of assessment units was based on the following rules:

- The area is a unique regional ecosystem; or
- The area is the same regional ecosystem but in a different condition; or
- The area is an isolated area.

Assessment units were then further grouped by Broad Vegetation Groups (BVG's) (**Table 1**). The BVG's for RE10.3.6a and RE10.5.5a, which provide habitat for Black-throated Finch, were combined as one assessment unit (BVG 17a/17b) due to the similar habitat structure, resources and values these areas provide for the target species, as well as the difficulty in delineating these communities through aerial photographic interpretation (API). Further analysis was undertaken to determine whether the entirety of this assessment unit provided habitat for the threatened species, particularly Black-throated Finch. This involved buffering all known water points (farm dams, troughs, creeks and wetlands) and Black-throated Finch records by 5 km, and identifying habitat that intersected the buffer.

Table 1: SSBVs within the Carmichael Coal Mine mining footprint and the corresponding ground-truthed REs and BVGs

SSBV	Desert Uplands RE's	Brigalow Belt RE's	BVG
Endangered REs (VM Class)	-	11.4.9	25a
Of Concern REs (VM Class)	-	11.4.6	26a
Wetlands	10.3.4b, 10.3.13a, 10.3.14a, 10.4.5a	11.3.25, 11.3.27f, 11.4.9	16a, 25a, 26a, 34d
Watercourses	10.3.4b, 10.3.6a, 10.3.12a, 10.3.13a, 10.3.14a	11.3.10, 11.3.25, 11.3.27f	16a, 17a, 18a, 26a
Black-throated Finch habitat	10.3.6a, 10.3.6ax1, 10.3.12a, 10.3.13a, 10.3.14a, 10.5.1a, 10.5.1d, 10.5.5a, 10.7.5	11.3.10, 11.3.25, 11.3.27f	12a, 16a, 17a, 17b, 17c, 18a, 34d
Ornamental Snake habitat	10.3.4b, 10.3.13a, 10.3.14a, 10.4.3a, 10.4.5a	11.3.25, 11.3.27f, 11.4.6, 11.4.9	16a, 25a, 26a, 34d
Squatter Pigeon habitat	10.3.6a, 10.3.6ax1, 10.3.12a, 10.3.13a, 10.3.14a, 10.5.1a, 10.5.1d, 10.5.5a, 10.7.5	11.3.10, 11.3.25, 11.3.27f	12a, 16a, 17a, 17b, 17c, 18a, 34d
Yakka Skink habitat	10.3.6a, 10.3.6ax1, 10.3.12a, 10.3.13a, 10.3.14a, 10.5.1a, 10.5.1d, 10.5.5a, 10.7.5	11.3.10, 11.3.25, 11.3.27f	12a, 16a, 17a, 17b, 17c, 18a, 34d
Square-tailed Kite habitat	10.3.6a, 10.3.6ax1, 10.3.12a, 10.3.13a, 10.3.14a, 10.5.1a, 10.5.1d, 10.5.5a, 10.7.5	11.3.10, 11.3.25, 11.3.27f	12a, 16a, 17a, 17b, 17c, 18a, 34d
Black-chinned Honeyeater habitat	10.3.6a, 10.3.6ax1, 10.3.12a, 10.3.13a, 10.3.14a, 10.5.1a, 10.5.1d, 10.5.5a, 10.7.5	11.3.10, 11.3.25, 11.3.27f	12a, 16a, 17a, 17b, 17c, 18a, 34d
Black-necked Stork habitat	10.3.13a, 10.3.14a	11.3.25, 11.3.27f	16a, 34d
Cotton Pygmy-goose habitat	10.3.14a	11.3.27f	16a, 34d
Little Pied Bat habitat	10.3.6a, 10.3.6ax1, 10.3.12a, 10.3.13a, 10.3.14a, 10.5.1a, 10.5.1d, 10.5.5a, 10.7.5	11.3.10, 11.3.25, 11.3.27f	12a, 16a, 17a, 17b, 17c, 18a, 34d
Koala habitat	10.3.6a, 10.3.6ax1, 10.3.12a, 10.3.13a, 10.3.14a	11.3.10, 11.3.25, 11.3.27f	12a, 16a, 17a, 17b, 17c, 18a, 34d
Echidna habitat	10.3.6a, 10.3.6ax1, 10.3.12a, 10.3.13a, 10.3.14a, 10.5.1a, 10.5.1d, 10.5.5a, 10.7.5	11.3.10, 11.3.25, 11.3.27f	12a, 16a, 17a, 17b, 17c, 18a, 34d
Waxy Cabbage Palm	10.3.13a	11.3.25	16a

No High Value Regrowth was identified on the site and although there is one Threshold RE polygon (RE11.3.5) it is not located within the mine footprint.

2.1.2 State significant biodiversity values (SSBVs)

The SSBVs identified across the Carmichael Coal Mine sites that were assessed through the ecological condition field component are listed below:

- Remnant Endangered RE11.4.9
- Remnant Of Concern RE11.4.6
- Wetlands
- Watercourses
- Threatened and migratory fauna species:
 - Squatter Pigeon (*Geophaps scripta scripta*)
 - Black-throated Finch (southern) (*Poephila cincta cincta*)
 - Black-necked Stork (*Ephippiorhynchus asiaticus*)
 - Cotton Pygmy-goose (*Nettapus coromandelianus*)
 - Little Pied Bat (*Chalinolobus picatus*)
 - Ornamental Snake (*Denisonia maculata*)
 - Yakka Skink (*Egernia rugosa*)
 - Square-tailed Kite (*Lophoictinia isura*)
 - Black-chinned Honeyeater (*Melithreptus gularis*)
- Threatened flora species, Waxy Cabbage Palm (*Livistona lanuginosa*)

Further details on each of the SSBVs listed above are shown in **Table A1** of **Appendix A**.

2.1.3 Matters of national environmental significance (MNES)

The EIS and SEIS identified three MNES across the Carmichael Coal Mine as significantly impacted. Sites were assessed simultaneously during the ecological condition field component for the three MNES listed below:

- Brigalow Belt Threatened Ecological Community
- Black-throated Finch (southern) (*Poephila cincta cincta*)
- Waxy Cabbage Palm (*Livistona lanuginosa*)

Other MNES known to occur across the Carmichael Coal Mine site but which will not be significantly impacted by the mine footprint and were therefore not assessed as MNES during this survey, include:

- Squatter Pigeon (*Geophaps scripta scripta*)
- Ornamental Snake (*Denisonia maculata*)
- Koala (*Phascolarctos cinereus*)
- Yakka Skink (*Egernia rugosa*)

2.1.4 Site stratification

The site stratification framework was developed based on the known occurrence of SSBVs and MNES as listed above. A total of eight assessment units were delineated across the mining footprint. Assessment unit 4 (BVG 17a/17b) is the largest units and is associated with Black-throated Finch

habitat. Further analysis through buffering of all water points and species records indicated that the entirety of this unit is potential habitat for the species. **Table 2** and **Figure 1** provide an outline of each of the assessment units and the area (ha) of impact due to the surface mining footprint.

At the time of site stratification and field survey, version 7 of the Regional Ecosystem Description Database (REDD) was used. For this report, REDD version 8 has been used. This has resulted in the conservation status change of RE10.7.4 from of concern to least concern/no concern at present for both VM class and Biodiversity Status. Four sites were sampled within RE10.7.4 (EE5, EE6, EE7, EE8) making up an assessment unit for BVG 19d. This assessment unit will not be further discussed in this report, leaving the total number of assessment units as eight with the total number of EE sites as 46 (**Table 2**).

Table 2: Assessment unit delineation and site stratification results

Assessment unit	BVG	Total surface ¹ impacted area on mining lease (EPC1690 and eastern portion of EPC1080 (ha)	Total area on mining lease (EPC1690 and eastern portion of EPC1080 (ha)	EE sites
1	12a	13	13	EE10
2	16a	50	407	EE1, EE2, EE11, EE12, EE31, EE32, EE33, EE34, EE45, EE50
3	34d	33	56	EE3, EE4, EE9
4	17a/17b	8,811	20,823	EE13, EE14, EE15, EE16, EE17, EE18, EE19, EE20, EE21
5	17c	711	5,754	EE22, EE23, EE24, EE25, EE26
6	18a	332	385	EE27, EE28, EE29, EE30, EE46, EE47
7	25a	573	851	EE35, EE36, EE37, EE38, EE39, EE44
8	26a	430	912	EE40, EE41, EE42, EE43, EE48, EE49
Other	19d, 21b, 24a	115	615	n/a
Total²		10,942	29,201	46 EE sites

1. Disturbance of surface area within the mining footprint only, does not include underground disturbance

2. Total area values do not include 'Other'.

The Bygana West Nature Refuge is located south of the Carmichael River and extends across both EPC1690 and EPC1080. An area designated as a Nature Refuge is not regarded as a SSBV under the QBOP. However, it contains SSBVs that require offsets and these have been considered and included in the assessment.

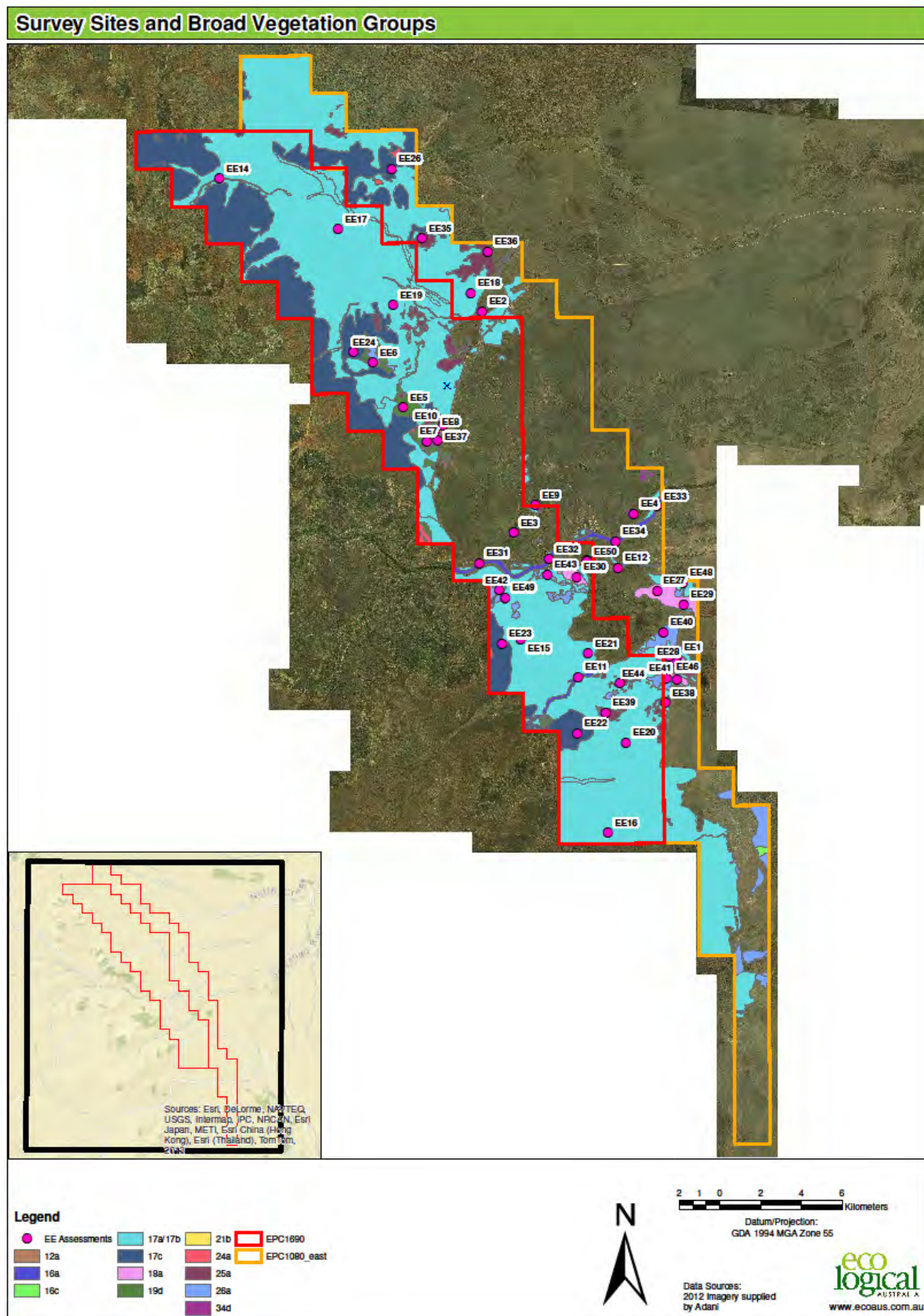


Figure 1: Ecological equivalence survey sites and broad vegetation groups

2.2 Field survey – ecological condition

Field survey was undertaken by two teams of ecologists (i.e. four ecologists) from 9-16 December 2013. The survey consisted of data collection relating to ten field based indicators of ecological condition identified in the EEM (refer to **Appendix B**). Data was collected at 46 sites representing the eight assessment units, refined based on the results of the Stage 1 assessment. Survey of each of these sites was completed over five days.

Ecological condition of the areas to be impacted by mining activities was assessed using the method outlined in the EEM and the *BioCondition Assessment Manual* (Eyre et al. 2011).

The only variation from the prescribed method was that three sampling sites (EE2, EE12, and EE45) were sampled using a plot size of 100 m x 25 m (0.25 ha), as opposed to the recommended plot size of 100 m x 50 m (0.5 ha). Each of these sites consisted of a relatively narrow strip of riparian vegetation. All scores were adjusted accordingly for the ecological condition scoring in **Section 3.3**.

2.2.1 Additional survey consideration of MNES

In addition to the ecological condition indicators collected for SSBVs, the following was also recorded for MNES threatened species:

- Black-throated Finch – presence of key grass species and permanent water bodies within Black-throated Finch habitat
- *Livistona lanuginosa* – counts of individuals where clearing is proposed within habitat (i.e. the Carmichael River corridor)

2.3 GIS analysis – ecological condition

The GIS analysis was undertaken independent of the field assessment. This section describes the methods used in both the calculation and scoring of spatial features for ecological condition, as defined under the EEM (DERM 2010). Special features scoring methods are discussed in **Section 2.4**.

Assessment of the GIS-based indicators was undertaken using the GIS analysis protocols set out in the EEM. The four indicators (listed in **Table B2** of **Appendix B**) measured are:

- 11. Patch size
- 12. Connectivity
- 13. Context
- 14. Distance from permanent water

The intact landscape of the DEU bioregion requires only the GIS-based indicator 14 to be assessed. The BRB bioregion is classified as a fragmented landscape and requires assessment of GIS-based indicators 11, 12 and 13. Ecological indicator 13 and the special features indicators require assessment of patch characteristics using Queensland Government GIS data.

The updated RE map layer (GTRE_Jan14, ELA 2014) was used in the assessment of GIS-based indicators. The spatial layers used to assess the GIS-based ecological indicators were:

- GTRE_Jan14 (updated RE mapping, ELA 2014)
- RE mapping Version 8 (EHP RE Mapping)
- Dams_Hydro_Indicative_MorayDowns_GHD_Pre_20130101 (GHD 2013)
- PastSurveys_Waterbodies_GHD_Pre_20130101 (GHD 2013)

- Carmichael River spatial location
- Aerial imagery provided by Adani

2.4 Special features

Assessment of the special features indicators was undertaken using the special features assessment protocols set out in the EEM. The scoring criteria for the special features are listed in **Table B3** of **Appendix B**. The spatial layers used to assess the special features were:

- GTRE_Jan14 (updated RE mapping, ELA 2014)
- QLD_VEG_OFFSET_BPA_SF_CUR (State-wide special features data based on Biodiversity Planning Assessments)
- SEIS_Footprint_Breakdown_v3 (GHD 2013)
- Aerial imagery provided by Adani

Calculation of indicators 1 to 12 involved querying the Queensland Government's offsets special features dataset spatial layer. Special features indicator 13 requires the calculation of the percentage of remnant and high value regrowth vegetation within a 1 km buffer around the assessment unit. Special features indicator 14 requires determination of whether the area is within a 2 km buffer from the boundary of a protected area estate.

The updated RE map layer (GTRE_Jan14, ELA 2014) was intersected with the state-wide special features data (QLD_VEG_OFFSET_BPA_SF_CUR.shp), the mining footprint (SEIS_Footprint_Breakdown_v3) and the lease boundaries of EPC1690 and eastern portion of EPC1080 to determine special features for each assessment unit within the clearing area. As each assessment unit intersected with a range of special feature polygons, the special feature score for each unique assessment unit/special feature combination was calculated separately and then summed across each assessment unit (refer to **Table D1** in **Appendix D** for the breakdown of clearing areas and special feature scores).

3 Ecological equivalence scoring

3.1 Clearing area assessment units

A description of each assessment unit sampled on the Carmichael Coal Mine site is given below and the location of each on the mine site is shown in **Figure 2**. Photos representative of each assessment unit are presented in **Appendix E**.

Assessment unit 1

Eucalyptus thozetiana dominates the woodland canopy in association with *Acacia harpophylla*. Low trees or shrubs such as *Eremophila mitchellii*, *Carissa lanceolata* and *Eremophila deserti* are frequently present. The ground layer is sparse with the exotic *Cenchrus ciliaris* often the most prominent species. Occurs on lower slopes with shallow stony soils.

Assessment unit 2

Eucalyptus camaldulensis dominates the woodland canopy with *E. coolabah* dominating on clay soils and *Melaleuca leucadendra* fringing the Carmichael River. Other eucalypts such as *E. brownii* and *Corymbia tessellaris* are occasionally present. Low trees and shrubs including *Acacia salicina*, *Livistona lanuginosa* occur in the mid layers. The ground layer is sparse and dominated by grasses such as *Themeda triandra*, *Chrysopogon fallax* and the rush like *Lomandra longifolia*. Occurs along watercourses.

Assessment unit 3

Wetlands dominated by *Eucalyptus coolabah* open woodland with a ground layer dominated by *Eleocharis* sp. and ephemeral forbs and grasses. Occurs in closed depressions with clay soils that are frequently flooded. The tree layer is absent from wetter areas.

Assessment unit 4

Eucalyptus melanophloia or *E. brownii* dominate the open woodland to woodland tree layer. Other species such as *Corymbia plena*, *C. dallachiana* and may be present in the tree layer. A sparse low tree/shrub layer occurs with a variety of species including *Carissa lanceolata*, *Acacia coriacea*, *Maytenus cunninghamii* and *Melaleuca nervosa*. The ground layer is dominated by grasses most commonly *Aristida* spp., *Triodia* spp. and *Bothriochloa* spp. The exotic *Cenchrus ciliaris* was prevalent. Occurs on gently undulating plains with sandy surface soils.

Assessment unit 5

Eucalyptus similis and/or *Corymbia setosa* dominate the low open woodland canopy. The low tree/shrub layer is usually sparse with a wide range of species including *Melaleuca nervosa*, *M. tamariscina*, *Grevillea parallela*, *Bursaria incana*, *Petalostigma* spp. and *Acacia leptostachya*. *Triodia pungens* usually dominates the very sparse to mid-dense ground layer. Occurs on flat to gently undulating sand-plains with sandy soils which are sometimes shallow.

Assessment unit 6

Corymbia plena dominates the open woodland tree layer with other species including *C. dallachiana* prominent. Scattered trees and shrubs occur including *Grevillea parallela* and *Petalostigma pubescens*. The ground layer is sparse to moderate and often dominated by the exotic *Cenchrus ciliaris*. Occurs on sandy alluvial terraces.

Assessment unit 7

Acacia harpophylla dominates the woodland – low woodland tree layer with *Eucalyptus cambageana* and *Acacia cambagei* co-occurring in the tree layer or as emergents. There is a low tree/shrub layer comprising a wide range of species including *Lysiphyllum carronii*, *Eremophila mitchellii*, *Carissa lanceolata*, *Terminalia oblongata*. The ground layer is sparse comprising grasses and forbs including *Sporobolus actinocladius*, *Paspalidium caespitosum*, and *Bothriochloa ewartiana*. Occurs on flat to undulating clay plains with brown to grey clay soils often with gilgai. The gilgai are ephemerally flooded during which time they support wetland species including *Eleocharis* sp.

Assessment unit 8

Acacia cambagei dominates the sparse low woodland canopy often in association with *Acacia harpophylla*. A range of small trees/shrubs are frequently present including *Lysiphyllum carronii* and *Terminalia oblongata*, *A. cambagei*, *Alectryon diversifolius*, *Erythroxylon australe*, *Atalaya hemiglauca*, *Santalum lanceolatum*, *Carissa* spp.. The ground layer is sparse comprising grasses and forbs including *Sporobolus actinocladius*, *Paspalidium caespitosum*, and *Bothriochloa ewartiana*. Occurs on flat to undulating clay plains with brown to grey clay soils often with gilgai. The gilgai are ephemerally flooded during which time they support wetland species including *Eleocharis* sp.

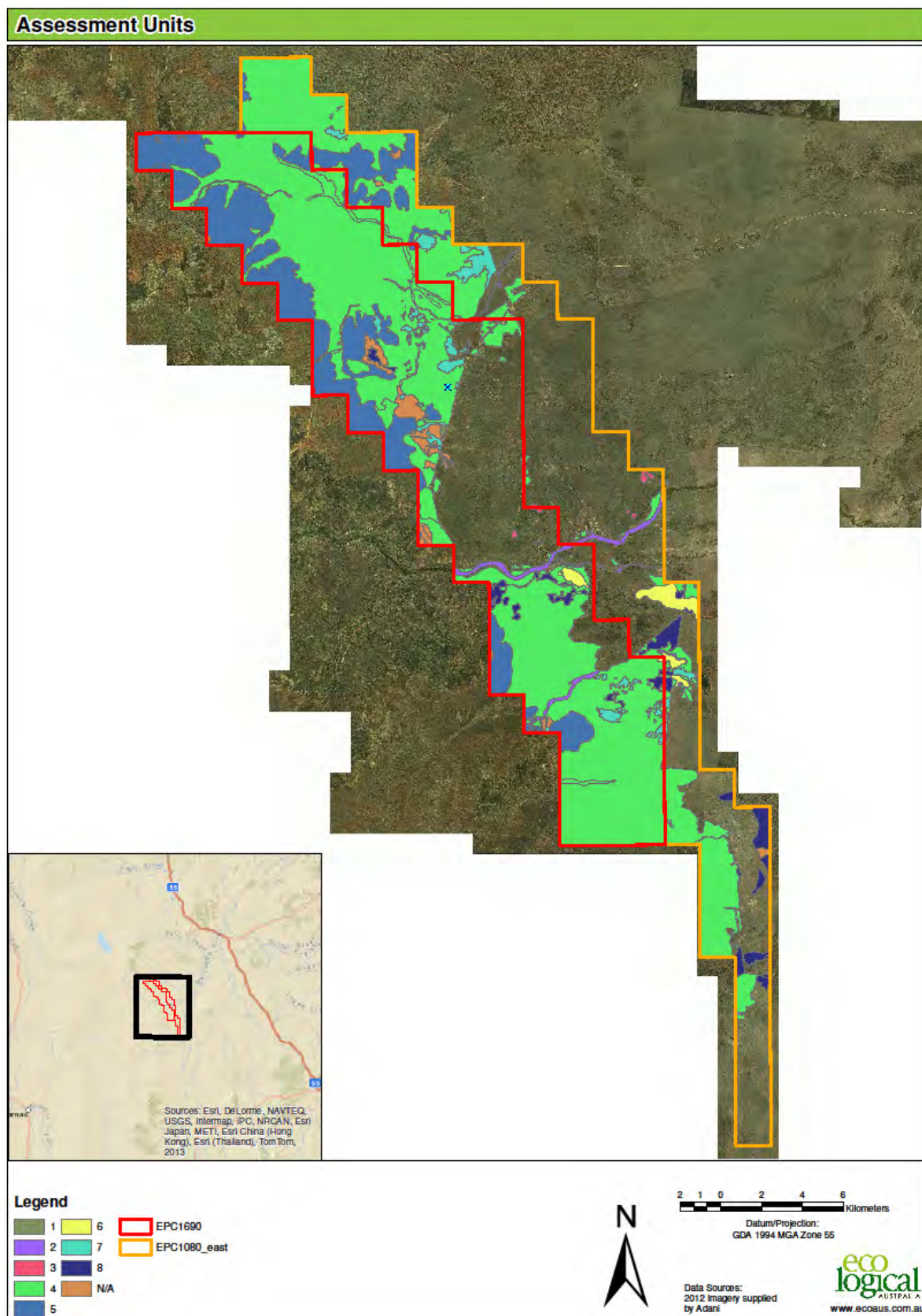


Figure 2: Assessment units on the Carmichael Coal Mine site

3.2 Offset area assessment units

Assessment of offset areas was not included as part of the scope for this project and hence has not been undertaken.

3.3 Ecological condition scoring

The scores for each of the 14 ecological condition indicators in the clearing area assessment units are presented in **Table 3**. These scores were derived from comparison of the field and GIS site data to the benchmark data and scored using **Table B1** (field based attributes) and **Table B2** (GIS attributes) listed in **Appendix B**. The full breakdown on ecological condition scoring for each sample site within assessment units is presented in **Table C1** in **Appendix C**.

Table 3: Ecological condition indicator scores for each assessment unit

Ecological condition indicators	Clearing assessment units							
	1	2	3	4	5	6	7	8
Field based attributes								
Recruitment	5.0	3.7	4.3	5.0	4.6	4.7	4.7	4.7
Native plant species richness	17.5	16.5	7.5	14.2	15.5	14.2	14.6	15.8
Tree canopy height	5.0	4.8	4.2	4.9	2.6	5.0	4.5	4.2
Tree canopy cover	1.5	2.7	3.0	2.6	2.2	3.3	4.3	3.0
Shrub canopy cover	3.0	1.9	0.0	4.1	3.8	1.5	4.0	3.7
Native perennial grass cover	3.0	3.1	0.7	4.8	4.6	1.0	2.7	2.3
Organic litter cover	3.0	4.4	5.0	3.2	4.6	4.0	4.7	4.0
Large trees	15.0	13.5	15.0	11.1	5.0	10.0	7.5	8.3
Coarse woody debris	5.0	3.8	4.0	3.7	5.0	3.5	4.0	4.0
Weed cover	10.0	6.0	8.3	7.2	10.0	3.8	7.5	6.3
Total Field based attributes	68.0	60.4	52.0	60.7	57.9	50.9	58.4	56.3
GIS based attributes								
Fragmented - Patch size	0.0	1.0	2.0	0.0	0.0	0.0	1.7	3.3
Fragmented - Connectivity	0.0	0.4	2.3	0.0	0.0	0.0	0.8	1.7
Fragmented - Context	0.0	0.4	1.3	0.0	0.0	0.0	0.7	1.5
Intact - Distance from water	2.0	3.0	0.0	3.8	4.4	5.3	3.3	2.0
Total BioCondition Score	70.0	65.2	57.7	64.5	62.3	56.3	64.9	64.8
Area (ha)	13	50	33	8,811	711	332	573	430
Assessment unit ecological condition score	9.1	32.6	19.0	5,683.1	443.0	186.8	372.0	278.8

3.3.1 Benchmarks

It is important to note that benchmarks were not available for all REs. **Table 4** below lists which benchmarks were used and provides justification where necessary.

Table 4: Regional ecosystem benchmarks used in the ecological condition scoring

Regional ecosystem	Benchmark used in scoring	Origin and justification for use of benchmark
10.3.4b	11.4.6	Preliminary draft benchmarks Galilee draft benchmarks for the Galilee Project supplied by Queensland Herbarium, Jan 2014. BRB equivalent.
10.3.6ax1	10.3.6a	Preliminary draft benchmarks Galilee draft benchmarks for the Galilee Project supplied by Queensland Herbarium, Jan 2014.
10.3.12a	10.3.12a	Preliminary draft benchmarks Galilee draft benchmarks for the Galilee Project supplied by Queensland Herbarium, Jan 2014.
10.3.13a	10.3.13a	Preliminary draft benchmarks Galilee draft benchmarks for the Galilee Project supplied by Queensland Herbarium, Jan 2014.
10.3.14a	10.3.14a	Preliminary draft benchmarks Galilee draft benchmarks for the Galilee Project supplied by Queensland Herbarium, Jan 2014.
10.4.3a	11.4.9	Draft benchmark supplied by Queensland Herbarium, Jan 2014. BRB equivalent.
10.4.5a	11.4.6	Preliminary draft benchmarks Galilee draft benchmarks for the Galilee Project supplied by Queensland Herbarium, Jan 2014. BRB equivalent.
10.5.1a	Derived benchmark for 10.5.1a	The benchmark for 10.5.1a was derived by Bruce Wilson (ELA) based on the current technical descriptions combined with expert knowledge. The tree and shrub canopy height and covers were taken directly from the mean values in the technical descriptions. The grass cover was assumed to equate to 80% of the ground layer cover. The technical descriptions do not have mean values for the species richness, organic litter, large tree number and coarse woody debris. For these attributes, RE site benchmark values were made by inspection of the technical descriptions in combination with the mode values recorded from the Carmichael Coal Mine sites, which were considered by the author to generally be in good condition.
10.5.1d	Derived benchmark for 10.5.1d	The benchmark for 10.5.1d was derived by Bruce Wilson (ELA) based on the current technical descriptions combined with expert knowledge. The tree and shrub canopy height and covers were taken directly from the mean values in the technical descriptions. The grass cover was assumed to equate to 80% of the ground layer cover. The technical descriptions do not have mean values for the species richness, organic litter, large tree number and coarse woody debris. For these attributes, RE site benchmark values were made by inspection of the technical descriptions in combination with the mode values recorded from the Carmichael Coal Mine sites, which were considered by the author to generally be in good condition.
10.5.5a	10.3.6a	Preliminary draft benchmarks Galilee draft benchmarks for the Galilee Project supplied by Queensland Herbarium, Jan 2014. Both REs are very similar in vegetation structure, understorey composition and species

		diversity with the main difference being the dominant canopy species.
10.7.5	10.7.5	Preliminary draft benchmarks Galilee draft benchmarks for the Galilee Project supplied by Queensland Herbarium, Jan 2014.
11.3.3c	11.3.3	Draft benchmark supplied by Queensland Herbarium, Jan 2014.
11.3.25	11.3.25	Queensland Herbarium (2013) BioCondition benchmarks of Regional Ecosystems, (June, 2013) (Department of Science, Information Technology, Innovation and the Arts: Brisbane).
11.4.6	11.4.6	Preliminary draft benchmarks Galilee draft benchmarks for the Galilee Project supplied by Queensland Herbarium, Jan 2014.
11.4.9	11.4.9	Draft benchmark supplied by Queensland Herbarium, Jan 2014.

3.4 Special features scoring

The special features scores for each of the clearing area assessment units are shown in **Table 5**. These scores were derived from comparison of the GIS data to the special feature indicator scores listed in **Table B3** in **Appendix B**. Further breakdown of the special features scoring is presented in **Table D1** of **Appendix D**, which includes the areas of impact used in the calculations.

Table 5: Special features indicator scores for each assessment unit

Special feature indicators	Clearing area assessment units							
	1	2	3	4	5	6	7	8
Centres of endemism	0.0	0.5	0.0	0.2	1.7	0.0	0.0	0.0
Wildlife refugia	2.5	8.3	2.3	645.7	66.3	57.8	15.2	17.8
Disjunct populations	0.0	4.6	0.0	372.5	39.7	6.3	7.0	8.3
Taxa at limits of geographic range	0.0	1.5	0.0	124.2	13.2	2.1	2.3	2.8
High species richness	0.0	8.1	0.0	633.6	68.0	11.2	12.6	14.6
Relictual populations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Regional ecosystems with distinct variation in species associated with geomorphologic and other environmental variables	0.0	0.2	0.0	6.4	0.8	0.0	4.8	0.0
Artificial waterbody of ecological significance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
High density hollow bearing trees	0.0	2.0	0.0	149.0	15.5	2.8	3.1	3.6
Breeding or roosting areas used by significant numbers of individuals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Special feature indicators	Clearing area assessment units							
	1	2	3	4	5	6	7	8
Strategic ecological corridor	2.5	6.0	2.0	1,135.5	92.8	4.4	54.6	33.0
Priority species within the bioregion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Significance of patch within a 1 km buffer	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0
Protected areas estate buffer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Assessment unit special features score	5.1	31.2	9.3	3,067.1	297.9	84.6	99.7	80.1

3.5 EPBC calculator scoring

The impact calculation component of the OAG for the Brigalow TEC, Black-throated Finch habitat and *Livistona lanuginosa* is presented in **Table 6**. Photos depicting the three MNES on the CCM site are presented in **Appendix E**.

Table 6: EPBC Act Offsets Assessment Guide impact calculator scores

Protected matter attribute	MNES	Area of community (ha)	Quality	Total quantum of impact
Ecological community	Brigalow TEC	124.7	7	87.29
Protected matter attribute	MNES	Area of habitat (ha)	Quality	Total quantum of impact
Threatened species habitat	Black-throated Finch	9,950.0	7	6,965.00
Protected matter attribute	MNES	Number of individuals		Total quantum of impact
Threatened species	<i>Livistona lanuginosa</i>	12		12 individuals

The score of quality for the Brigalow TEC is based on the BioCondition assessment for the only applicable RE within the CCM mining footprint, i.e. RE11.4.9 *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains. The BioCondition assessment is based on the same attributes as the ecological condition indicators listed in **Table B1** and **Table B2** of **Appendix B** and take into account both field based and spatial attributes including:

- Native plant species richness
- Canopy height and cover
- Native perennial grass cover

- Organic litter cover
- Weed cover
- Number of large trees
- Coarse woody debris
- Size of patch
- Connectivity
- Surrounding remnant vegetation and high value regrowth

The ecological condition score for RE11.4.9 was 73 out of a possible 100 against the benchmark data. This was conferred as a quality score of 7 on the scale of 1-10 for the OAG. This calculated a total quantum of impact of 87.29.

Determination of habitat quality for Black-throated Finch was based on the ecological condition scores, presence of key grass species and presence of waterbodies. The ecological condition scores were averaged with a result of 63.6. The number of key grass species at each site was averaged with a result of one key grass species being present. Presence of water was given a score of 1 and absence of water a score of 0, with the percentage of sites with water being 33%. Qualitative assessment using the above indicators suggests that a habitat quality score of 7 for the OAG would be justified. This calculated a total quantum of impact of 6,965.00.

Nine sites were surveyed within habitat for *Livistona lanuginosa* that intersected the mining footprint. The 12 *Livistona lanuginosa* individuals were found to occur within a 20 m buffer zone of the two designated road crossings of the Carmichael River in the mining footprint. Six of these individuals are in the road alignment and will be directly impacted. The other six individuals will either be directly or indirectly impacted depending upon the final road width and clearing zone during construction.

4 Biodiversity values

4.1 State significant biodiversity values and matters of environmental significance

The following sections discuss the SSBVs and MNES that formed this ecological equivalence assessment in the context of their condition and value to the Carmichael Coal Mine site.

4.1.1 Remnant Endangered and Of Concern Regional Ecosystems.

The REs listed as Endangered or Of Concern under the VM Act 1999 include the Brigalow (*Acacia harpophylla* - 11.4.9 endangered) and Gidgee (*A. cambagei* - 11.4.6 of concern) dominated woodlands on clay plains in the Brigalow Belt bioregion. The Brigalow ecosystem RE 11.4.9 is also considered a MNES as it is included in the Brigalow (*Acacia harpophylla* dominant and co-dominant) endangered ecological community listing under the EPBC Act.

The Brigalow ecosystem (11.4.9) is mapped on the site across an area of 126.1 ha which mostly occurs in two patches adjacent to the sand plains of the Desert Uplands (**Figure 3**). Another small area of remnant Brigalow also occurs north of the Carmichael River (**Figure 3**). All but 1.4 ha of this area falls within the proposed mine surface footprint. This ecosystem is in good condition on the site although the canopy is more open and lower than normal and the species richness is low which perhaps reflects its location at western limit of the ecosystems range.

The Gidgee ecosystem (11.4.6) is mapped across 220 ha all of which occurs within the proposed mine surface footprint (**Figure 4**). The sites assessed were in good condition although were shorter and more open than good examples of this community elsewhere in the bioregion.

Areas of Brigalow and Gidgee RE's also occur in the Desert Uplands however these communities have a VM Class of Least Concern and therefore do not require offsets.

4.1.2 Wetlands

Seasonal and ephemeral wetlands include the small areas of Coolibah woodlands on closed depressions. Most of the wetlands occur on the flood plains of the Carmichael River (**Figure 5**). These wetlands only fill with water for short durations following rain when they support a range of wetland flora (observed during field survey) and fauna (few observed). There is 32.6 ha of this ecosystem mapped in the proposed surface footprint. The wetlands are in reasonable condition although are isolated by clearing of surrounding vegetation up to their edges.

Other very small (< 0.25 ha) wetlands are associated with gilgai that are a minor feature across the Gidgee and Brigalow REs on low lying clay plains in both the Brigalow Belt and Desert Uplands bioregions (**Figure 5**). These ecosystems are generally made up of large numbers of small gilgai of varying relief. A substantial number of these were full of water at the time of the survey and supported wetland flora.

Riverine wetlands are associated with the Carmichael River, Cabbage Tree Creek and unnamed creeks to the north and south of Carmichael River (**Figure 5**). These areas are generally quite narrow due to clearing up to the high bank of the watercourses. They are therefore subject to edge effects and impacts from grazing and weed incursions are often evident.

4.1.3 Watercourses

Watercourses on the sites are associated with River Red Gum (*Eucalyptus camaldulensis*) or Coolibah (*E. coolabah*) woodlands that occur along the Carmichael River and Cabbage Tree Creek and smaller drainage lines running across the sand plains (**Figure 6**). There are also more minor watercourses traversing through various woodlands on sand plains and clay plains that do not support distinctive riparian vegetation. The habitats associated with water courses are generally in good condition although there is some high grazing impacts to the ground layer and weed incursions in some areas particularly associated with permanent water along the Carmichael River and Cabbage Tree Creek.

4.1.4 Threatened and migratory fauna species

Black-throated Finch (southern) (Poephila cincta cincta)

This species is associated with a range of grassy eucalypt woodland to open woodlands, particularly those areas with permanent to semi-permanent water sources, which are widespread on sand and alluvial plains across the site (**Figure 7**). All information currently available for Black-throated Finch on the CCM site (including those recorded by GHD in the EIS and SEIS and subsequent observations by ELA during the EEA survey) show that the species is mainly recorded north of the Carmichael River. Habitat for the Black-throated Finch occurs mostly within either the 3 km buffer of water sources or the 5 km buffer of Black-throated Finch sightings, each described as a key determination of habitat in the EPBC Act Significant Impact Guidelines for Black-throated Finch (DEWHA 2009) (**Figure 7**). These habitats are generally in good condition and mostly occur in large continuous tracts. Several of the seeding grass species (e.g. *Themeda triandra*, *Alloteropsis semialata*, *Panicum decompositum*, *Dichanthium sericeum* and *Eragrostis sororia*) associated with preferential habitat were commonly found in these habitats.

This species is also listed as a MNES.

Woodland dependent fauna

Numerous threatened species associated with woodland to open woodland habitat have been recorded on the site or are considered likely to occur. These species may potentially use the extensive woodland habitat that dominates the remnant vegetation on the site, as suggested by EIS and SEIS records and observations by ELA during the EEA survey (**Figure 8**). This vegetation is generally in good condition occurring in large continuous tracts.

In particular, several woodland birds including the Squatter Pigeon (*Geophaps scripta scripta*), Square-tailed Kite (*Lophoictinia isura*) and Black-chinned Honeyeater (*Melithreptus gularis*), as well as the Little Pied Bat (*Chalinolobus picatus*) are likely to utilise all woodland habitats across the site. These species are generally potentially associated with the range of eucalypt woodland to open woodlands that are widespread across the sand and alluvial plains on the site. Woodland habitat close to permanent water is likely to be more important for the Squatter Pigeon which is also listed as a MNES.

Two Koala (*Phascolarctos cinereus*) observations have been made on the site during ecological surveys (One during the EIS surveys by GHD and one by ELA during the December 2013 survey) (**Figure 8**). Koalas are more likely to use riparian habitats where preferred food trees, especially River Red Gum (*Eucalyptus camaldulensis*), occur. They may occasionally use other eucalypt ecosystems on the site for dispersals and shelter. This species is listed as a MNES.

Yakka Skink (*Egernia rugosa*) is associated with woodland vegetation on landzones 3, 4, 5 and 7, particularly areas with microhabitats such as fallen timber and log/rock piles. These microhabitats occur occasionally across the site but are not common. This species is listed as a MNES.

Wetland dependent fauna

Two species associated with wetland habitat are known or likely to occur on the site, Black-necked Stork (*Ephippiorhynchus asiaticus*) and Cotton Pygmy-goose (*Nettapus coromandelianus*). These species are mainly associated with permanent water which occurs along the Carmichael River and large dams (**Figure 9**). Ephemeral wetlands will also provide habitat for these species when filled with water (**Figure 9**).

Ornamental Snake (Denisonia maculata)

Suitable habitat for this species on the Carmichael Coal Mine site is associated with the gilgai and clay soils of the Brigalow and Gidgee ecosystems as well as riparian habitats such as Carmichael River and Cabbage Tree Creek (**Figure 10**). These communities are found scattered across the western parts of the site where they are surrounded by the eucalypt woodlands on the sand plains. In the east of the site there are more fragmented remnants of suitable habitat left after clearing of the surrounding vegetation.

This species is listed as a MNES.

4.1.5 Threatened flora species

Waxy Cabbage Palm (*Livistona lanuginosa*) is associated with the River Red Gum (*Eucalyptus camaldulensis*) woodlands that occur on the levees of the Carmichael River (**Figure 11**). The density of the species varied across its range although generally where it occurred the sites were in good condition with a range of age classes present. A detailed search found 12 individuals in or immediately adjacent to the proposed mine surface impact area.

This species is also listed as a MNES.

4.1.6 Connectivity

A large portion of the site is mapped within a state significant corridor (**Figure 12**). Remnant vegetation within this area is considered to provide important connectivity for biodiversity.

4.1.7 Matters of national environmental significance

Although seven MNES are known to exist or likely to occur on the site, only three are expected to be significantly impacted by the Carmichael Coal Mine and therefore require offsets (SEIS, GHD 2013). These MNES are the Brigalow TEC (endangered), Black-throated Finch (endangered) and *Livistona lanuginosa* (vulnerable).

Brigalow TEC is associated with RE 11.4.9 of which 126.1 ha occurs in three patches across the site (**Figure 3**). All but 1.4 ha of this area falls within the proposed mine surface footprint. This ecosystem is in good condition on the site although the canopy is more open and lower than normal and the species richness is low which perhaps reflects its location at western limit of the ecosystems range.

Refer to previous section for discussion of the Black-throated Finch and *Livistona lanuginosa*.

4.2 Interpretation of ecological equivalence scores

The ecological equivalence score is the main output of the ecological equivalence assessment in Queensland. An ecological equivalence score is calculated for each assessment unit where multiple units have been assessed.

These scores need to be compared to equivalent scores derived by applying the ecological equivalence methodology to proposed offset areas. Similarly, proposed offset areas would need to be compared to

the SSBVs identified in **Section 2.1.2**. This can only be done once potential offset areas have been identified and assessed.

For the offset area to be ecologically equivalent to the clearing area, and hence meet ecological equivalence requirements under QBOP, the offset area must obtain:

- an overall ecological condition score equal to or greater than the overall ecological condition score for the clearing areas
- an overall special features score equal to or greater than the overall special features score for the clearing areas
- a minimum score for ecological condition indicator 1 (recruitment of woody perennial species) must have a minimum score of three (i.e. >20 of overstorey species present as regeneration) and ecological condition indicator 4 (tree canopy cover) must have a minimum score of two (i.e. >10% and less than 50% benchmark) on offset areas (DERM 2011).

In order for ecological equivalence to be met and therefore satisfy the conditions listed in the current EA for EPC1690 (permit no. EPPR00745013), the overall ecological condition and special features scores for the offset areas must be equal to or greater than those derived on the clearing sites.

Where ecological equivalence cannot be demonstrated, the offset area will be deemed as not meeting the relevant requirement within the QBOP.

4.2.1 EPBC Act Environmental Offsets Policy

Under the EPBC Act Offsets Policy and accompanying Offsets Assessment Guide (OAG), it is essential to establish the total quantum of residual impact to a protected matter in order to determine the offset requirements. To assist in determining the level of impact for threatened species and ecological communities, a measure of habitat condition of the impact area is required. The ecological equivalence scores calculated using the BioCondition method of survey provides a metric condition value that can be measured against a benchmark value. This score, combined with other condition measures described in **Section 3.5** were used to calculate the total quantum of impact for the OAG calculator.

As for the state ecological equivalence scores, the final score calculations under the EPBC Act Offsets Policy cannot be completed until suitable offset areas have been identified and assessed.

The offset requirements under the EPBC Act Offsets Policy are:

- Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter
- Suitable offsets must be built around direct offsets but may include other compensatory measures
- Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter
- Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter
- Suitable offsets must effectively account for and manage the risks of the offset not succeeding
- Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs
- Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable

- Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

It is also important to note when determining suitable offset supply areas that a state offset will count toward an offset under the EPBC Act to the extent that it compensates for the residual impact to the protected matter identified under the EPBC Act.

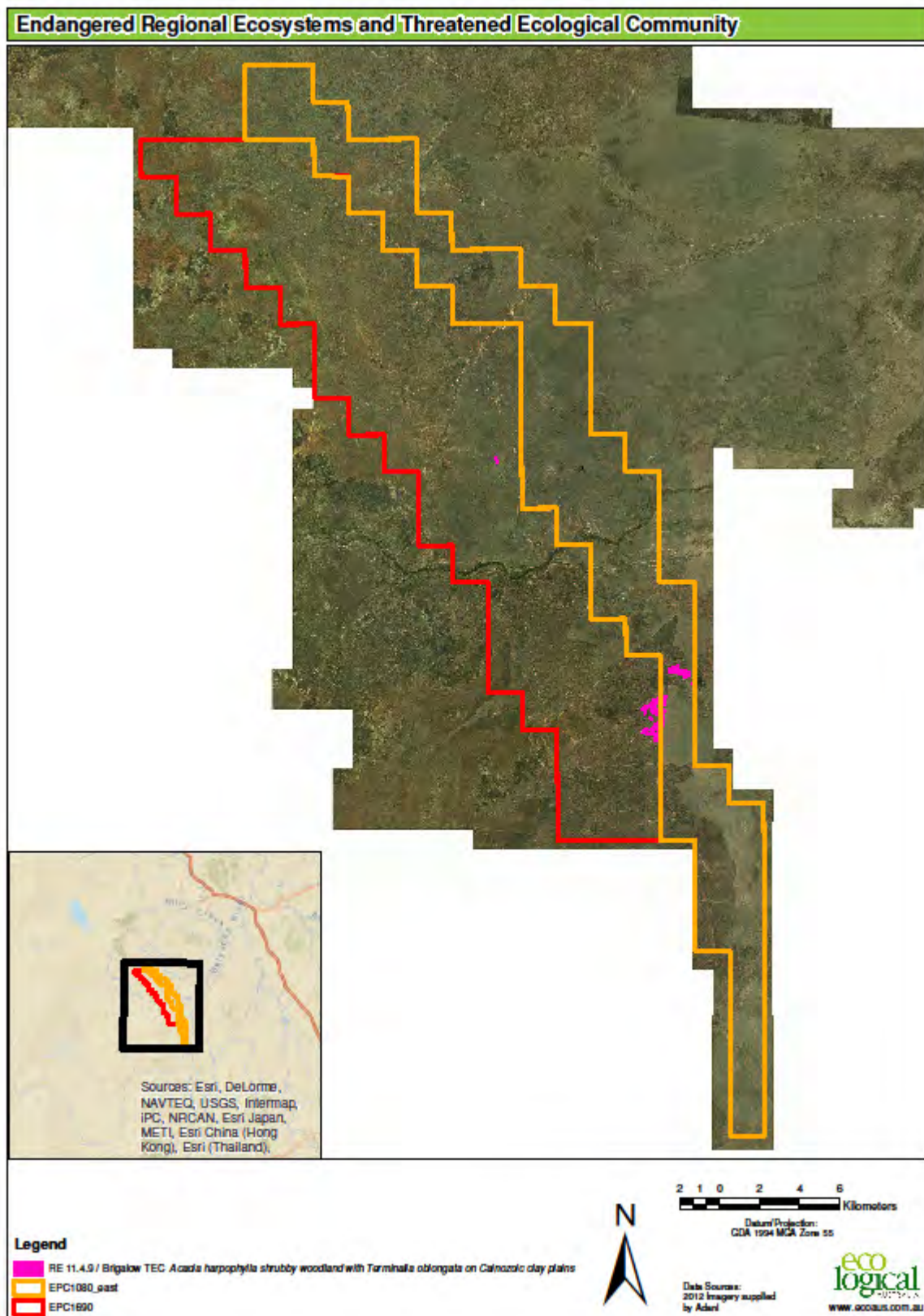


Figure 3: Endangered Regional Ecosystems and Threatened Ecological Community

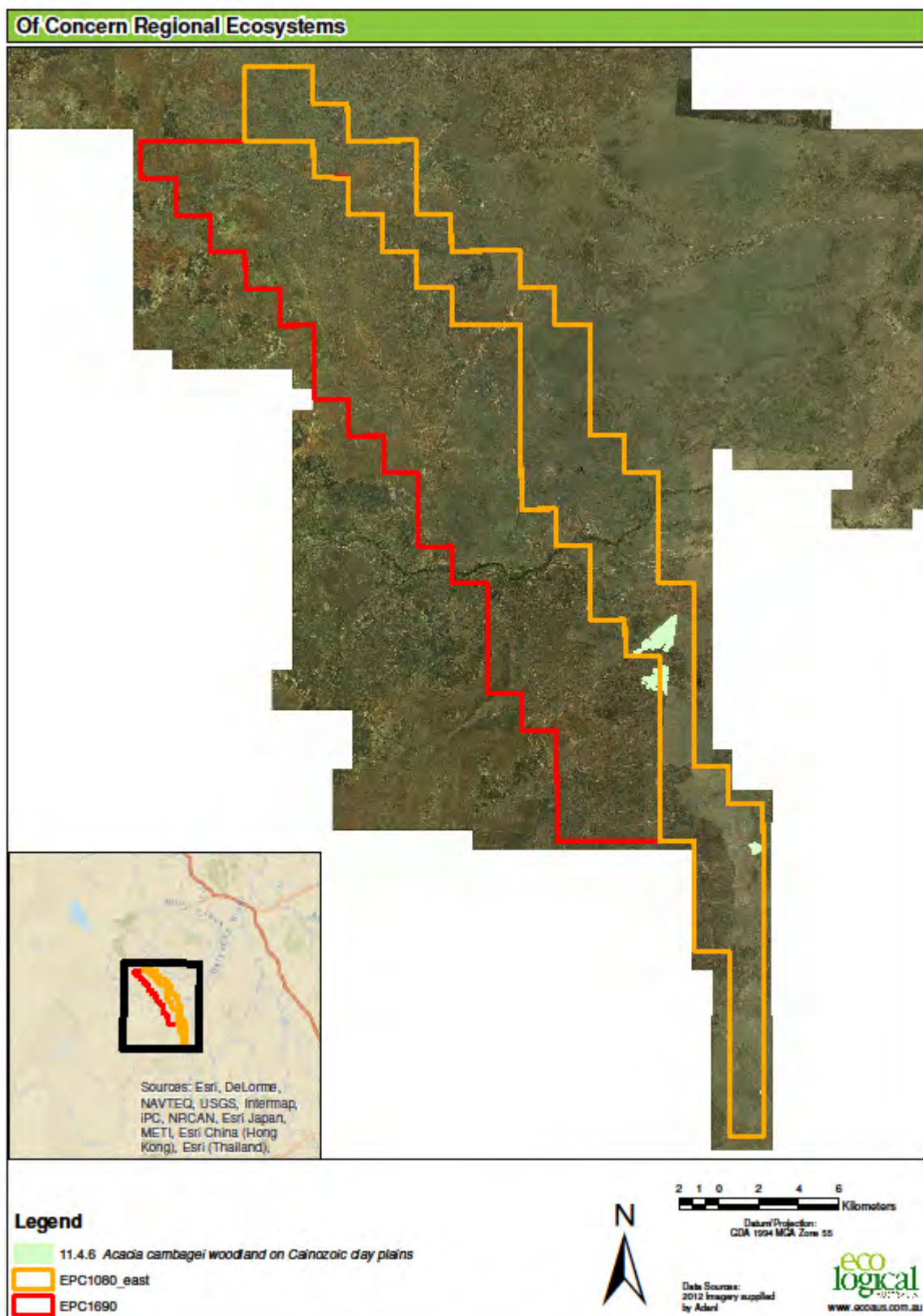


Figure 4: Of Concern Regional Ecosystems

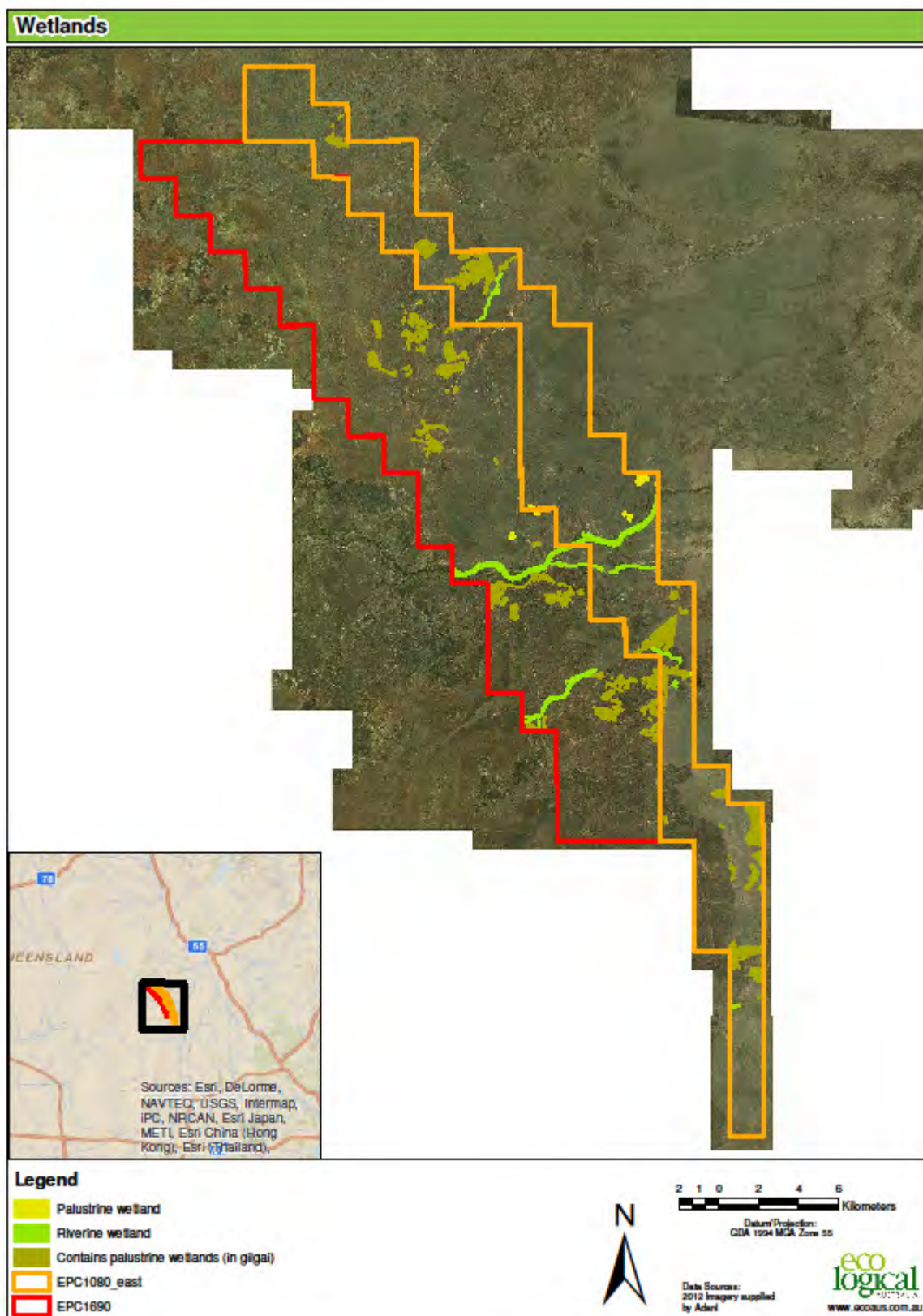


Figure 5: Wetlands

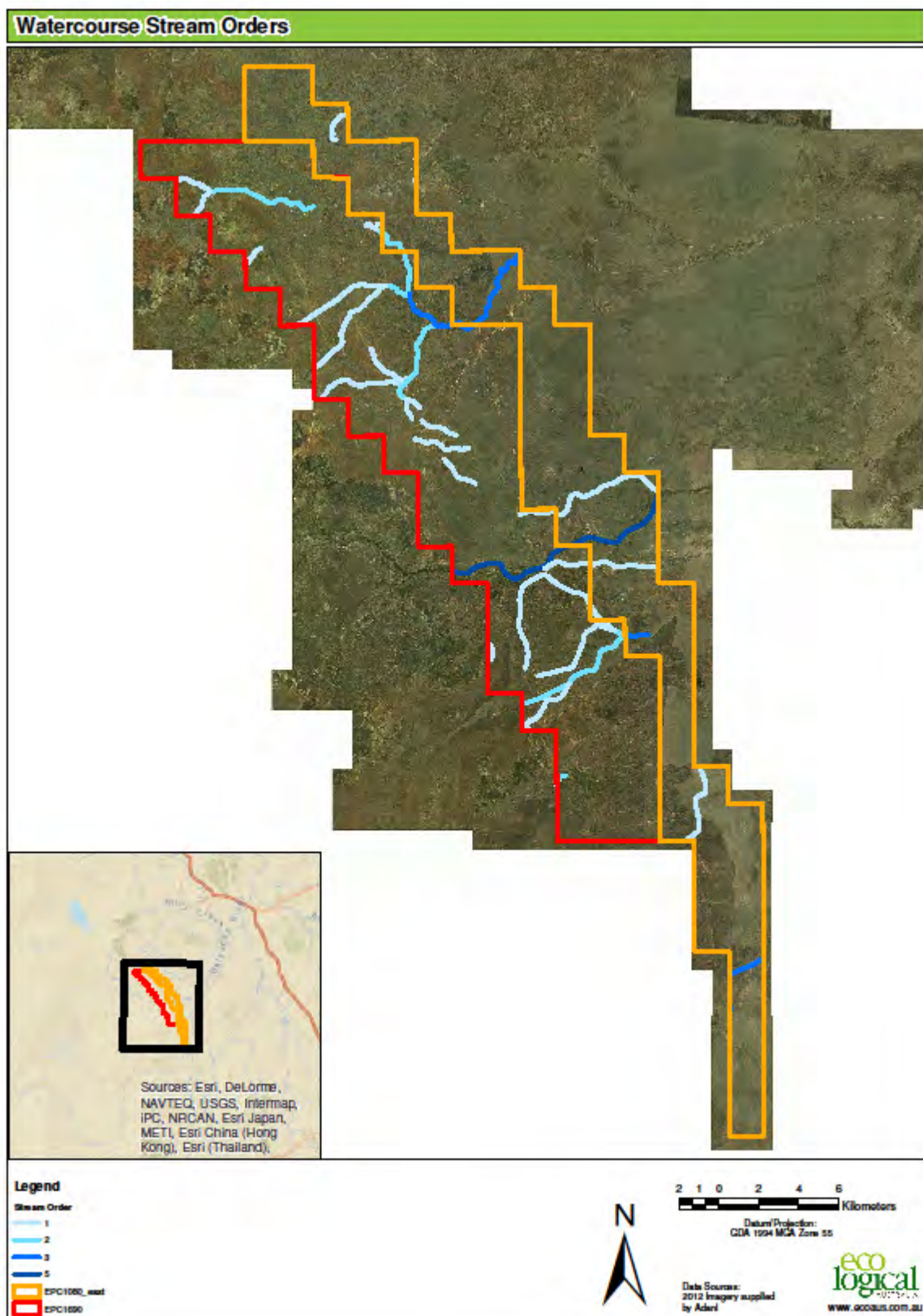


Figure 6: Watercourses

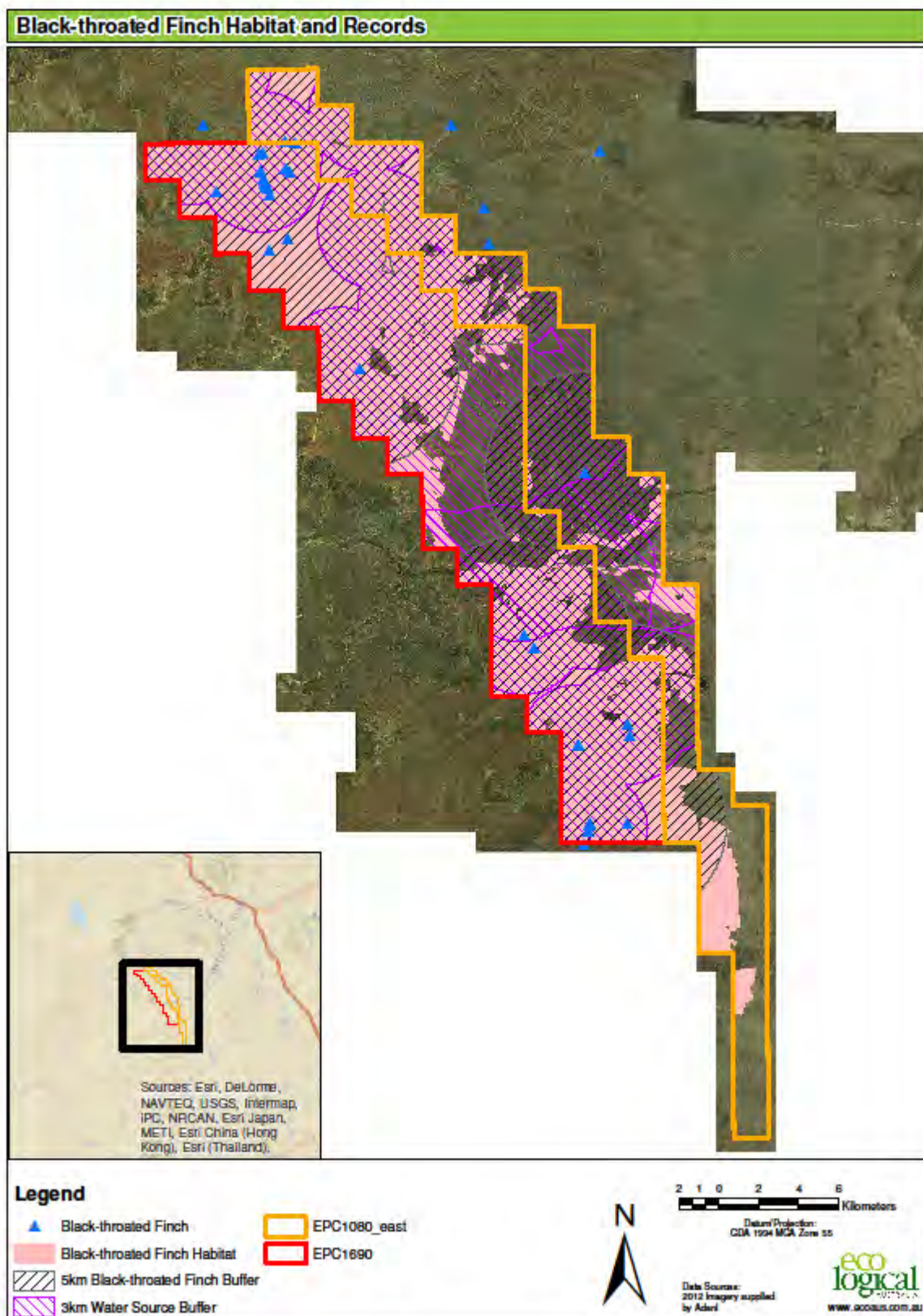


Figure 7: Black-throated Finch habitat and records (based on surveys for EIS and SEIS by GHD, and EEA survey by ELA)

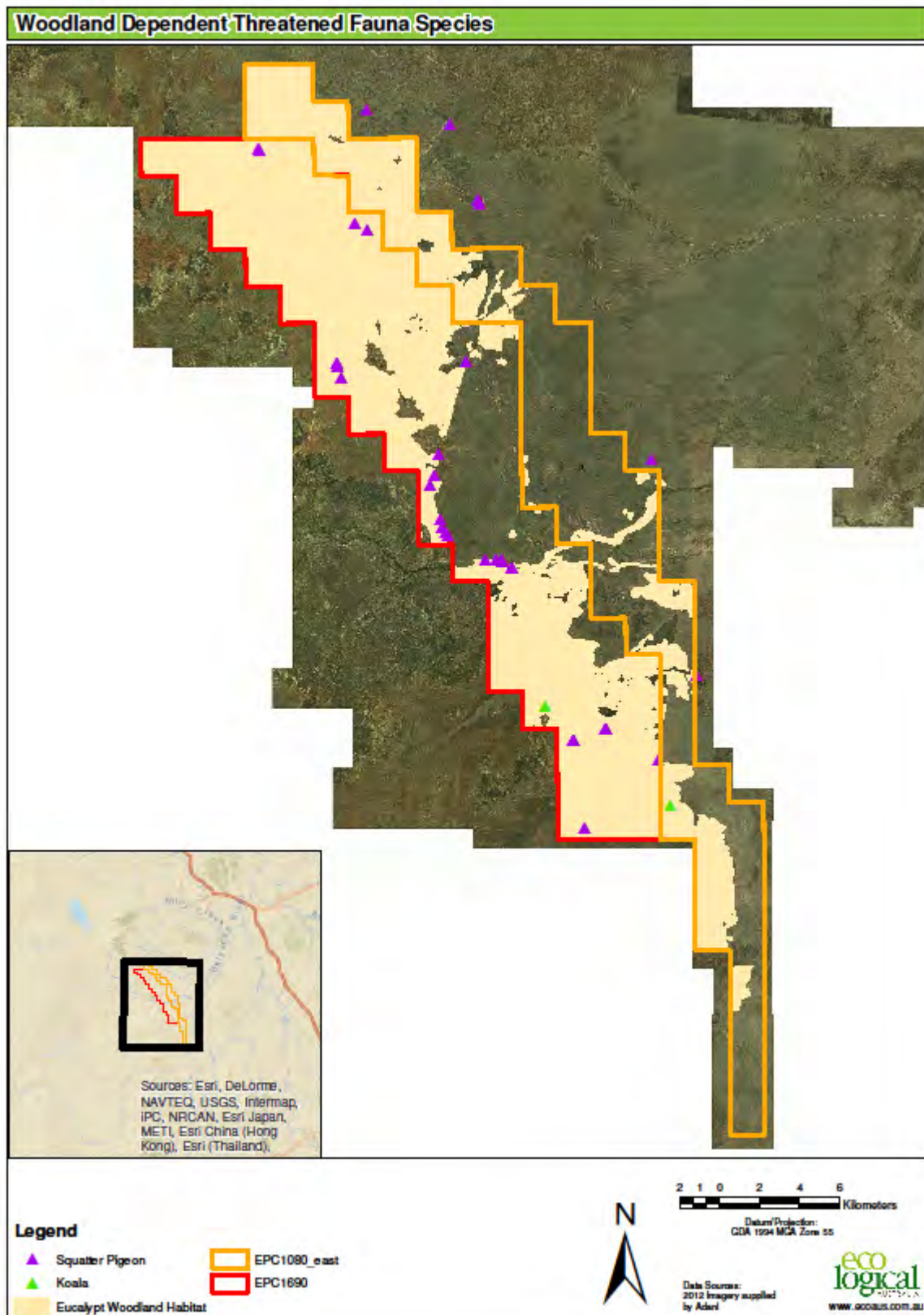


Figure 8: Woodland dependent threatened fauna species (based on surveys for EIS and SEIS by GHD, and EEA survey by ELA)

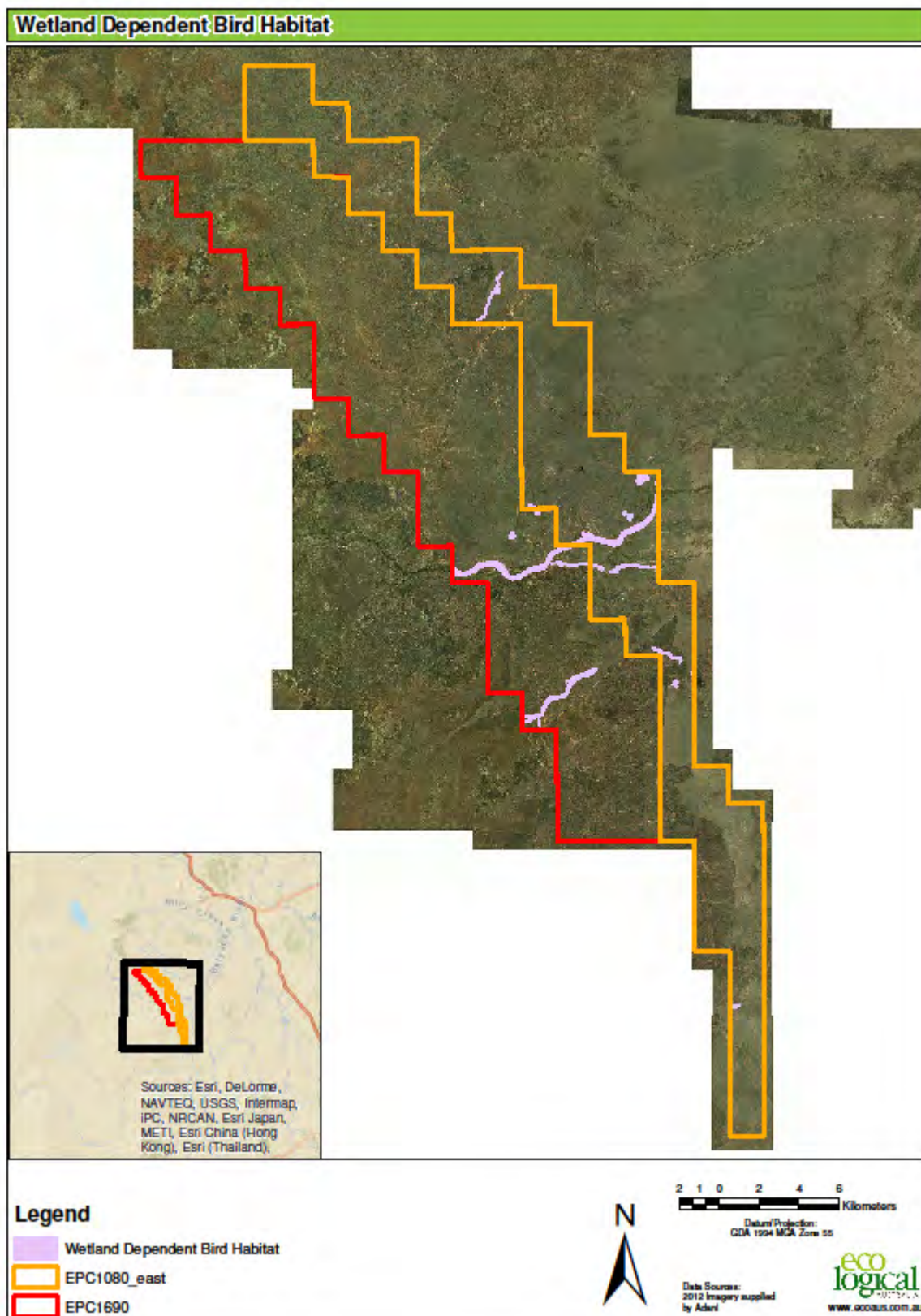


Figure 9: Wetland dependent bird habitat

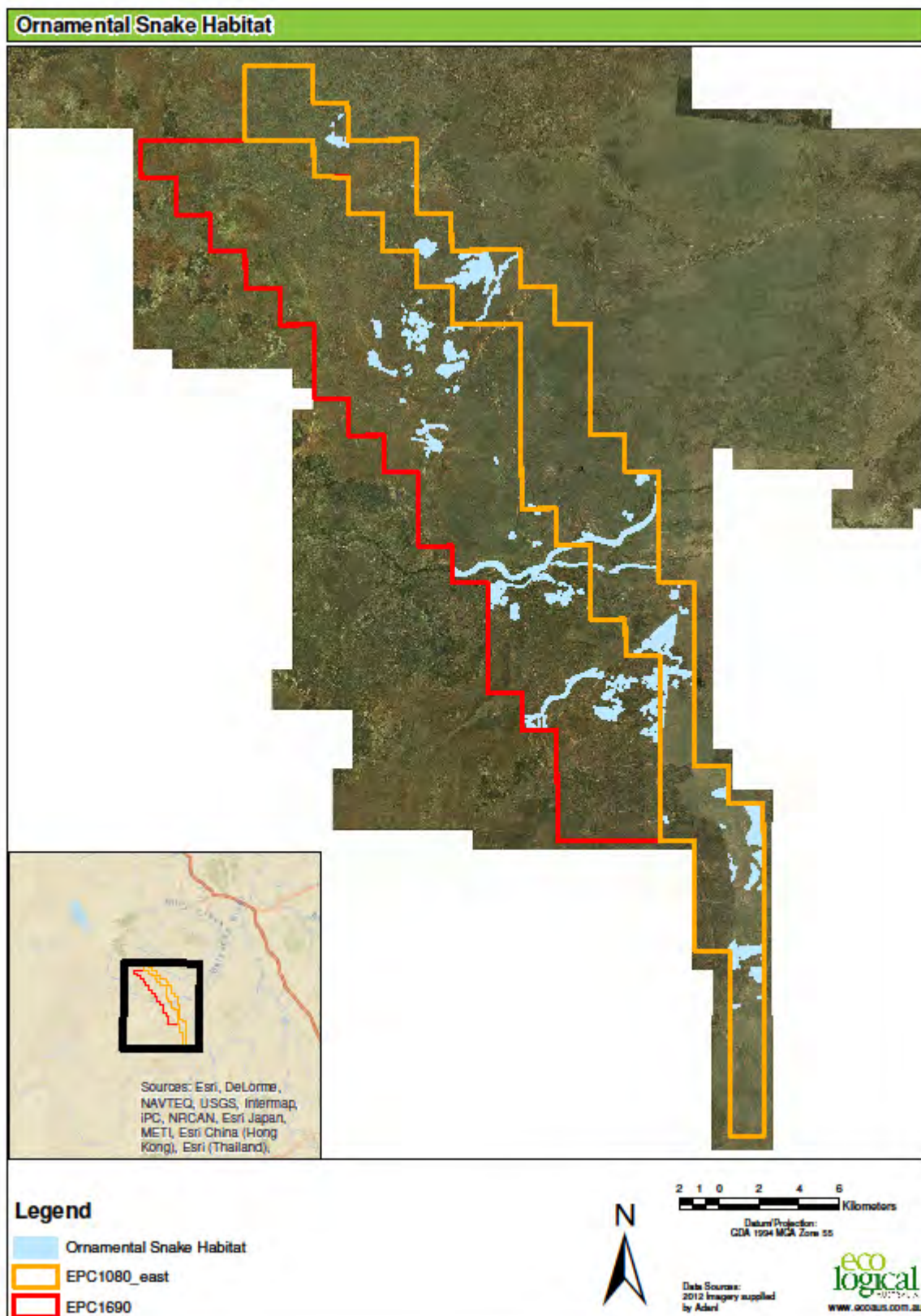
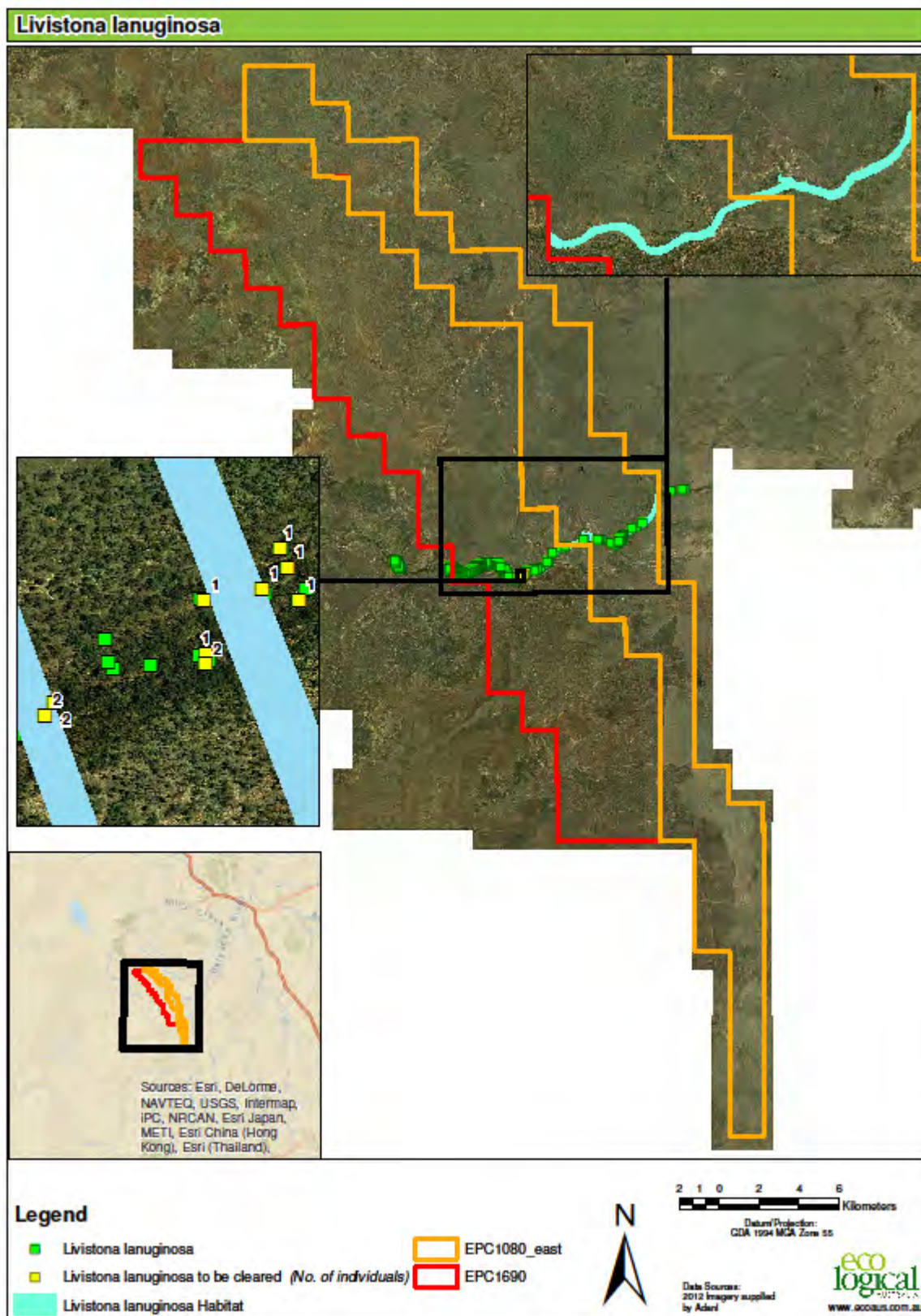


Figure 10: Ornamental snake habitat

Figure 11: *Livistona lanuginosa* habitat and records

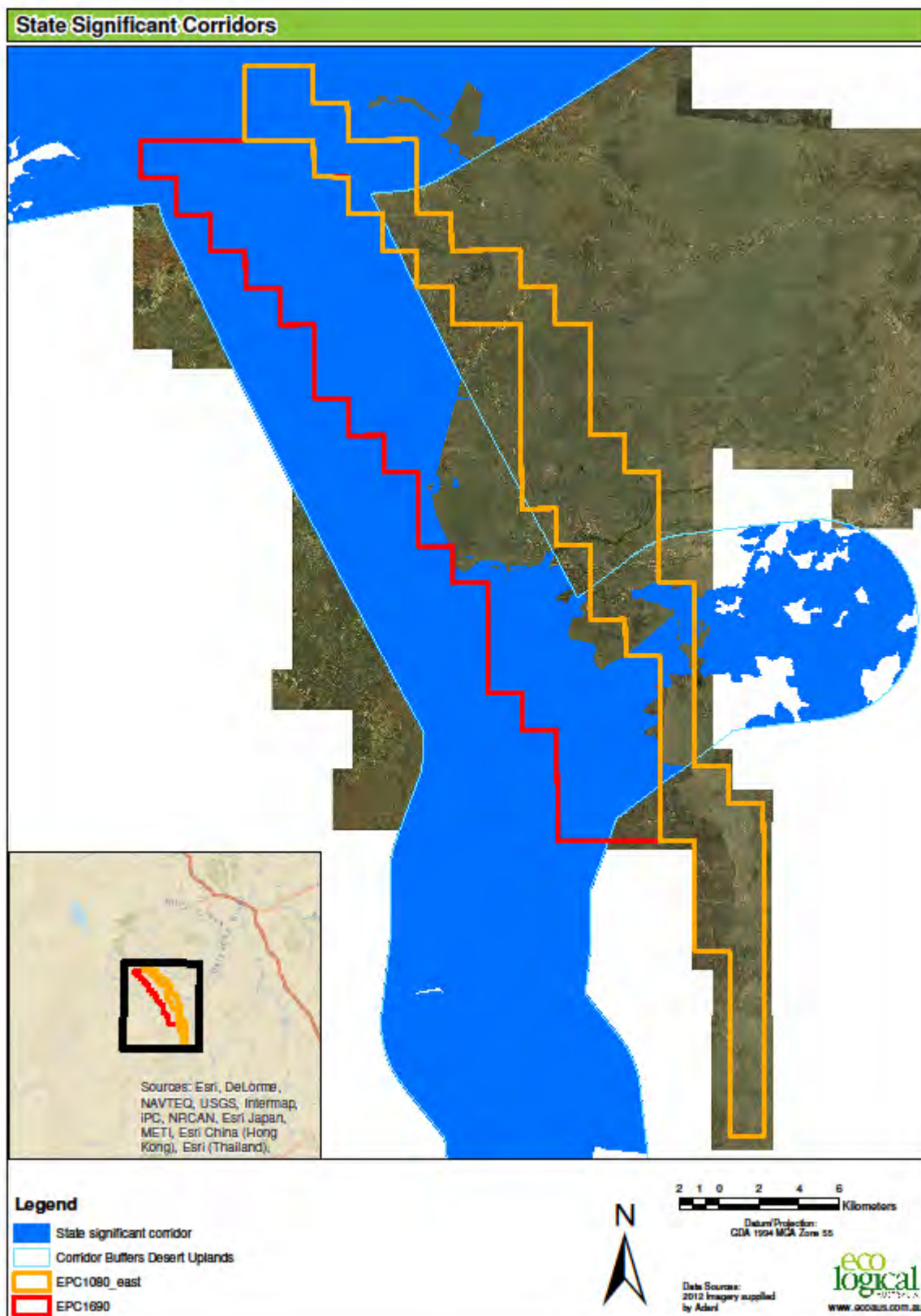


Figure 12: State significant corridors

5 Recommendations

5.1 Offset options

The offset area ecological condition and special feature scores need to exceed those of the clearing area, i.e. the impact area of the mining footprint. Offset areas need to be in the same BVG as the clearing area RE and need to be of equal or higher VM class.

The QBOP requires ecological equivalence to be demonstrated between the offset area and the clearing area. However, the EEM is not a definitive measure as to whether an offset will be approved by EHP; it is to assist in determining if ecological equivalence has been achieved. Similarly the offsets for MNES must provide a minimum conservation gain.

Ecological equivalence is only part of an offsets proposal. The offsets proposal will also need to demonstrate how the area has been legally secured and will also include a management and monitoring plan for the area.

If Moray Downs does not supply all offset areas required to meet ecological equivalence, Adani will need to either secure alternative offset supply areas with the aid of an offset broker or negotiate with EHP on indirect offset options.

5.2 Conclusions

The ecological equivalence assessment presented in this report represents a scenario of the impacts to SSBVs based on the proposed mining footprint. The total area of direct impact to SSBVs is 10,942 ha.

The assessment also included a preliminary indication of the impact calculations required under the EPBC Act Offset Assessment Guide for Brigalow TEC, Black-throated Finch habitat and *Livistona lanuginosa*. The total area of direct impact to MNES is 10,075 ha (Brigalow TEC and Black-throated Finch habitat) as well as 12 *Livistona lanuginosa* individuals.

Further assessment will be needed of the potential offset areas in order to fulfil obligations under the QBOP and anticipated approval conditions under the EPBC Act. For the QBOP this will need to include ecological equivalence assessments for relevant state significant biodiversity values on offset areas.

In order to achieve ecological equivalence, the offset areas will need to achieve a higher score for the ecological condition and special features scores for each relevant assessment unit as identified in **Table 7**.

Table 7: Ecological condition and special features scores for each assessment unit

	Clearing assessment units							
	1	2	3	4	5	6	7	8
Ecological condition score	9.1	32.6	19.0	5,683.1	443.0	186.8	372.0	278.8
Special features score	5.1	31.2	9.3	3,067.1	297.9	84.6	99.7	80.1

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Appendix A: State significant biodiversity values

Table A 1: Details of each state significant biodiversity value

Environmental Value	Relevant to CCM	VM Act Class (Version 8.0) or NC Act status	Biodiversity status (Version 8.0)	EPBC Act status	Relevant BVG's	Relevant Assessment Units
Endangered Regional Ecosystems	11.4.9 <i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains	Endangered	Endangered	Endangered	25a	7
Of Concern Regional Ecosystems	11.4.6 <i>Acacia cambagei</i> woodland on Cainozoic clay plains	Of concern	Endangered	-	26a	8
Wetland (Vegetation Management Act 1999)	10.3.4a Contains palustrine wetland (e.g. in swales). <i>Acacia cambagei</i> open woodland (western)	Least concern	Of concern	-	26a	8
	10.3.13a: Riverine wetland or fringing riverine wetland. <i>Eucalyptus camaldulensis</i> dominates the very sparse to sparse canopy. <i>E. coolabah</i> , <i>Casuarina cunninghamiana</i> and <i>Melaleuca leucadendra</i> are frequently present in the canopy	Least concern	Of concern	-	16a	2
	10.3.14a: Floodplain (other than floodplain wetlands). <i>Eucalyptus coolabah</i> dominates the very sparse canopy	Least concern	Of concern	-	16a	2
	10.4.5a: Contains palustrine wetland (e.g. in swales). <i>Acacia cambagei</i> dominates the small tree layer sometimes with <i>A.</i>	Least concern	Of concern	-	26a	8

Environmental Value	Relevant to CCM	VM Act Class (Version 8.0) or NC Act status	Biodiversity status (Version 8.0)	EPBC Act status	Relevant BVG's	Relevant Assessment Units
	<i>harpophylla</i> . Occurs on plains and gently undulating downs on Cainozoic lake deposits					
	11.3.25 <i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Least concern	Of concern	-	16a	2
	11.3.27f: Palustrine wetland (e.g. vegetated swamp). <i>Eucalyptus coolabah</i> and/or <i>E. tereticornis</i> open woodland to woodland fringing swamps	Least concern	Of concern	-	34d	3
	11.4.9 <i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains	Endangered	Endangered	Endangered	25a	7
Significant wetland (Vegetation Management Act 1999)	11.3.27f: Palustrine wetland (e.g. vegetated swamp). <i>Eucalyptus coolabah</i> and/or <i>E. tereticornis</i> open woodland to woodland fringing swamps	Least concern	Of concern	-	34d	3
Watercourses	Stream orders 1 and 2 – watercourse vegetation	-	-	-	12a, 16a, 17a, 17b, 17c, 26a & 34d (only those areas interested by watercourses)	1, 2, 4, 5, 7 & 8 (only those areas interested by watercourses)
	Stream orders 3 and 4 – watercourse	-	-	-	17a, 17b, 25a	4, 7 & 8 (only

Environmental Value	Relevant to CCM	VM Act Class (Version 8.0) or NC Act status	Biodiversity status (Version 8.0)	EPBC Act status	Relevant BVG's	Relevant Assessment Units
	vegetation				& 26a (only those areas interested by watercourses)	those areas interested by watercourses)
	Stream orders 5 or greater – watercourse vegetation	-	-	-	16a (Carmichael River only)	2 (Carmichael River only)
Connectivity	State significant corridor remnant vegetation and SSBV remnant vegetation >5ha	-	-	-	12a, 16a, 17a, 17b, 17c, 18a, 25a, 26a & 34d	1, 2, 3, 4, 5, 6, 7 & 8
Protected animals	Squatter Pigeon (southern) (<i>Geophaps stricta stricta</i>)	Vulnerable	-	Vulnerable	12a, 16a, 17a, 17b, 17c, 18a & 34d	1, 2, 3, 4, 5, & 6
	Black-throated Finch (southern) (<i>Poephila cincta cincta</i>)	Endangered	-	Endangered	12a, 16a, 17a, 17b, 17c, 18a & 34d	1, 2, 3, 4, 5, & 6
	Black-necked Stork (<i>Ephippiorhynchus asiaticus</i>)	Near threatened	-	n/a	16a & 34d	2 & 3
	Cotton Pygmy-goose (<i>Nettapus coromandelianus</i>)	Near threatened	-	n/a	16a & 34d	2 & 3
	Little Pied Bat (<i>Chalinolobus picatus</i>)	Near threatened	-	n/a	12a, 16a, 17a, 17b, 17c, 18a	1, 2, 3, 4, 5, & 6

Environmental Value	Relevant to CCM	VM Act Class (Version 8.0) or NC Act status	Biodiversity status (Version 8.0)	EPBC Act status	Relevant BVG's	Relevant Assessment Units
					& 34d	
	Koala (<i>Phascolarctos cinereus</i>)	Special least concern	-	Vulnerable	12a, 16a, 17a, 17b, 17c, 18a & 34d	1, 2, 3, 4, 5, & 6
	Echidna (<i>Tachyglossus aculeatus</i>)	Special least concern	-	n/a	12a, 16a, 17a, 17b, 17c, 18a & 34d	1, 2, 3, 4, 5, & 6
	Ornamental Snake (<i>Denisonia maculata</i>)	Vulnerable	-	Vulnerable	16a, 17a, 25a, 26a & 34d	2, 3, 7 & 8
	Yakka Skink (<i>Egernia rugosa</i>)	Vulnerable	-	Vulnerable	12a, 16a, 17a, 17b, 17c, 18a & 34d	1, 2, 3, 4, 5, & 6
	Square-tailed kite (<i>Lophoictinia isura</i>)	Near threatened	-	n/a	12a, 16a, 17a, 17b, 17c, 18a & 34d	1, 2, 3, 4, 5, & 6
	Black-chinned honeyeater (<i>Melithreptus gularis</i>)	Near threatened	-	n/a	12a, 16a, 17a, 17b, 17c, 18a & 34d	1, 2, 3, 4, 5, & 6
Protected plants	Waxy Cabbage Palm (<i>Livistona lanuginosa</i>)	Vulnerable	-	Vulnerable	16a	2

Appendix B: Indicator scores

Table B 1: Field based ecological condition indicator scores (reproduced from the Ecological Equivalence Methodology Guideline, v1 (DERM 2011))

Indicator	Description	Score
1. Recruitment of woody perennial species	<20% of overstorey species present as regeneration	0
	≥20 -75 of overstorey species present as regeneration	3
	≥75% of overstorey species present as regeneration	5
2. Native plant species richness (trees, shrubs, grasses, forbs)	<25% of benchmark number of species within each life-form	0
	≥25% to 90% of benchmark number of species within each life-form	2.5
	>90% of benchmark number of species within each life-form	5
3. Tree canopy height	<25% of benchmark height	0
	≥25% to 70% of benchmark height	3
	≥70% of benchmark height	5
4. Tree canopy cover	<10% of benchmark	0
	≥10% and <50% of benchmark	2
	≥50% to ≤200% of benchmark	5
	>200% of benchmark	3
5. Shrub canopy cover	<10% of benchmark shrub cover	0
	<50% or >200% of benchmark shrub cover	3
	≥50% to ≤200% of benchmark shrub cover	5
6. Native perennial grass cover	<10% of benchmark perennial grass cover	0
	≥10 to 50% of benchmark perennial grass cover	1
	>50 to 90% of benchmark perennial grass cover	3
	>90% of benchmark perennial grass cover	5
7. Organic litter cover	<10% of benchmark organic litter	0
	<50% or >200% of benchmark organic litter	3
	≥50% to ≤200% of benchmark organic litter	5
8. Large trees	No large trees present	0
	0 to 50% of benchmark large trees	5
	>50% to 100% of benchmark of large trees	10
	>benchmark number of large trees	15

Indicator	Description	Score
9. Coarse woody debris	<10% of benchmark number or total length of CWD	0
	<50% or >200% of benchmark number or total length of CWD	2
	≥50% or ≤200% of benchmark number or total length of CWD	5
10. Weed cover	>50% weed cover	0
	>25 to 50% weed cover	3
	≥5 to 25% weed cover	5
	<5% weed cover	10

Table B 2: GIS based ecological condition indicator scores (reproduced from the Ecological Equivalence Methodology Guideline, v1 (DERM 2011))

Indicator	Description	Score
11. Size of patch <i>(measured only in fragmented landscapes)</i>	<5 ha	0
	5-25 ha	2
	26-100 ha	5
	101-200 ha	7
	>200 ha	10
12. Connectivity <i>(measured only in fragmented landscapes)</i>	The assessment unit is not connected using any of the below descriptions	0
	The assessment unit adjoins with adjacent remnant vegetation along $\geq 10\%$ to $< 50\%$ of its perimeter; or adjoins with adjacent remnant vegetation along $< 10\%$ of its perimeter AND adjoins with adjacent non-remnant native vegetation $> 25\%$ of its perimeter	2
	The assessment unit adjoins with adjacent remnant vegetation along 50% to 75% of its perimeter	4
	The assessment unit adjoins with adjacent remnant vegetation along $> 75\%$ of its perimeter; or includes > 500 ha remnant vegetation	5
13. Context <i>(measured only in fragmented landscapes)</i>	$< 10\%$ remnant vegetation AND $< 30\%$ native non-remnant vegetation (regrowth)	0
	$\geq 10\%$ to 30% remnant vegetation AND $< 30\%$ high value regrowth; or $< 10\%$ remnant vegetation AND $\geq 30\%$ high value regrowth	2
	$\geq 30\%$ to 75% remnant vegetation; OR $\geq 10\%$ to 30% remnant vegetation AND $\geq 50\%$ high value regrowth	4
	$> 75\%$ remnant vegetation	5
14. Distance from permanent water <i>(measured only in intact landscapes)</i>	0-500 m from water point	0
	500 m to 1 km from water point	2
	1-3 km from water point	5
	3-5 km from water point	10
	> 5 km from water point	20

Table B 3: Special features indicator scores (reproduced from the Ecological Equivalence Methodology Guideline, v1 (DERM 2011))

Special feature indicator	Description	Score
1: Centres of endemism	No value	0
	Medium	5
	High	17
	Very high	20
2: Wildlife refugia	No value	0
	Medium	7
	High	17
	Very high	20
3: Areas with concentrations of disjunct populations	No value	0
	Medium	3
	High	12
	Very high	15
4: Areas with taxa at limits of geographic range	No value	0
	Medium	1
	High	4
	Very high	5
5: Areas with high species richness	No value	0
	Medium	5
	High	17
	Very high	20
6: Areas considered to be important for maintaining populations of ancient and primitive taxa	No value	0
	Medium	3
	High	12
	Very high	15
7: Areas containing regional ecosystems with distinct variation in taxa composition associated with geomorphology and other environmental variables	No value	0
	Medium	2
	High	8
	Very high	10
8: Artificially created waterbodies of ecological significance	No value	0
	Medium	1
	High	4

Special feature indicator	Description	Score
	Very high	5
9: Areas considered to be important because of high relative density of hollow-bearing trees	No value	0
	Medium	1
	High	4
	Very high	5
10: Breeding or roosting sites used by significant number of individuals	No value	0
	Medium	3
	High	12
	Very high	15
12: Priority species	No value	0
	Medium	5
	High	8
	Very high	10

Appendix C: Ecological condition scores for each site

Table C 1: Ecological condition scores for each sample site in each assessment unit

Assessment unit	Sample site	Recruitment of woody perennial species	Native plant species richness	Tree canopy height	Tree canopy cover	Shrub canopy cover	Native perennial grass cover	Organic litter cover	Large trees	Coarse woody debris	Weed cover	Total Field based attributes	Patch size	Connectivity	Context	Distance from water (km)	Total BioCondition Score
1	EE10	5	17.5	5	1.5	3	3	3	15	5	10	68	0	0	0	2	70
2	EE1	3	17.5	5	3	5	3	5	10	5	10	66.5	0	0	0	5	71.5
2	EE2	3	10	5	2.5	0	0	3	15	5	0	43.5	0	0	0	5	48.5
2	EE11	5	17.5	2.5	1.5	0	3	5	10	2	10	56.5	0	0	0	10	66.5
2	EE12	0	12.5	5	3	3	0	3	15	2	0	43.5	0	0	0	0	43.5
2	EE31	5	20	5	3	3	5	5	10	2	10	68	0	0	0	5	73
2	EE32	5	17.5	5	3	0	5	5	15	5	10	70.5	0	0	0	0	70.5
2	EE33	5	20	5	5	0	5	3	15	5	5	68	10	4	4	0	86
2	EE34	5	15	5	1.5	5	5	5	15	2	5	63.5	0	0	0	5	68.5
2	EE45	3	15	5	3	3	0	5	15	5	0	54	0	0	0	0	54
2	EE50	3	20	5	1.5	0	5	5	15	5	10	69.5	0	0	0	0	69.5
3	EE3	5	5	5	4	0	0	5	15	2	10	51	2	0	0	0	53
3	EE4	5	7.5	2.5	2.5	0	1	5	15	5	10	53.5	2	2	2	0	59.5
3	EE9	3	10	5	2.5	0	1	5	15	5	5	51.5	2	5	2	0	60.5
4	EE13	5	10	5	1.5	5	5	3	15	5	5	59.5	0	0	0	2	61.5
4	EE14	5	12.5	5	4	3	5	3	10	2	5	54.5	0	0	0	5	59.5

Assessment unit	Sample site	Recruitment of woody perennial species	Native plant species richness	Tree canopy height	Tree canopy cover	Shrub canopy cover	Native perennial grass cover	Organic litter cover	Large trees	Coarse woody debris	Weed cover	Total Field based attributes	Patch size	Connectivity	Context	Distance from water (km)	Total BioCondition Score
4	EE15	5	17.5	5	3	3	5	3	5	2	5	53.5	0	0	0	0	53.5
4	EE16	5	15	5	4	3	5	3	10	2	10	62	0	0	0	5	67
4	EE17	5	12.5	4	1.5	5	5	3	10	5	5	56	0	0	0	5	61
4	EE18	5	12.5	5	3	5	5	5	15	5	10	70.5	0	0	0	5	75.5
4	EE19	5	15	5	1.5	3	5	3	10	5	5	57.5	0	0	0	5	62.5
4	EE20	5	17.5	5	1.5	5	5	3	15	2	10	69	0	0	0	2	71
4	EE21	5	15	5	3	5	3	3	10	5	10	64	0	0	0	5	69
5	EE22	5	20	2.5	1.5	5	3	5	10	5	10	67	0	0	0	0	67
5	EE23	5	15	5	4	3	5	5	15	5	10	72	0	0	0	5	77
5	EE24	3	17.5	1.5	1.5	3	5	5	0	5	10	51.5	0	0	0	2	53.5
5	EE25	5	10	1.5	2.5	3	5	5	0	5	10	47	0	0	0	10	57
5	EE26	5	15	2.5	1.5	5	5	3	0	5	10	52	0	0	0	5	57
6	EE27	5	12.5	5	2.5	0	0	5	10	5	0	45	0	0	0	10	55
6	EE28	5	15	5	5	0	1	3	10	5	5	54	0	0	0	5	59
6	EE29	5	17.5	5	2.5	0	1	3	5	2	3	44	0	0	0	5	49
6	EE30	3	12.5	5	4	3	1	3	10	2	5	48.5	0	0	0	5	53.5
6	EE46	5	15	5	1.5	3	3	5	10	2	5	54.5	0	0	0	5	59.5
6	EE47	5	12.5	5	4	3	0	5	15	5	5	59.5	0	0	0	2	61.5
7	EE35	5	20	5	2.5	3	3	5	5	5	5	58.5	0	0	0	5	63.5

Assessment unit	Sample site	Recruitment of woody perennial species	Native plant species richness	Tree canopy height	Tree canopy cover	Shrub canopy cover	Native perennial grass cover	Organic litter cover	Large trees	Coarse woody debris	Weed cover	Total Field based attributes	Patch size	Connectivity	Context	Distance from water (km)	Total BioCondition Score
7	EE36	5	15	4	5	5	5	3	10	5	5	62	0	0	0	5	67
7	EE37	3	15	4	3.5	5	3	5	10	2	5	55.5	0	0	0	0	55.5
7	EE38	5	10	5	5	3	1	5	5	5	10	54	10	5	4	0	73
7	EE39	5	12.5	4	5	5	1	5	10	5	10	62.5	0	0	0	5	67.5
7	EE44	5	15	5	5	3	3	5	5	2	10	58	0	0	0	5	63
8	EE40	5	20	5	2.5	3	3	5	5	2	5	55.5	10	5	4	0	74.5
8	EE41	5	15	5	4	5	1	3	15	2	10	65	10	5	5	0	85
8	EE42	5	15	2.5	2.5	3	3	5	5	5	10	56	0	0	0	5	61
8	EE43	3	12.5	2.5	2.5	3	3	5	0	5	5	41.5	0	0	0	2	43.5
8	EE48	5	15	5	4	5	3	3	15	5	3	63	0	0	0	0	63
8	EE49	5	17.5	5	2.5	3	1	3	10	5	5	57	0	0	0	5	62

Appendix D: Special features scoring

Table D 1: Breakdown of special feature indicators scoring by each special feature and assessment unit combination including the impact area of the surface disturbance in the mining footprint

Special feature indicator	Assessment unit	Area of surface impact (ha)	Special feature rating	Special feature score
1: Centres of endemism	2	2.47536	VERY HIGH	20
	4	1.09866	HIGH	17
	4	0.14044	VERY HIGH	20
	5	9.929	HIGH	17
2: Wildlife refugia	1	12.6865	VERY HIGH	20
	2	41.2638	VERY HIGH	20
	3	13.6556	HIGH	17
	4	182.124	HIGH	17
	4	3073.79	VERY HIGH	20
	5	26.1981	HIGH	17
	5	309.389	VERY HIGH	20
	6	289.032	VERY HIGH	20
	7	0.05081	HIGH	17
	7	75.9085	VERY HIGH	20
	8	89.2262	VERY HIGH	20
3: Areas with concentrations of disjunct populations	2	38.291	HIGH	12
	4	3104.08	HIGH	12
	5	330.493	HIGH	12
	6	52.748	HIGH	12
	7	58.3631	HIGH	12
	8	68.9356	HIGH	12
4: Areas with taxa at limits of geographic range	2	38.291	HIGH	4
	4	3104.08	HIGH	4
	5	330.493	HIGH	4
	6	52.748	HIGH	4
	7	58.3631	HIGH	4
	8	68.9356	HIGH	4
5: Areas with high species richness	2	2.47536	HIGH	17

Special feature indicator	Assessment unit	Area of surface impact (ha)	Special feature rating	Special feature score
	2	38.291	VERY HIGH	20
	4	182.264	HIGH	17
	4	3013.01	VERY HIGH	20
	5	26.1981	HIGH	17
	5	317.538	VERY HIGH	20
	6	55.7965	VERY HIGH	20
	7	0.05081	HIGH	17
	7	62.977	VERY HIGH	20
	8	72.9189	VERY HIGH	20
6: Areas considered to be important for maintaining populations of ancient and primitive taxa	na	nil	nil	nil
7: Areas containing regional ecosystems with distinct variation in taxa composition associated with geomorphology and other environmental variables	2	2.47536	HIGH	8
	4	71.135	HIGH	8
	4	7.2	VERY HIGH	10
	5	9.23229	HIGH	8
	5	0.45711	VERY HIGH	10
	7	47.813	VERY HIGH	10
8: Artificially created waterbodies of ecological significance	na	nil	nil	nil
9: Areas considered to be important because of high relative density of hollow-bearing trees	2	40.7664	VERY HIGH	5
	4	2980.52	VERY HIGH	5
	5	309.389	VERY HIGH	5
	6	55.7965	VERY HIGH	5
	7	62.977	VERY HIGH	5
	8	72.9189	VERY HIGH	5
10: Breeding or roosting sites used by a significant number of individuals	na	nil	nil	nil
11: Ecological corridors	1	12.6865	State	20
	2	1.19583	State	20
	2	26.0584	State	20
	2	2.6032	State	20
	3	10.0065	State	20

Special feature indicator	Assessment unit	Area of surface impact (ha)	Special feature rating	Special feature score
	4	0.63988	State	20
	4	5671.82	State	20
	4	5.04492	State	20
	5	463.938	State	20
	6	22.0084	State	20
	7	273.11	State	20
	8	165.222	State	20
12: Priority species	na	nil	nil	nil
13: Significance of patch within a 1 km buffer	na	nil	nil	nil
14: Protected area estate buffer	na	nil	nil	nil

Appendix E: Photos



Assessment unit 1 – *Eucalyptus thozetiana* dominated woodland



Assessment unit 2 – *Eucalyptus camaldulensis* dominated woodland with *Melaleuca leucadendra* fringing the Carmichael River



Assessment unit 3 – Wetlands dominated by *Eucalyptus coolabah*



Assessment unit 4 – *Eucalyptus melanophloia* or *E. brownii* dominated woodland



Assessment unit 5 – *Eucalyptus similis* and/or *Corymbia setosa* dominated low open woodland



Assessment unit 6 – *Corymbia plena* dominated woodland



Assessment unit 7 – *Acacia harpophylla* dominated woodland



Assessment unit 8 – *Acacia cambagei* dominated woodland



Brigalow (*Acacia harpophylla* dominant and co-dominant) endangered ecological community (Brigalow TEC) under the EPBC Act.



Waxy Cabbage Palm (*Livistona lanuginosa*) listed as vulnerable under the EPBC Act



Black-throated Finch (southern) (*Poephila cincta cincta*) listed as endangered under the EPBC Act

**HEAD OFFICE**

Suite 4, Level 1
2-4 Merton Street
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

CANBERRA

Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

COFFS HARBOUR

35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

PERTH

Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 08 9322 1358

DARWIN

16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601

SYDNEY

Level 6
299 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9264 0717

NEWCASTLE

Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

ARMIDALE

92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

WOLLONGONG

Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

BRISBANE

51 Amelia Street
Fortitude Valley QLD 4006
T 07 3503 7191

ST GEORGES BASIN

8/128 Island Point Road
St Georges Basin NSW 2540
T 02 4443 5555
F 02 4443 6655

NAROOMA

5/20 Cauty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

MUDGEES

Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

GOSFORD

Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897

1300 646 131
www.ecoaus.com.au