Australian Government

Department of Agriculture, Water and the Environment

Mr Chris Lauritzen
General Manager – Resource Development
MACH Energy Australia Pty Ltd
GPO Box 94
BRISBANE QLD 4001

Mount Pleasant Project, 4km northwest of Muswellbrook, New South Wales (EPBC 2011/5795): Offset Management, Re-establishment and Mine Site Rehabilitation Plans.

Dear Mr Lauritzen

Thank you for submitting the above management plans for approval in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Officers of the Department have advised me on the plans and on the requirements of the EPBC Act conditions of approval for this project. On this basis, and as a delegate of the Minister for the Environment, I have decided to approve:

- the *Mount Pleasant Operation: Offset Management Plan and Re-Establishment Plan*, Revision 2, signed on 7 October 2020, in accordance with Conditions 11 and 32D of the approval; and

- the *Mount Pleasant Operation: EPBC Act Threatened Ecological Community Mine Site Rehabilitation Plan,* Revision 4, signed on 10 May 2020, in accordance with Condition 19 of the approval.

The approved plans must now be implemented, and must be published on a website within one month of the date of this notice. Please note that if you wish to vary an approved plan you must do so in accordance with Conditions 32-32D of the approval.

Should you require any further information please contact Vaughn Cox directly or by email at postapproval@awe.gov.au.

Yours sincerely

Declan O'Connor-Cox, Assistant Secretary (A/g)
Environment Assessments (Vic, Tas) and Post Approvals Branch

22 October 2020

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MOUNT PLEASANT OPERATION

OFFSET MANAGEMENT PLAN AND RE-ESTABLISHMENT PLAN

Document ID:	01053551		
Company	MACH Energy Australia Pty Ltd		
Effective Date:	22 October 2020	**Status:**	Approved
Approved By:	Chris Lauritzen	**Revision Number:**	02

DECLARATION OF ACCURACY

I declare that:

1. To the best of my knowledge, all the information contained in, or accompanying this Mount Pleasant Operation Offset Management Plan and Re-establishment Plan is complete, current and correct.

2. I am duly authorised to sign this declaration on behalf of the approval holder.

3. I am aware that:

a. Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.

b. Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) where the person knows the information or document is false or misleading.

c. The above offences are punishable on conviction by imprisonment, a fine or both.

Signed

Full name (please print)
Chris Lauritzen

Organisation (please print)
MACH Energy Australia Pty Ltd

Date: 07/ 10 / 2020

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

The Mount Pleasant Operation is an open cut coal mine, located in the Hunter Valley in New South Wales (NSW), approximately 4 km north-west of Muswellbrook. The Mount Pleasant Operation was granted approval by the Minister for the Environment (Minister) for the Mount Pleasant Project in February 2012, under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), approval reference 2011/5795. MACH Energy Australia Pty Ltd (MACH Energy) acquired the Mount Pleasant Operation and all of its assets in 2016.

MACH Energy has approval to clear no more than 2,591 hectares (ha) of native vegetation from the proposed disturbance footprint for mining activities. This native vegetation includes 571.8 ha of the Coastal Grey Box/White Box Intergrade Woodland and 2,019.1 ha of Derived Native Grassland, which is an important part of the *White Box–Yellow Box-Blakely's Red Gum Grassy Woodland* (Box Gum Grassy Woodland) *and Derived Native Grassland* ecological community. This ecological community is listed under the EPBC Act as a Critically Endangered Ecological Community (CEEC).

To offset the impact of the vegetation clearing, 12,875 ha of land comprising similar ecological communities and habitat quality, are to be managed and secured (in perpetuity) for biodiversity offsets. This will significantly increase the area of Box Gum Grassy Woodland within the protected area estate in Australia. It will provide the largest known area of contiguous Box Gum Grassy Woodland managed principally for conservation in Australia. It will also contribute to regional strategies for improved catchment health and function administered by Local Land Services (LLS). The offset area must also protect at least 8,475 ha (part of the 12,875 ha) of suitable habitat for the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Greater Long-eared Bat (the Greater Long-eared Bat species is commonly referred to as Corben's Long-eared Bat in contemporary ecological assessments. Accordingly, it is referred to as Corben's Long-eared Bat in this document).

The lands to be used as the offset were part of several properties that were productive farming properties and will continue to be managed as agricultural enterprises with conservation as the principle outcome. The Biodiversity Management Areas (BMAs), shown on Figure 1, include the land (12,875 ha) to be secured, as well as land to continue to sustain a viable agricultural enterprise. This Offset Management Plan (OMP) will provide the framework for this integrated management approach.

The Mount Pleasant Operation EPBC Approval 2011/5795 also requires MACH Energy to deliver an increase in spatial extent and improve the condition of at least 677 ha of existing remnant woodland on the BMAs. Accordingly, MACH Energy has identified areas of land within the BMAs which will be revegetated to satisfy this requirement. These areas will be the Re-establishment Areas. A Re-establishment Plan (RP) has been developed in accordance with the requirements of Condition 13 of the Mount Pleasant Operation EPBC Approval, and has been incorporated into this OMP (Section 4.5).

The BMAs are located near the NSW townships of Merriwa and Cassilis in Upper Hunter Valley and near Gunnedah. Figure 1 provides a location of the BMAs and proximity to the Mount Pleasant Operations site.

Section 2 provides further description of the BMA's and those portions that satisfy the 12,875 ha offset requirement.

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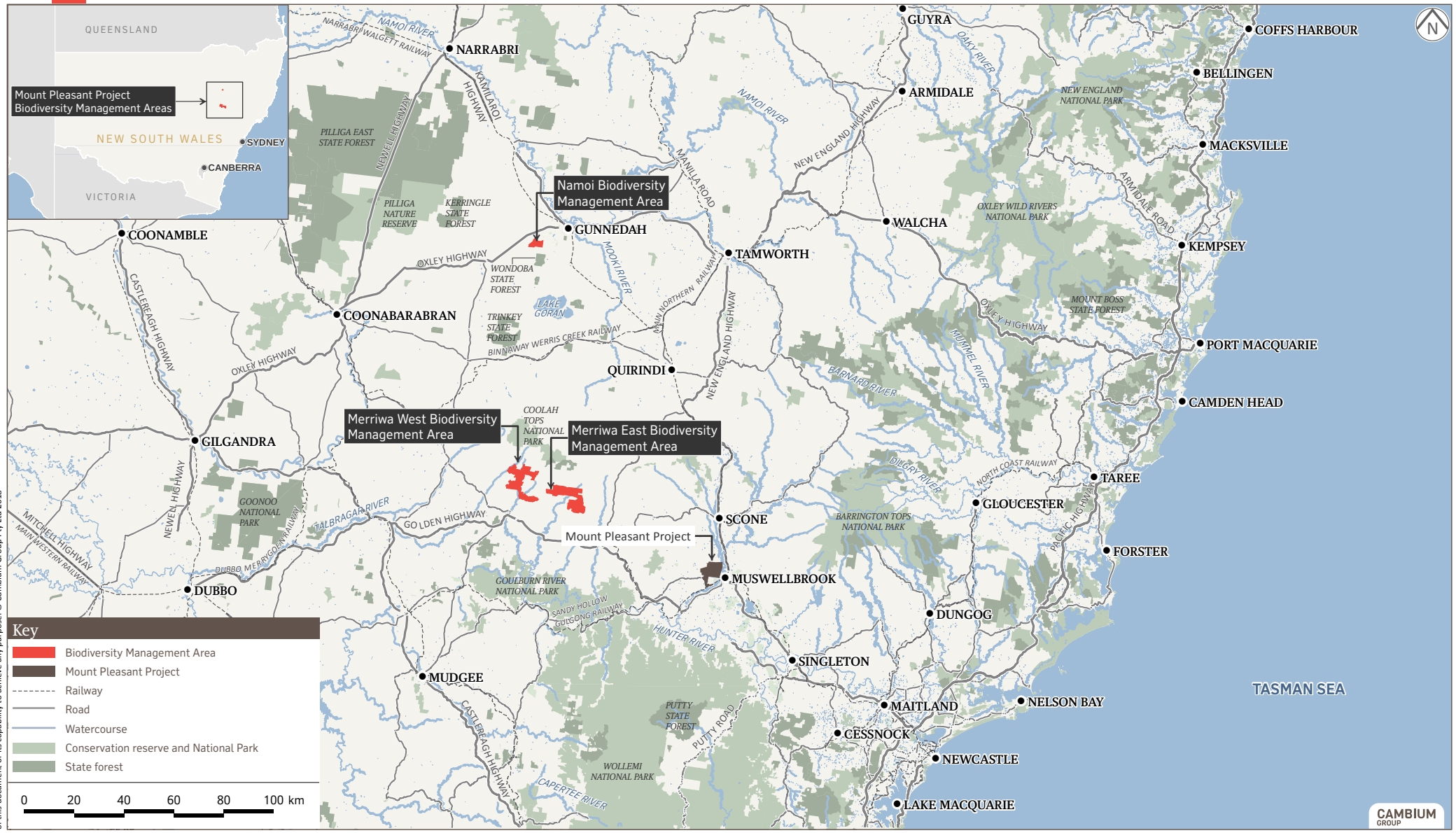
Location of the Biodiversity Management Areas

Offset Management Plan

Figure 1



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1.1.1 EPBC Act Approval Conditions

This OMPRP has been prepared for the BMAs to satisfy the Mount Pleasant Project EPBC Approval (2011/5795) Conditions. EPBC Approval (2011/5795) Conditions are listed in Appendix A along with cross references to the relevant sections within this plan where the condition is addressed.

The principal Conditions relevant to the OMPRP are listed below. A copy of EPBC Approval 2011/5795 is provided on MACH Energy's website for the Mount Pleasant Operation (https://machenergyaustralia.com.au/mount-pleasant/).

> ***Approval Condition 3***
>
> *The person taking the action must submit to the **Minister** for approval an Offset Management Plan for the Biodiversity Management Areas by no later than 31 May 2013, or as otherwise agreed to in writing by the **Minister.** The Offset Management Plan must contain details of measures to offset the impacts to the White Box—Yellow Box—Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community, and fauna species identified in condition 2.*
>
> *The approved Offset Management Plan must be implemented.*

In accordance with Approval Condition 3, an OMP was submitted prior to 31 May 2013 and was subsequently approved. This version of the OMP (including the RP) has been prepared as an update since MACH Energy acquired the Mount Pleasant Operation.

> ***Approval Condition 11***
>
> *Within 3 years of the commencement of construction the person undertaking the action must provide, for approval of the Minister, a Re-establishment Plan for the Biodiversity Management Areas secured under condition 2. The approved Re-establishment Plan must be implemented.*

> ***Approval Condition 12***
>
> *The Re-establishment Plan must provide for commitments and activities to deliver the increase in the spatial extent and improvement in the condition of existing remnants by at least 677 ha within 5 years of the commencement of construction, and for the establishment of self sustaining functional remnant vegetation community, with the capacity to provide habitat for the species identified in condition 2.*

In accordance with Condition 11, a RP was submitted to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) by 25 November 2019. Consistent with the DAWE's comments on the RP, the RP has been incorporated into this OMP, and includes other updates to address the DAWE's review comments.

1.1.2 Offset Security

> ***Approval Condition 2***
>
> *The person taking the action must register a legally binding conservation covenant over the Biodiversity Management Areas in the map at Appendix B no later than 25 November 2019. The mechanism must provide enduring protection of no less than:*
>
> *a) 12,875 ha of White Box – Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community*
>
> *b) 8,475 ha of suitable habitat for Anthochaera phrygia (regent honeyeater) and Lathamus discolour (swift parrot)*
>
> *c) 8,475 ha of suitable habitat for Dasyurus maculatus maculatus (spotted quoll)*
>
> *d) 8,475 ha of suitable habitat for Nyctophilus corbeni (greater long-eared bat).*
>
> *Note: Offsetting requirements for some species' habitat may be accommodated within the White Box – Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community components it this habitat is verified as present and included specific habitat requirements for each relevant species*

MACH Energy has attempted various options to secure the BMA's since acquiring the Mount Pleasant Operation and taking control of the BMA's. This has included Voluntary Conservation Agreements under NSW legislation and Restrictive Covenants, including approaching various agencies to act as the Prescribed Authority. No NSW agency is willing to act as the Prescribed Authority as the BMA's are not required under NSW legislation. MACH Energy has subsequently applied to the Department for the BMA's to be secured via a conservation agreement under the EPBC Act. Discussions with the Department regarding conservation security are ongoing.

The portions of the Offset Area required to satisfy Condition 2 of EPBC Approval (2011/5795) are to be secured using a legally binding mechanism to provide enduring protection for no less than 12,875 ha of Box Gum Grassy Woodlands and Derived Native Grasslands (Plate 1) and no less than 8,475 ha of suitable habitat for the Regent Honeyeater, Swift Parrot, Spotted-tail Quoll and Corben's Long-eared Bat. As described in Condition 2 of EPBC Approval 2011/5795 *Offsetting requirements for some species' habitat may be accommodated within the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community components if this habitat is verified as present and includes specific habitat requirements for each relevant species*. This OMPRP describes the management of approximately 13,401 ha, which provides for the requirements of the EPBC Approval as well as additional offset land for future projects. A detailed breakdown of areas is provided at Section 2.4.1.

Plate 1: Box Gum Grassy Woodland, Clare Park at Merriwa East BMA (Cumberland Ecology, 2013)

1.2 FUNCTION OF THE OFFSET MANAGEMENT PLAN

The OMPRP provides the framework for integrated management of the BMAs to achieve management outcomes for improved biodiversity, economic and social factors for the local rural communities. Principally, this will be achieved via the implementation of conservation management strategies to improve biodiversity values. The use of strategic grazing will provide the opportunity to support an agricultural enterprise, while managing threats such as weeds and encouraging native species diversity.

The properties within the BMAs have been leased since approval of the original OMP in 2013. The implementation of the OMPRP is a key condition of the lease agreements. Lease agreements have been issued on a long-term basis to foster a partnership approach between MACH Energy and the Leaseholder and to protect and conserve the biodiversity values on the BMAs.

The Leaseholder responsibilities encompass the day to day management of the BMAs, including grassland monitoring, livestock management and implementation of on-ground works. The presence of Leaseholders ensures security by providing a deterrent to illegal activities, including clearing for firewood or hunting.

In addition, Leaseholders can respond quickly to emergency events such as bushfires or floods. To enhance the Leaseholder's ability to protect the biodiversity values, training and support will be provided in native plant and animal identification, identification of weeds species and sustainable grazing management.

1.2.1 Structure

The OMPRP is comprised of the following Sections:

- Section 2 – Biodiversity Management Areas: This section describes the BMAs, Land Management Units (LMUs) and portions thereof that provide the 12,875 ha offset;
- Section 3 – Conservation objectives and key performance indicators: This section outlines the primary conservation objectives for the OMP as well as the biodiversity values, nested conservation values and key performance indicators that have guided the development of conservation management strategies and the monitoring programme;
- Section 4 – Conservation Management Strategies: This section outlines primary management strategies used to improve the extent, connectivity and condition of Box Gum Grassy Woodlands and Derived Native Grassland consistent with the "*White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan*" (DECCW, 2010) and "*A Guide to Managing Box Gum Grassy Woodlands*" (Rawlings, 2010). This section also includes the RP;
- Section 5 – Monitoring Programme: This section details programmes to measure short, medium and long term impacts of the OMPRP conservation management strategies. These assessments will provide quantitative data to guide adaptive management, monitor long term trends in biodiversity values and attainment of key performance indicators; and
- Section 6 – Risks and Contingency Measures: This section contains a risk matrix to cross check activities against key risks to ensure the OMPRP is comprehensive and responsive.
- Section 7 – Conclusion: This section summarises the overarching premise and key aspects of this OMPRP.

1.2.2 Information Dissemination

Successful implementation of the OMPRP will rely upon the sharing of skills, knowledge and resources, as well as careful monitoring and reporting of management activities.

The sharing of information will be facilitated through the online Biodiversity Offsets Portal. This Portal has been designed to centralise and share information among authorised users and will include spatial data, an image library, reports and other non-spatial data as well as project management information such as stakeholder details and safety information. The Portal will greatly improve communication among stakeholders, transparency of management and monitoring activities and will ensure data security and integrity (e.g. preventing risks of data loss due to staff turnover and minimising the risk of using superseded information). Ultimately, this will result in improved decision making and adaptive management that is responsive to seasonal conditions and operational challenges.

The Portal will also provide access to an Interactive Map that will allow users to visualise data in a geo-spatial context, assisting in data interpretation. This data will include aerial imagery, site information (e.g. cadastral, site access, topographic, infrastructure, geology) and data relating to management and monitoring activities. The Interactive Map will allow users to query information, turn layers on and off, mark up and print maps. This is an easy to use but powerful tool that does not require knowledge of Geographic Information Systems on the part of the user.

The following Figure 2 provides an outline of the Portal and elements of the database that will form an important component in the overall planning, management and compliance of the BMAs.

Key documents (including this OMPRP) will also be available on the MACH Energy website.

1.2.3 Key Project Stakeholders and Roles

The key project stakeholders relevant to this OMPRP are identified by their roles in Table 1.

Table 1
Key Project Roles and Stakeholders

Approval Roles	Responsible Entity	Details
Regulator – Approval Conditions for EPBC Act – approval reference 2011/5795. The Minister is to approval plans (OMPRP, Weed Project Plan, and Woodland Birds Project Plan).	Australian Government - Department of Agriculture, Water and the Environment	EPBCmoitoring@awe.gov.au PostApproval@awe.gov.au
Project Proponent and land owner – prepare plans and operational documents. Supervise management of the BMAs, review monitoring reports and adapt management.	MACH Energy	Land and Property Superintendent 1800 272 745 Ian.webber@machenergy.com.au
Advisory Committee – the committee is required to provide advice on the management of the BMAs and review plans.	MACH Energy	Refer to MACH Energy website
Leaseholder – day to day management of the BMAs, adhere to OMPRP and preparation of monthly reports.	Appointed by MACH Energy.	Leaseholders will be managed by MACH Energy. Demonstrated ability to implement the OMPRP will be a key lease condition.
Biodiversity Auditor – monitor the MNES and improvement in extent and condition of the biodiversity values.	Person/s engaged by MACH Energy to undertake monitoring programme.	MACH Energy will engage suitably qualified person/s.

Table 1 (continued)
Key Project Roles and Stakeholders

Approval Roles	Responsible Entity	Details
Agriculture Auditor – monitor the strategic grazing, other agricultural matters and prepare quarterly reports.	Person/s engaged by MACH Energy to undertake monitoring programme.	MACH Energy engages Rural & Environmental Management Pty Ltd as suitably qualified person/s.
Regulate control of priority weeds.	Upper Hunter Weeds Authority. Gunnedah Shire Council.	Works Coordinator, Upper Hunter Weeds Authority Ph. 02 6549 3802 www.muswellbrook.nsw.gov.au/Council-service/Environment/Weeds/ wuwa@muswellbrook.com.nsw.gov.au Senior Weeds Officer, Gunnedah Shire Council. 02 6740 2225 www.gunnedah.nsw.gov.au council@infogunnedah.nsw.gov.au
Regulate control of pest animals	Hunter Local Land Services. North West Local Land Services.	Hunter Local Land Services (Scone) 02 6545 1311 www.hunter.lls.gov.au North West Local Land Services (Gunnedah) 02 6742 9220 www.northwest.lls.nsw.gov.au

1.2.4 Reporting, Review and Responsibilities

Reporting

Reporting to the DAWE will occur on an annual basis to meet EPBC compliance report required by Condition 28 of EPBC Approval 2011/5795.

Annual reports will be a critical tool to review performance of the OMPRP and adapt the conservation management strategies. The annual compliance report will include a summary of progress in management and monitoring activities undertaken during the reporting period, an overview of performance or outcomes of actions undertaken and monitoring results and a description of proposed management activities for the next reporting period including any need for improved management and actions to ensure attainment of the plan's performance criteria. The annual compliance report will be supplied to key project stakeholders and published on the Biodiversity Offsets Portal and MACH Energy website.

All monthly Paddock Assessment Reports, quarterly Agricultural Audit reports (Section 5.3) and ecological monitoring reports (Section 5.2) will also be provided on the online Biodiversity Offsets Portal, and can be accessed by authorised stakeholders at any time.

Review

The OMPRP will be reviewed in early 2021 (after the September to November 2020 landscape monitoring campaign including aerial photo analysis and rapid condition assessments) to update information on the condition and extent of the ecological communities across the BMAs and refine conservation management strategies.

Thereafter, this OMPRP will be reviewed by MACH Energy every two years for the next six years of implementation to account for any approved modifications to the MPO, any learnings from revegetation activities and outcomes from implemented management measures, monitoring data and trials, and revised if necessary. This OMPRP is effective for the period of EPBC Approval 2011/5795 (i.e. to October 2035).

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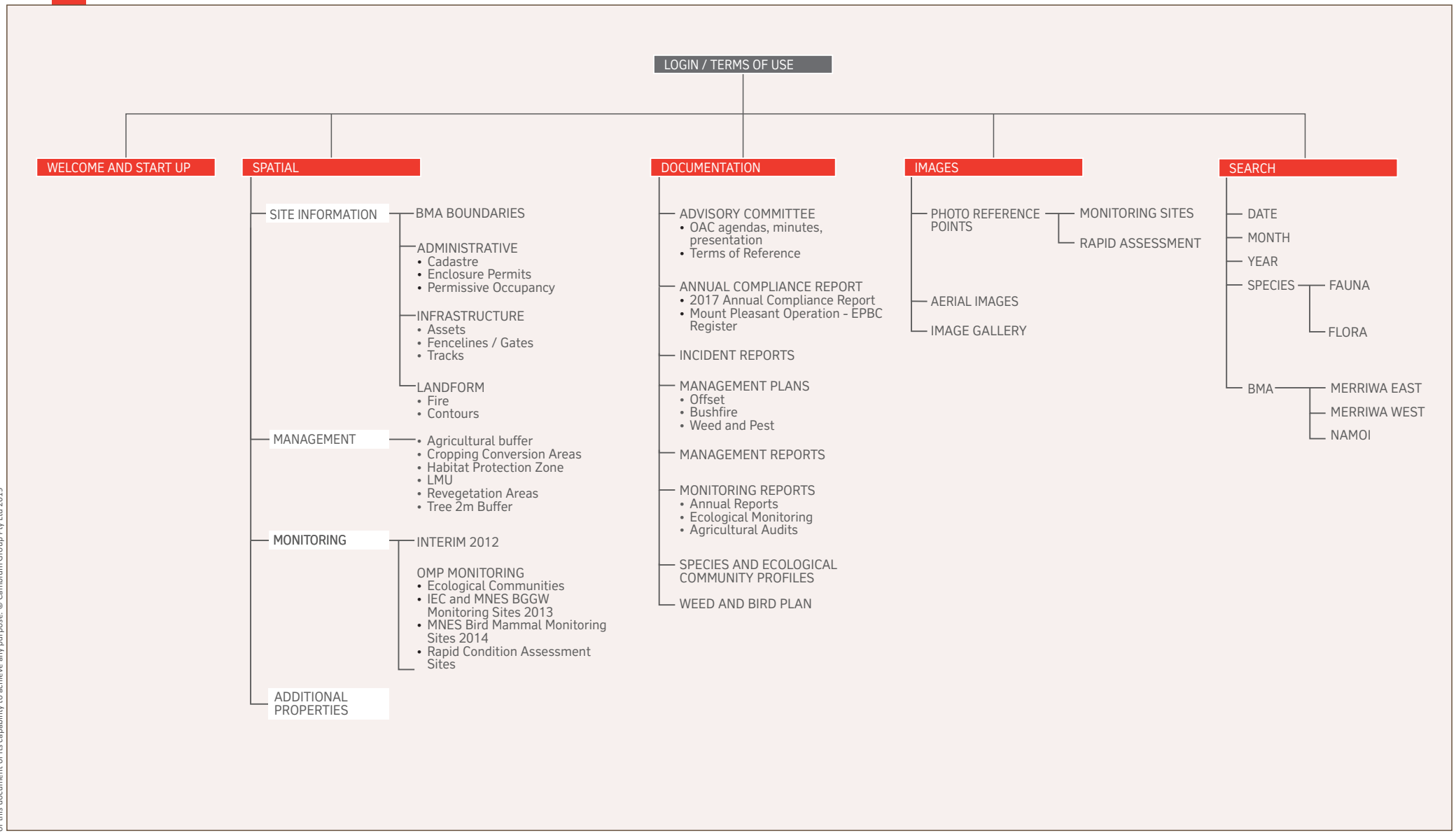
Portal Structure

Offset Management Plan

Figure 2



This OPMRP may be updated on an irregular basis to amend changes to contact details, agency names or other secondary information. The revised plan will be available through the Portal and the MACH Energy website.

In accordance with EPBC Approval 2011/5795, the OMPRP was provided to the MPO Offset Advisory Committee for review, prior to submission to DAWE for approval.

Responsibilities

The MACH Energy Land and Property Superintendent (or delegate) will be responsible for the review and implementation of this OMPRP.

2 BIODIVERSITY MANAGMENT AREAS

The BMAs are farming properties that will be managed for conservation purposes, with remnant patches of Box Gum Grassy Woodlands, Derived Native Grassland and Other Woodland ecological communities of varying ecological condition. These ecological communities also provide habitat for the MNES fauna.

The BMAs total 15,590 ha and include the 12,875 ha to be offset. The remaining 2,715 ha is used to support agricultural enterprises. Notwithstanding, the remaining 2,715 ha is also managed to promote conservation and improvement of biodiversity values within the required 12,875 ha offset to be secured. The additional land may potentially be used as an offset for future projects.

2.1 LOCATION

There are three BMAs. The two largest, Merriwa East (7,285 ha) and Merriwa West (7,162 ha) are located near the townships of Merriwa and Cassilis respectively, and are both accessible from the Golden Highway. Merriwa East is approximately 20 km north-west of Merriwa and Merriwa West is approximately 5 km north of Cassilis. The third and smallest BMA, Namoi (1,143 ha), is situated approximately 20 km south-west of the township of Gunnedah, and is accessible via the Oxley Highway. In total there are six separate properties within the BMAs. Figure 3 (a) to (c) indicates the location of these properties within the BMAs and the key infrastructure assets, such as house, sheds, and quarries. The quarries across the BMAs have historically been operated by the Upper Hunter Shire Council. These quarries are excluded from the BMAs and are not subject to the requirements of this OMPRP and are operated by the Upper Hunter Shire Council to assist in the maintenance of council-owned roads.

All the BMAs are within the Brigalow Belt South bioregion, a bioregion that is under-represented in Australia's national reserve system. Table 2 provides the locality details for each of the properties within the BMAs.

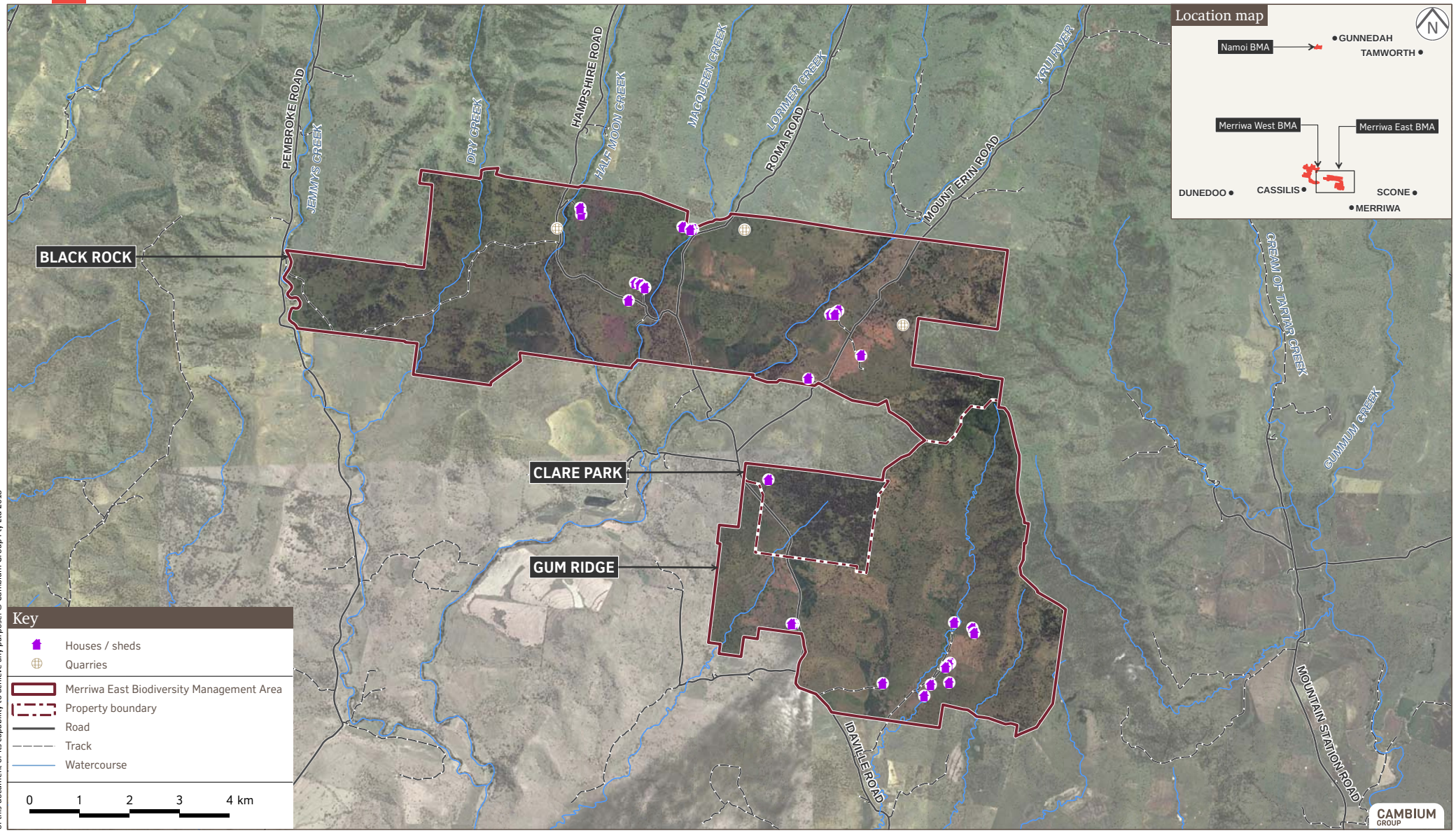
The Merriwa East and West BMAs form part of the Upper Hunter river catchment. These BMAs are intersected by north to south flowing rivers and creeks that drain into the Goulburn River. Remnant vegetation along these watercourses provides connectivity between the Goulburn River and Coolah Tops National Parks. Proposed management of these BMAs aims to improve this connectivity. The north-western corner of the Merriwa West BMA is located on the western side of the Great Dividing Range and drains into the Murray Darling Basin. The Namoi BMA is located within the Murray Darling Basin and forms a stepping stone for connectivity between Wondaba State Forest and the Pilliga Nature Reserve.

Appendix B provides further information on the biophysical characteristics of the BMAs.

Merriwa East Biodiversity Management Area and Infrastructure

Offset Management Plan

Figure 3a



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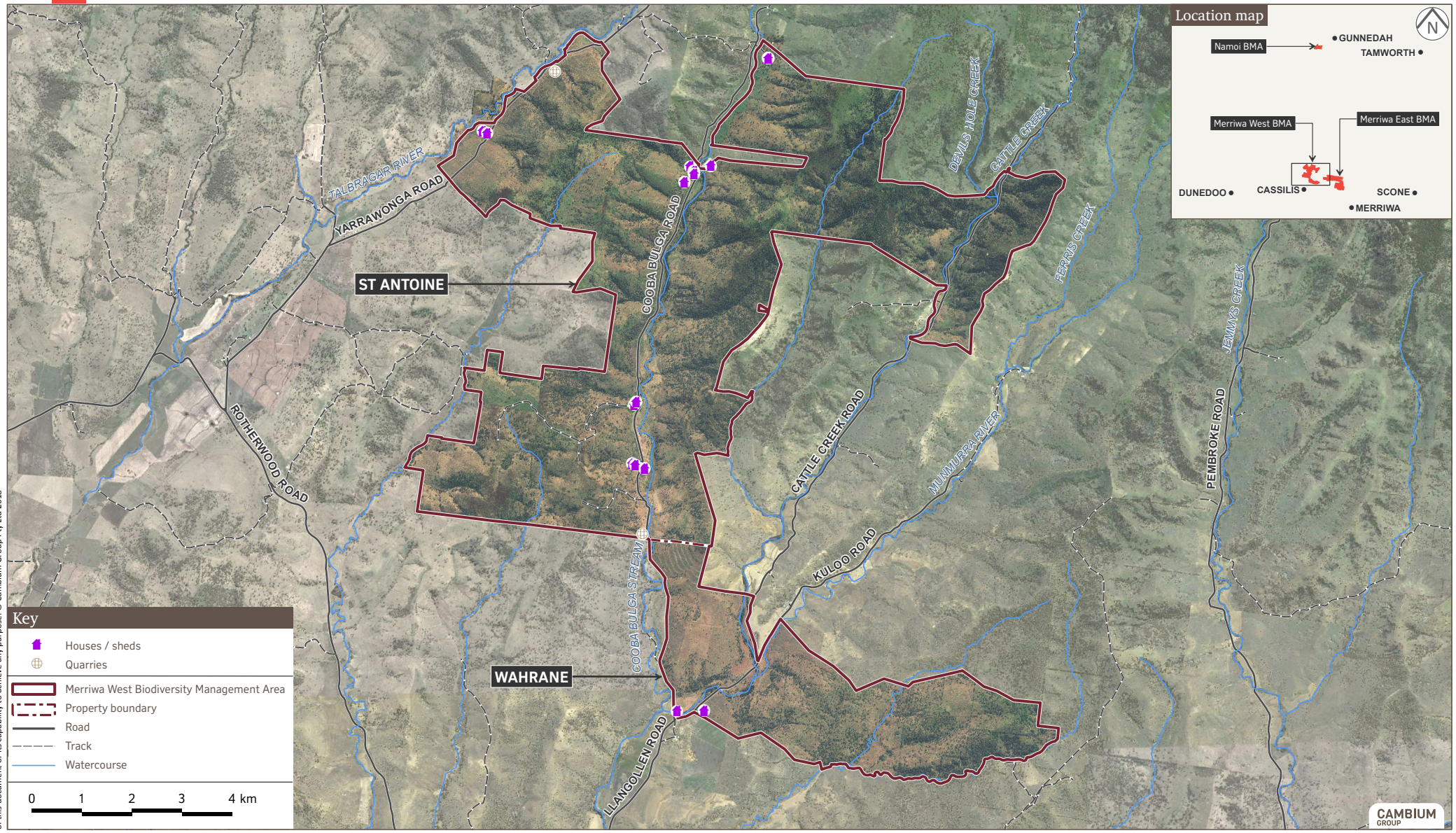
Merriwa West Biodiversity Management Area and Infrastructure

Offset Management Plan

Figure 3b



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Namoi Biodiversity Management Area and Infrastructure

Offset Management Plan

Figure 3c

Table 2
Biodiversity Management Areas Property Details

BMA	Bioregion	Bioregion Sub Region	LLS Region	Local Government Area	Land Owner	Properties	Area (ha)	Location
Merriwa East	Brigalow Belt South	Liverpool Range	Hunter LLS	Upper Hunter	MACH Energy	Black Rock	4,243	25 km northwest of Merriwa, via Mount Erin Rd and Golden Hwy
						Clare Park	409	20 km northwest of Merriwa, via Idaville Rd and Golden Hwy
						Gum Ridge	2,633	20 km northwest of Merriwa, via Idaville Rd and Golden Hwy
Merriwa West	Brigalow Belt South	Liverpool Range	Hunter LLS	Upper Hunter	MACH Energy	St Antoine	5,564	40 km northwest of Merriwa, via Cooba Bulga Rd and Golden Hwy
						Wahrane (Llangollen)	1,598	35 km northwest of Merriwa, via Llangollen Rd and Golden Hwy
Namoi	Brigalow Belt South	Liverpool Plains	North West LLS	Gunnedah	MACH Energy	Warrawoona	1,143	20 km southwest of Gunnedah, via Beeson Rd and Golden Hwy
						Total	15,590	

2.2 ECOLOGICAL COMMUNITIES

The ecological communities across the BMAs have been mapped as:

- Box Gum Grassy Woodlands (CEEC);
- Derived Native Grassland (CEEC);
- Low Diversity Derived Native Grassland; and
- Other Woodland.

These communities represent the primary biodiversity values within the BMAs and support a range of "nested" conservation values, including endangered flora and fauna species, habitat and cultural heritage. The remaining areas of land across the BMAs have been more intensively cleared and used for farming. They have been mapped as Agriculture and include exotic pastures and cropping areas. A small area (34 ha) has been mapped as infrastructure and it includes areas around houses, roads and small parcels of land where the land title needs to be reviewed.

Figure 4 (a) to (c) show the distribution of these ecological communities as at November 2012. These communities were delineated using data from vegetation surveys and sites visits collected between 2010 to 2012, in conjunction with aerial imagery captured from May to September 2012.

Table 3 provides the areas of ecological communities and the area of land allocated to agriculture.

Table 3
Biodiversity Management Areas

BMA	Box Gum Grassy Woodland (ha)	Derived Native Grassland (ha)	Low Diversity Derived Native Grassland (ha)	Other Woodland (ha)	Agriculture (ha)	Total (ha)
Merriwa East	3,998	1,701	154	74	1,356	7,284
Merriwa West	3,512	1,894	359	123	1,231	7,119
Namoi	524	211	0	45	369	1,149
Infrastructure					34	
Total	8,035	3,807	514	243	2,990	15,589

2.2.1 Box Gum Grassy Woodlands

The Box Gum Grassy Woodlands mapped across the BMAs currently satisfy the description of the listed CEEC under the EPBC Act and the NSW *Biodiversity Conservation Act 2016* (BC Act). They are characterised by tree cover, containing a patch of five or more trees at a spacing of no greater than 75 m apart, and a predominately native ground layer (or understorey). According to the guidelines for identification (DEH, 2006), patches of this woodland:

- contain at least 12 or more native species (excluding grasses) and at least one "important" species per 1,000 square metres; and/or
- are greater than two hectares in size, contain 20 or more mature trees (125 cm diameter at breast height (dbh)) per hectare or there is natural regeneration of the dominant overstorey eucalypts.

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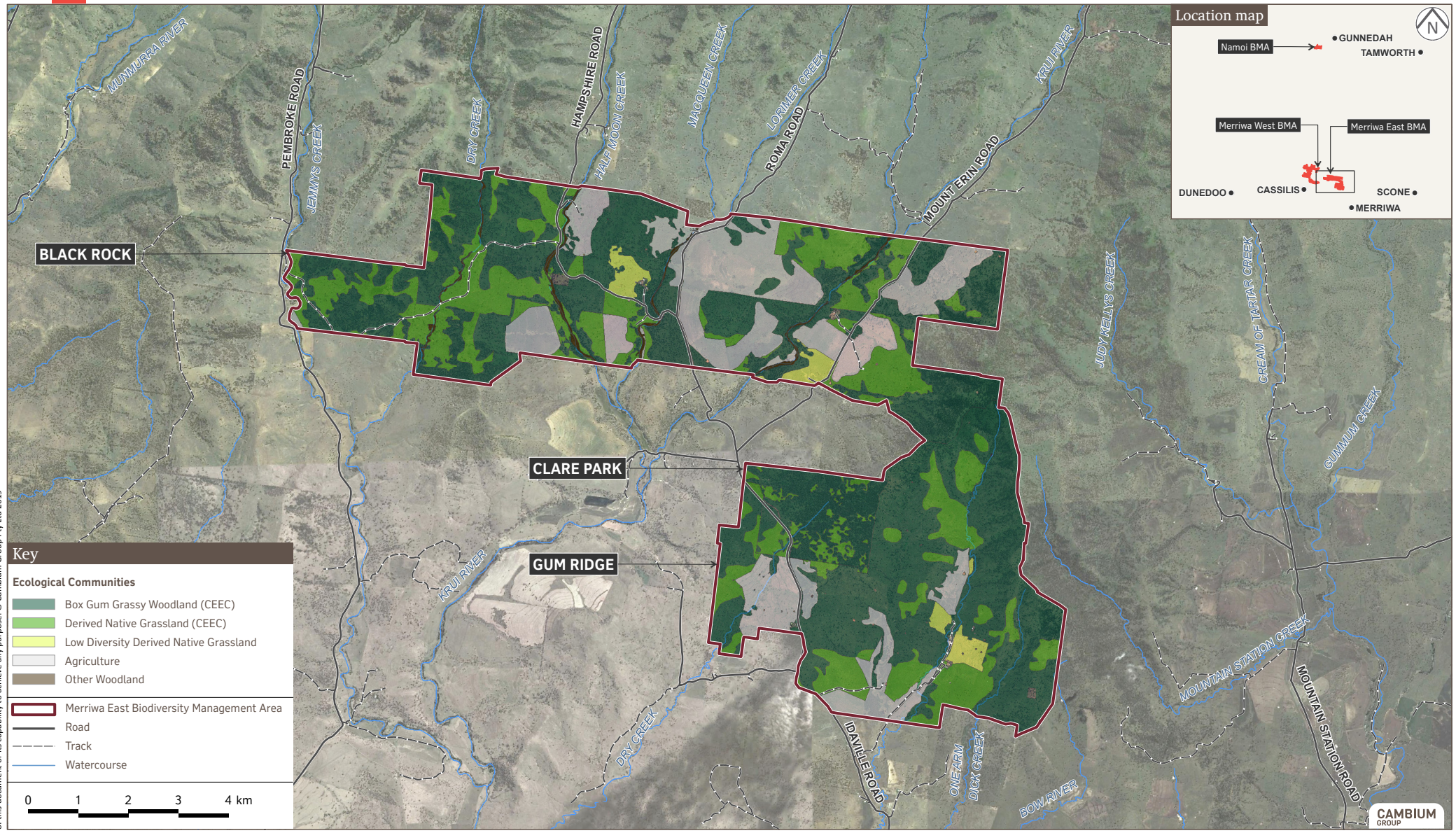
Merriwa East Ecological Communities

Offset Management Plan

Figure 4a



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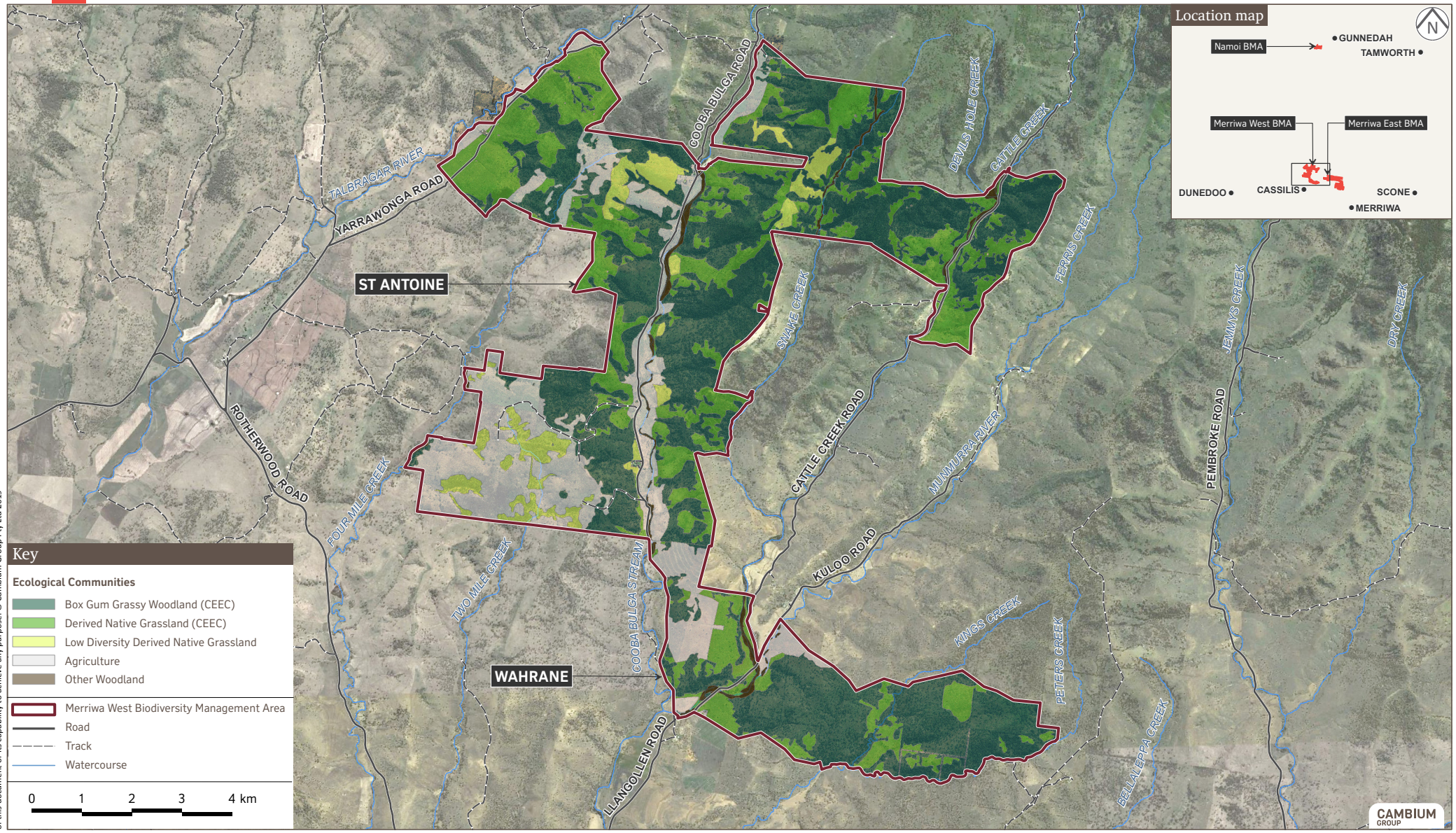
Merriwa West Ecological Communities

Offset Management Plan

Figure 4b



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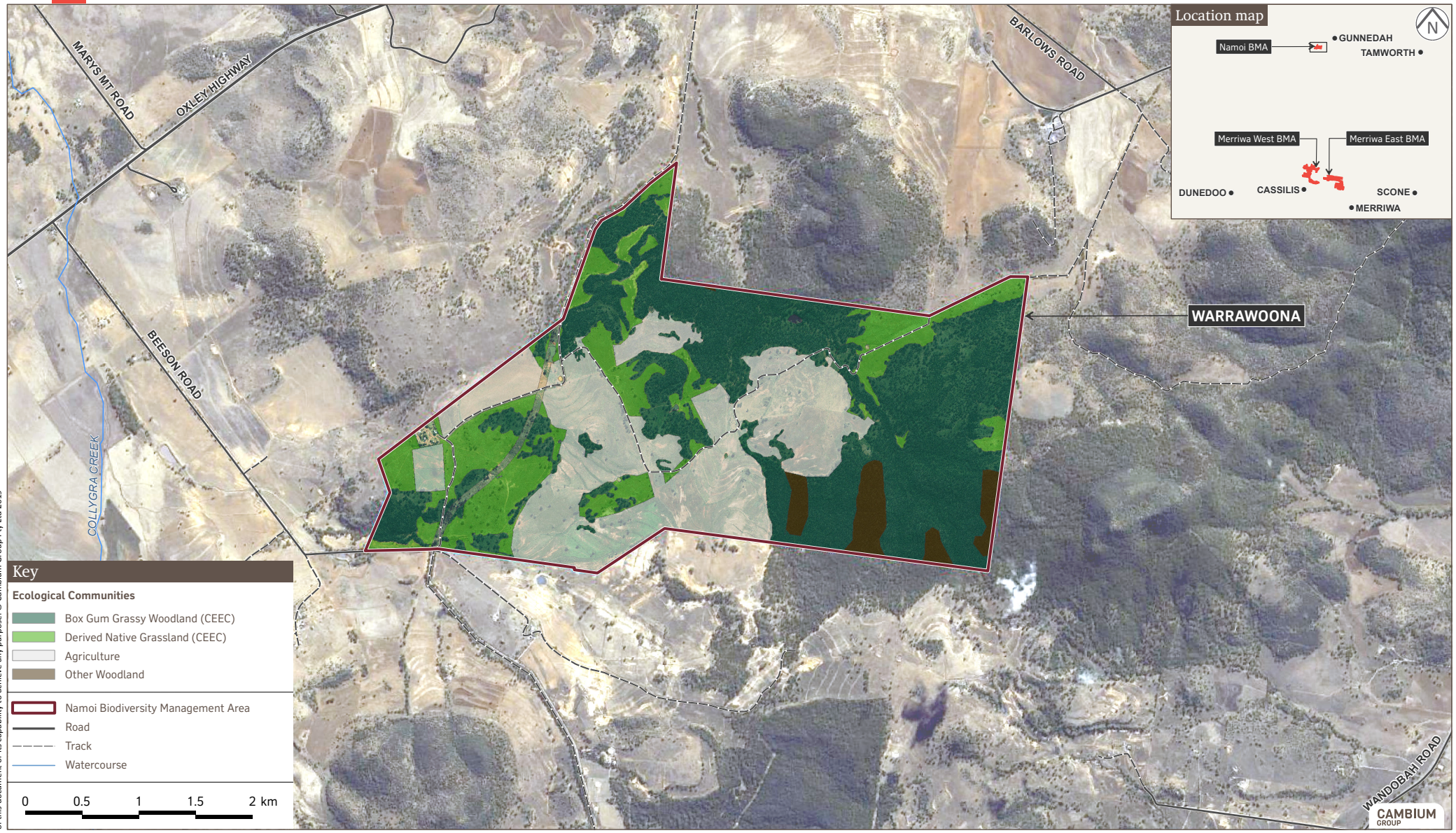
Namoi Ecological Communities

Offset Management Plan

Figure 4c



This EPBC Act listed Box Gum Grassy Woodland is comprised of a complex combination of vegetation communities that occupy a range of landscape positions, dominated or co-dominated by one or a combination of the following tree species: White Box *(Eucalyptus albens*) and Grey Box/White Box intergrades (*E. moluccana* / *E. albens* intergrades), Yellow Box (*E. melliodora*), and Blakely's Red Gum *(E. blakelyi*). The condition of this EPBC Act listed community across the BMAs is variable due to land use history.

The Merriwa East and Merriwa West BMAs Box Gum Grassy Woodlands are dominated by the Grey Box/White Box intergrades, with transitions to a dominant Yellow Box canopy on the lower slopes and along drainages lines. Other associated species observed include Blakely's Red Gum, Rough Barked Apple *(Angophora floribunda),* Kurrajong (*Brachychiton populneus*) and Silver Top Stringybark *(E. laevopinea).*

The Namoi BMA Box Gum Grassy Woodlands contain vegetation communities with the pure form of White Box including: White Box Grassy Woodland, White Box – White Cypress Pine Grassy Open Forest and associations with Yellow Box – Blakely's Red Gum Woodland.

It is important to note that DoEE advised that ecologically, the Grey Box/White Box intergrades found across the Merriwa East and West BMAs are an important component of the Box Gum Grassy Woodlands.

2.2.2 Derived Native Grassland

The Derived Native Grassland mapped within the BMAs are derived from the clearing of woodland once dominated by White Box (or Grey Box/White Box intergrades), Yellow Box or Blakely's Red Gum trees. At present this community only meets the description of the Derived Native Grassland, and cannot be classified as Box Gum Grassy Woodland due to absence of a tree cover. It contains at least 12 native non grassy understorey species (such as forbs, ferns, shrubs and sedges) within a 0.1 ha plot, with at least one being a recognised "important" species.

The Derived Native Grassland across the BMAs are typically dominated in various proportions by: Purple Wiregrass (*Aristida orrug),* Wallaby Grass (*Austrodanthonia spp.),* Plains Grass *(Austrostipa aristiglumis),* Pitted Bluegrass *(Bothriochloa decipiens),* Tall Windmill Grass *(Chloris orrugate),* Couch *(Cynodon dactylon),* Queensland Bluegrass (*Dicanthium sericeum* subsp*. sericeum),* Coolabah Grass *(Panicum queenslandicum)* and Common Rat-tail Grass *(Sporobolus creber*). Common native forbs included: Common Woodruff (*Asperula conferta),* Common Everlasting Daisy (*Chrysocephalum apiculatum),* Kidney Weed *(Dicondra repens),* Twining Glycine (*Glycine clandestina),* Corrugated Sida *(Sida orrugate),* Climbing Saltbush (*Einadia* sp.), Grassland Woodsorrel *(Oxalis perennans)* and Rock Ferns (*Cheilanthes sieberi*).

2.2.3 Low Diversity Derived Native Grassland

Low diversity Derived Native Grassland areas have been more extensively impacted by agriculture and contain a low diversity of native species. This community does not contain sufficient diversity of native species to meet the description for Derived Native Grassland or the grassland component of Box Gum Grassy Woodlands under the EPBC Act.

2.2.4 Other Woodland

A range of non-EPBC Act listed woodland communities also occur within the BMAs. The vegetation communities mapped as Other Woodland include: Narrow-leaved Ironbark (*Eucalyptus crebra)* Shrubby woodland and River Oak (*Casuarina cunninghamiana)* forests. The condition of these communities across the BMAs is variable due to land use history. These communities provide habitat for the MNES species; the Regent Honeyeater, Swift Parrot, Spotted-tail Quoll, and Corben's Long-eared Bat.

Merriwa East and West BMAs have long linear strips of River Oak forest, which typically have a highly disturbed exotic understorey, but retain the capacity to form critical habitat corridors along the rivers and creeks. These riparian corridors generally run from the north to the south, and form natural linkages throughout the landscape, increase connectivity and support the migration of woodland birds.

The Narrow-leaved Ironbark Shrubby woodland at the Namoi BMA has the potential to provide high quality habitat for the Corben's Long-eared Bat.

2.2.5 Agriculture

All BMAs have sustained long-term productive grazing enterprises, mostly cattle and sheep grazing. Some areas have been cultivated for cropping for fodder production.

2.3 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE FAUNA

EPBC Approval (2011/5795) requires the enhancement of the ecological communities across the BMAs to improve habitat for the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat. To date, only the Spotted-tail Quoll and Corben's Long-eared Bat have been observed within the BMAs. The management objective of the BMAs is to improve habitat condition and reconnect fragmented remnant vegetation to support species dispersal, foraging and in some cases breeding.

2.3.1 Swift Parrot

The Swift Parrot is small parrot about 25 cm long. It is bright green with red around the bill, throat and forehead. It has a long (12 cm), thin tail, which is dark red. The Swift Parrot is listed as Critically Endangered under the EPBC Act (Plate 2).

Plate 2: Swift Parrot (Chris Tzaros)

The Swift Parrot is a migratory bird species (although not listed on the EPBC Act as migratory) that occurs in south-east Australia, between Tasmania and NSW. In NSW, this species occurs mainly on and to the east of the Great Dividing Range, in the Central and Southern Tableland regions and in coastal regions south of the Hunter Valley. Some rarer scattered occurrences have been recorded further north and further to the west.

On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark and White Box. Also, the Swift Parrot commonly forages on lerp infested trees which include Western Grey Box, Coastal Grey Box and Blackbutt. The Swift Parrot returns to some foraging sites on a cyclical basis depending on food availability.

The *National Recovery Plan for the Swift Parrot* (Saunders, 2011) provides direction on the management actions for the long term protection and conservation of the species. The Swift Parrot is likely to frequent the BMAs during the winter months. The mature Yellow Box, Grey Box and White Box trees are key species across the BMAs for foraging opportunities.

Key management strategies for Swift Parrot protection and conservation include:

- no clearing of vegetation;
- revegetation to reconnect fragmented remnant vegetation;
- protection from high frequency fire events;
- control of predators, such as feral cats; and
- reduced competition for breeding hollows from European bees.

2.3.2 Regent Honeyeater

The Regent Honeyeater is a medium-sized honeyeater, about 200–230 mm long and weighing 31-50 grams as an adult. Plumage is predominantly black with bright yellow edges to the tail and wing feathers. Body feathers, except for the head and neck, are broadly edged in pale yellow or white. A large patch of yellowish to pinkish, bare, warty skin surrounds each eye. The overall visual impression is of a blackish bird boldly embroidered with yellow and white, with brilliant yellow flashes in wings and tail (Pizzey, 1981; Menkhorst, 1993, Commonwealth of Australia, 2016). The Regent Honeyeater is listed as Critically Endangered under the EPBC Act (Plate 3).

The Regent Honeyeater is nomadic and can undertake large-scale movements in the order of hundreds of kilometres. However, the exact nature of these movements is still poorly understood. It is likely that movements are dependent on the spatial and temporal distribution of flowering eucalypts, which are a major food source, and other resource patterns. Within its current distribution there are four known key breeding areas where the species is regularly recorded. These are the Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria. Breeding has also been regularly recorded in the Cement Mills-Durakai area west of Warwick, southern Queensland and in the Australian Capital Territory (Commonwealth of Australia, 2016).

Plate 3: Regent Honeyeater (Chris Tzaros)

The Regent Honeyeater typically inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Oak, particularly those on wet, fertile soils such as along creek flats and broad river valleys. These woodlands have significantly large numbers of mature trees, high canopy cover and an abundance of mistletoes. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. The species also utilises Coastal Grey Box, Narrow-leaved Ironbark, Silvertop Stringybark, Spotted Gum and Rough-barked Apple among many others. Nectar and fruit from the mistletoes *Amyema miquelii, Amyema pendula* and *Amyema cambagei* are also eaten during the breeding season.

The *National Recovery Plan for the Regent Honeyeater (Anthochaera Phrygia) 2016* (Commonwealth of Australia 2016) provides guidance on the management requirements and long term protection and conservation of the species. There have been no sightings of Regent Honeyeater across the BMAs; however there are critical components of their habitat requirements. The key threatening processes are similar to those for the Swift Parrot and management strategies sympathetic to these will be adopted to protect and enhance their habitat.

2.3.3 Spotted-tail Quoll

The Spotted-tail Quoll is a cat sized carnivorous marsupial up to approximately 75 cm long and 3 kg in weight. It has rich red-brown to dark brown fur above, covered by white spots of varying size. The fur underneath is a pale brown to cream and it has characteristic spots on its tail. This species is listed as Endangered under the EPBC Act (Plate 4).

Plate 4: Spotted-tailed Quoll (Michael Snedic)

The Spotted-tail Quoll is a mostly nocturnal carnivore, although it will sometimes hunt during the day. It spends most of the time on the ground, but it is also an excellent climber and may raid possum and glider dens and prey on roosting birds. Prey items include gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects, although it also eats carrion and takes domestic fowl opportunistically.

The Spotted-tail Quoll forages across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. The exact habitat requirements of the Spotted-tail Quoll are not known, however, habitat critical to the survival of this species has been described as land that contains large patches of forest with adequate denning resources and relative high densities of medium-sized mammalian prey.

The *National Recovery Plan for the Spotted-tail Quoll Dasyurus maculatus* (Department of Environment, Land, Water and Planning, 2016) provides a list of known threats including:

- loss, fragmentation and degradation of habitat through clearing of native vegetation and subsequent development;
- loss of large hollow logs and other potential den sites due to timber harvesting;
- accidental poisoning during wild dog and fox control programmes;
- competition for food with introduced predators such as cats and foxes;
- predation by introduced predators such as foxes and cats;
- road mortality;
- bushfire and prescription burning;
- poisoning by Cane Toads (*Rhinella marina*);

- climate change; and
- persecution by humans following perceived predation on stock and poultry.

These threats have been addressed in formulating the management strategies. There have been sightings recorded at St Antoine and Black Rock properties by previous landholders.

2.3.4 Corben's Long-eared Bat

The Corben's Long-eared Bat is a uniformly dark grey-brown bat. The ears are about 3 cm long and larger than the head. It has a low ridge of skin running between the eyes and across the nose. It has a head and body length of 5 – 7 cm and weighs about 14 g. This species is listed as Vulnerable under the EPBC Act (Plate 5).

Plate 5: Corben's Long-eared Bat (Pavel German)

The Corben's Long-eared Bat occurs in south-central Queensland, central western NSW, north-western Victoria and South Australia. Overall, the distribution of the south-eastern form coincides approximately with the Murray Darling Basin, with the Pilliga Scrub region being the major stronghold for this species.

The Corben's Long-eared Bat inhabits a variety of vegetation types. It is most commonly found in closed eucalypt woodland, but also occurs in open forest, savannas and mallee-type habitats in arid and semi-arid areas. It has been recorded from a range of species associations including mallee, Bulloak and Box Eucalypt dominated communities, but it is distinctly more common in the extensive areas of structurally complex box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. In NSW, this species is restricted to larger remnants of native vegetation.

The *Draft National Recovery Plan for the South-eastern Long-eared Bat (Nyctophilus corbeni)* (Schulz, 2010) highlights the main threats as:

- loss of remnant semi-arid woodland and mallee habitat;
- loss of hollow-bearing trees;
- changes in fire regimes;
- grazing; and
- application of pesticides in or adjacent to foraging areas.

These threats have been addressed in formulating the management strategies. There has been a recorded sighting by Cumberland Ecology in autumn 2012.

2.4 LAND MANAGEMENT UNITS

Land Management Units (LMUs) are units of land that support ecological communities of relatively consistent condition for the purpose of land management. LMUs are generally bounded by fence lines, roads or other infrastructure, facilitating the design and implementation of management strategies at this scale.

Each LMU within the BMAs has been assigned one of four condition categories with consideration of:

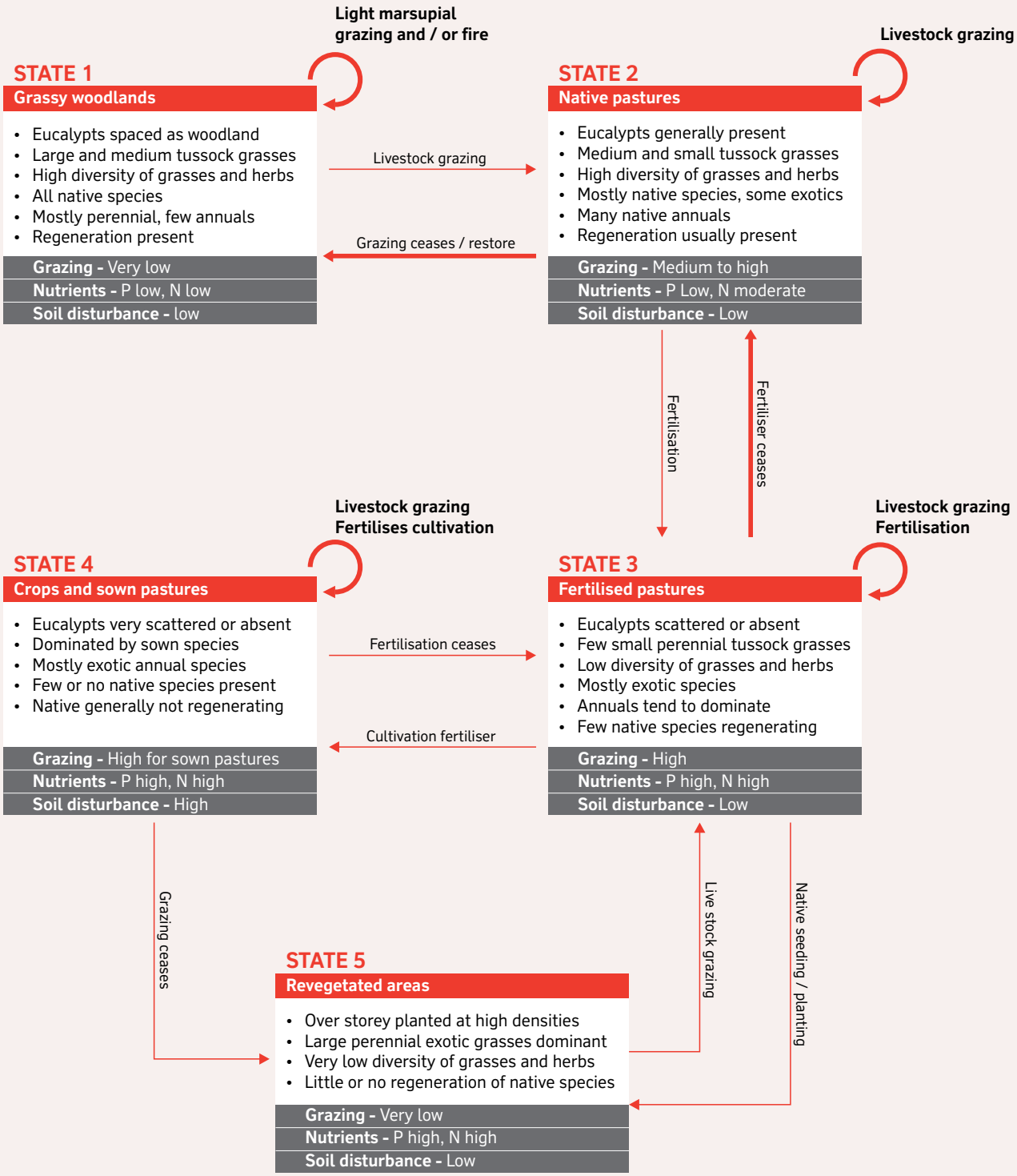
- the level of disturbance of the ecological communities;
- the extent and connectivity of the ecological communities; and
- the “state” as classified by the “State and Transition Model” described in A Guide to Managing Box Gum Grassy Woodlands (Rawlings, 2010)

The level of disturbance of the ecological communities was broadly assessed using aerial photo interpretation, and an ecosystem health and habitat condition score. This score was derived from rapid vegetation condition assessments undertaken during initial property inspections. The assessment consisted of a series of observations relating to the presence/absence of key habitat components and threatening processes for woodland communities. Site scores of 16 – 20 are generally considered to be areas of healthy woodland that are sustainable under current management. Site scores of 10 – 15 are generally considered to be areas of moderately disturbed woodland that have key elements missing and need improved management. Scores under 10 are highly disturbed, missing many key elements and are generally unsustainable under current management. The assessment is described in more detail in the *Rapid Condition Assessment* and Appendix C.

The “State and Transition Model” (Figure 5) describes typical characteristics of five states of Box Gum Grassy Woodlands, ranging from low-quality/highly disturbed states to high quality/minimally disturbed states. The model also identifies land management activities that drive transitions among these states and can be used as a guide to select management activities to promote the transition of Box Gum Grassy Woodlands to higher quality states.

Table 4 provides a broad definition of the four LMU categories and includes their correlation to the relevant state within the “State and Transition Model”, and their ecosystem health and habitat condition score.

Figure 5



The model has five states, each listing the characteristics typical for that state. Arrows between boxes represent the transition or change between states and the management activities that cause the transition. Thick arrows represent a more difficult transition. Circular arrows describe the mechanisms for maintaining a given state.

Source: Rawlings et al. (2010)

Table 4
Land Management Units Definitions

LMU	Definition
LMU 1	Very high quality Box Gum Grassy Woodlands, Derived Native Grassland and Other Woodland **(Rawlings State 1 and Ecosystem Health and Habitat Condition Score 16 to 20)** These areas can be described as being close to pristine ecological condition and require the lowest level of management intervention. The focus is minimal disturbance and exclusion. This LMU currently only occurs on the Namoi BMA and includes the pure form of White Box and Ironbark Shrubby Woodland vegetation communities that are known habitat for the Corben's Long-eared Bat.
LMU 2	Medium to high quality Box Gum Grassy Woodlands and Derived Native Grassland **(Rawlings State 1 or State 2 and Ecosystem Health and Habitat Condition Score 10 to 15)** These areas include the essential elements of the Box Gum Grassy Woodlands and Derived Native Grasslands, however the quality of has been impacted by clearing and farming disturbances. They are generally deficient in native species diversity and mature trees. These areas will require a low level of management intervention to encourage and support natural regeneration processes.
LMU 3	Low quality Box Gum Grassy Woodlands, Derived Native Grassland and Other Woodland **(Rawlings State 3 or State 5 and Ecosystem Health and Habitat Condition Score 5 to 10)** These areas include the lowest condition examples of these communities. They are generally deficient in tree canopy species and weeds are prominent in the grasslands. These areas will require ongoing management intervention for effective control of weeds and revegetation. This LMU includes Re-establishment Areas which are mostly State 5. The Re-establishment Areas will target the highly degraded River Oak forests along the rivers and creeks at the Merriwa East and West BMAs to improve the north - south connectivity. The Re-establishment Areas are a requirement of Approval Condition 2 and a Re-establishment Plan has been prepared to describe the establishment of these areas into "self-sustaining" functional ecological communities (Section 4.5).
LMU 4	Agriculture **(Rawlings State 4)** These areas have been significantly disturbed by farming activities. Small proportions of Box Gum Grassy Woodlands and individual trees are located within this LMU. Buffer zones will apply to protect them and adjoining Offset Areas (LMU1 to 3). Grazing management must maintain a minimum of sward height of 10 cm and 70% groundcover on at least 50% of the area to be grazed.

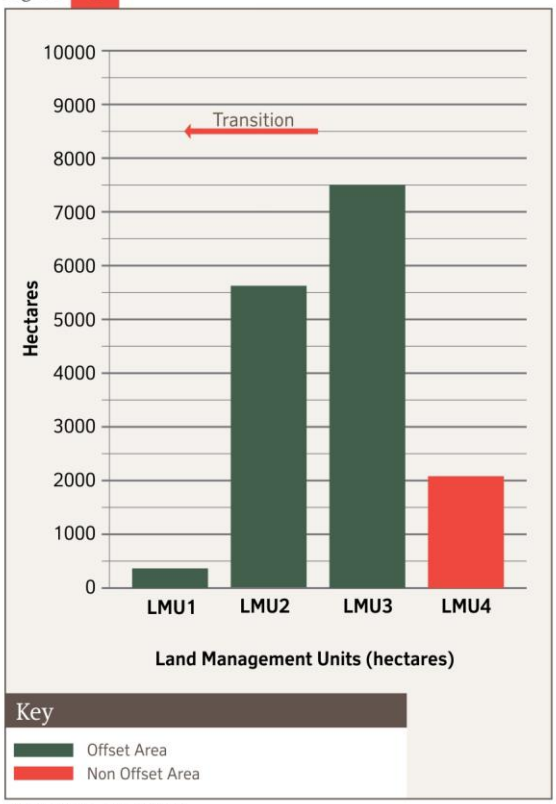
In summary, LMU1 represents the highest quality and most naturally functioning ecological condition. Consequently, management of LMU1 will focus on excluding agricultural activity and this category will attract little management invention. LMU2 and LMU3 will attract a higher level of management intervention to enhance the ecological condition. The lowest category, LMU 4, represents areas that have been highly disturbed by agriculture and are of the lowest ecological condition. Areas of LMU 4 do not form part of the areas required under the EPBC Approval and are not required to be secured to satisfy Condition 2 of EPBC Approval (2011/5795).

Figure 6 shows the total area of each LMU category within the BMAs as at November 2012. Overtime it is expected that implementation of the proposed management activities will result in an increase in the areas mapped as LMU1 and LMU2 and decrease in LMU3.

Total Area of each LMU Category within the BMAs

Offset Management Plan

Figure 6



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Figures 7 (a) to (e) show the distribution of LMUs on each property and their condition category. All of the land within LMU1 to LMU3 is to be protected as the Offset Area to provide enduring protection of Box Gum Grassy Woodlands, Derived Native Grassland and suitable habitat for the Regent Honeyeater, Swift Parrot, Spotted-tail Quoll and Corben's Long-eared Bat, as per Approval Condition 2. These figures also show the proposed Re-establishment Areas located within the Offset Area.

The Re-establishment Areas are currently agricultural areas that will be re-established to 'self-sustaining' ecological communities to provide a 'net gain' in Box Gum Grassy Woodlands and suitable habitat. The location of the Re-establishment Areas will also contribute to improving connectivity across the BMAs. The Re-establishment Plan in Section 4.5 details the strategies that will be implemented to achieve the objectives of the Re-establishment Areas.

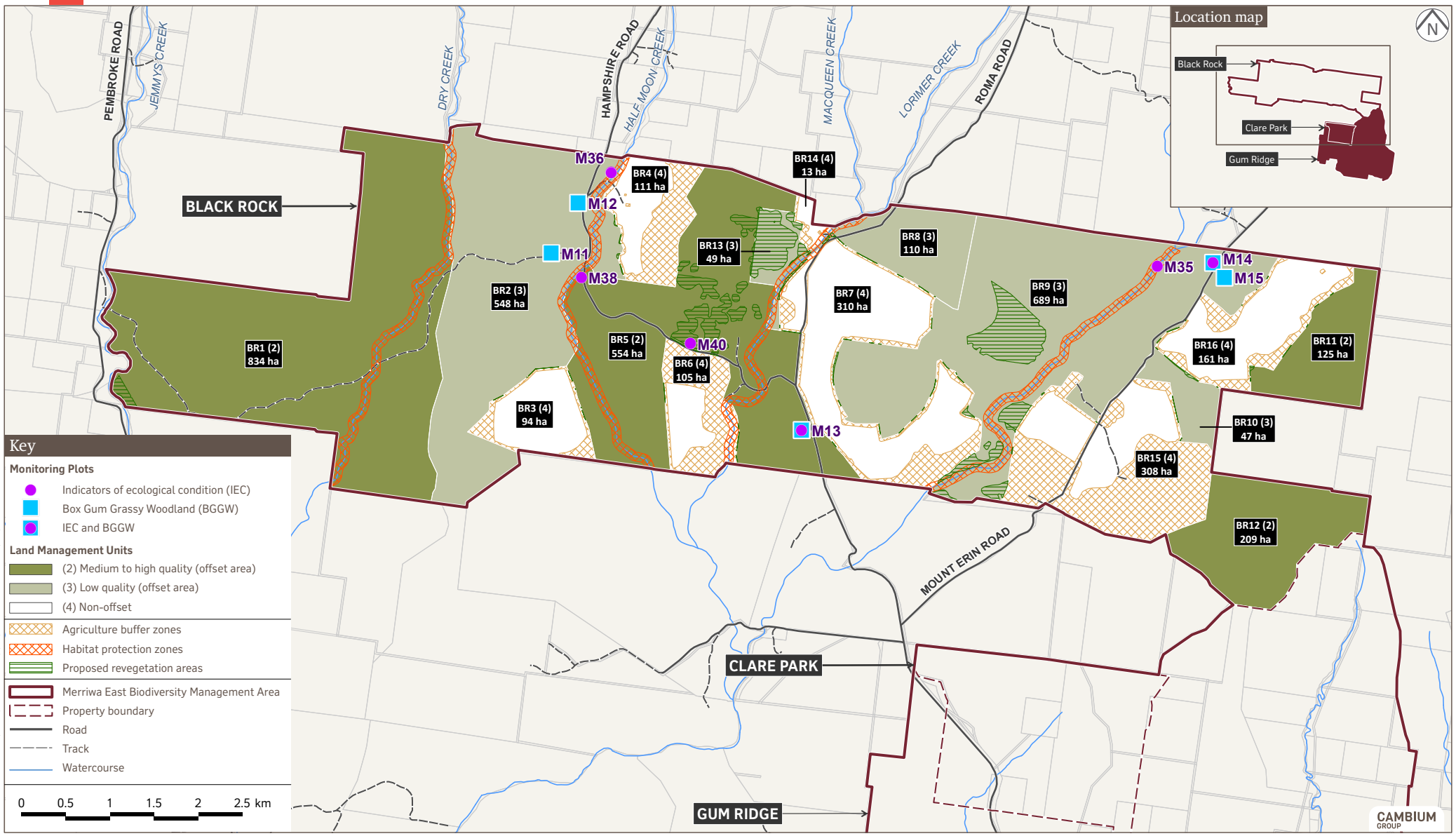
To assist in identification of LMUs within each property, a LMU compartment identifier has been allocated. The LMU compartment identifier represents the first initial of the property, followed by a compartment number, and the number in brackets indicates the LMU class. For example W1 (2) represents W1 (Warrawoona Compartment 1) and (2) is LMU2. These compartment areas may be sub-divided by fences into paddocks to assist in the management of the property. Appendix D provides the full list of LMU compartments on each property including the area of ecological communities within each LMU. Habitat Protection Zones indicate areas for specialised management and these areas are also shown in Figures 7a – 7e.

MACHEnergy

Black Rock Land Management Units, Habitat Protection Zones, Proposed Re-vegetation Areas and Monitoring Plots

Offset Management Plan

Figure 7a

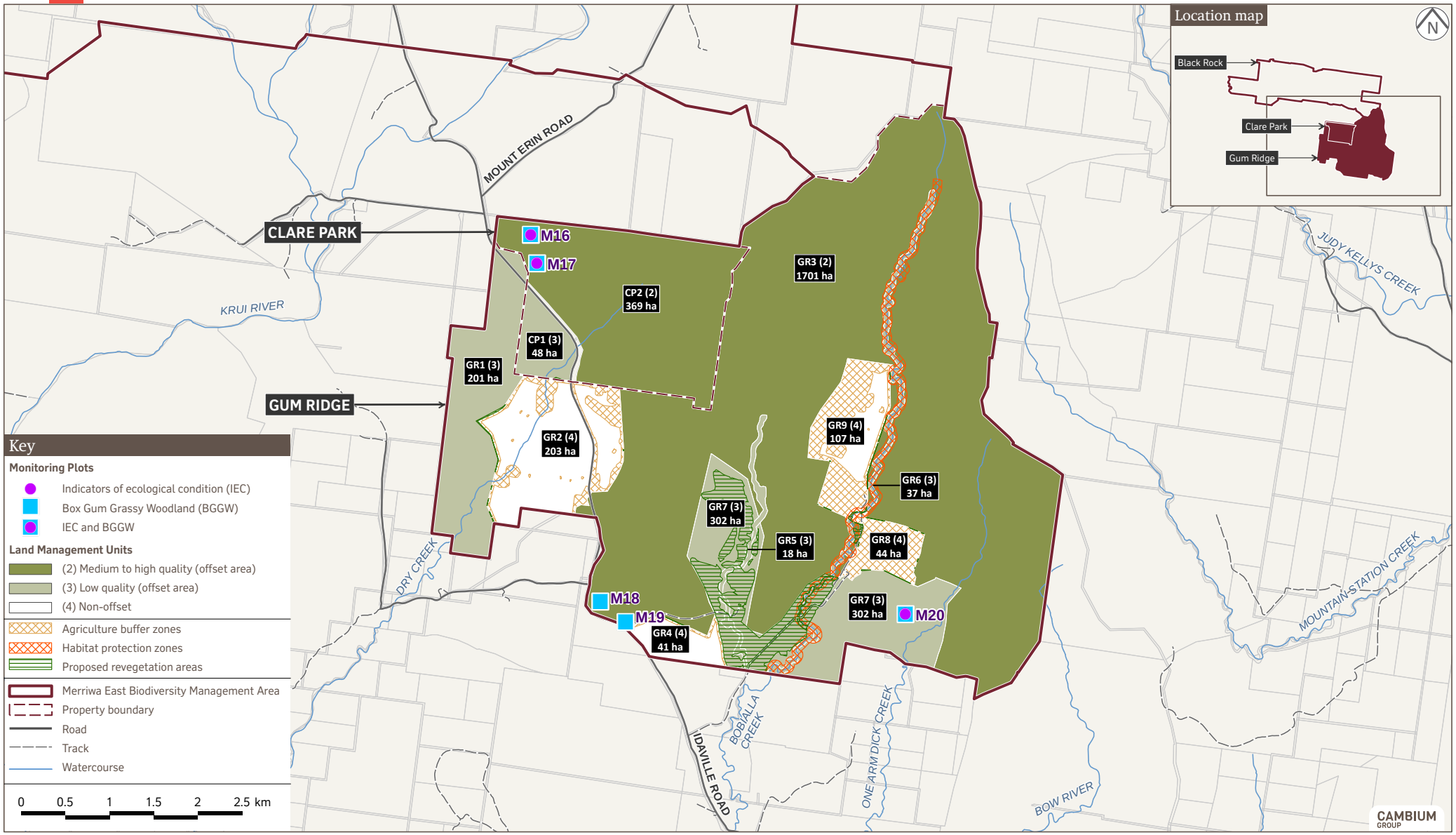


MACHEnergy

Clare Park and Gum Ridge Land Management Units, Habitat Protection Zones, Proposed Re-vegetation Areas and Monitoring Plots

Offset Management Plan

Figure 7b



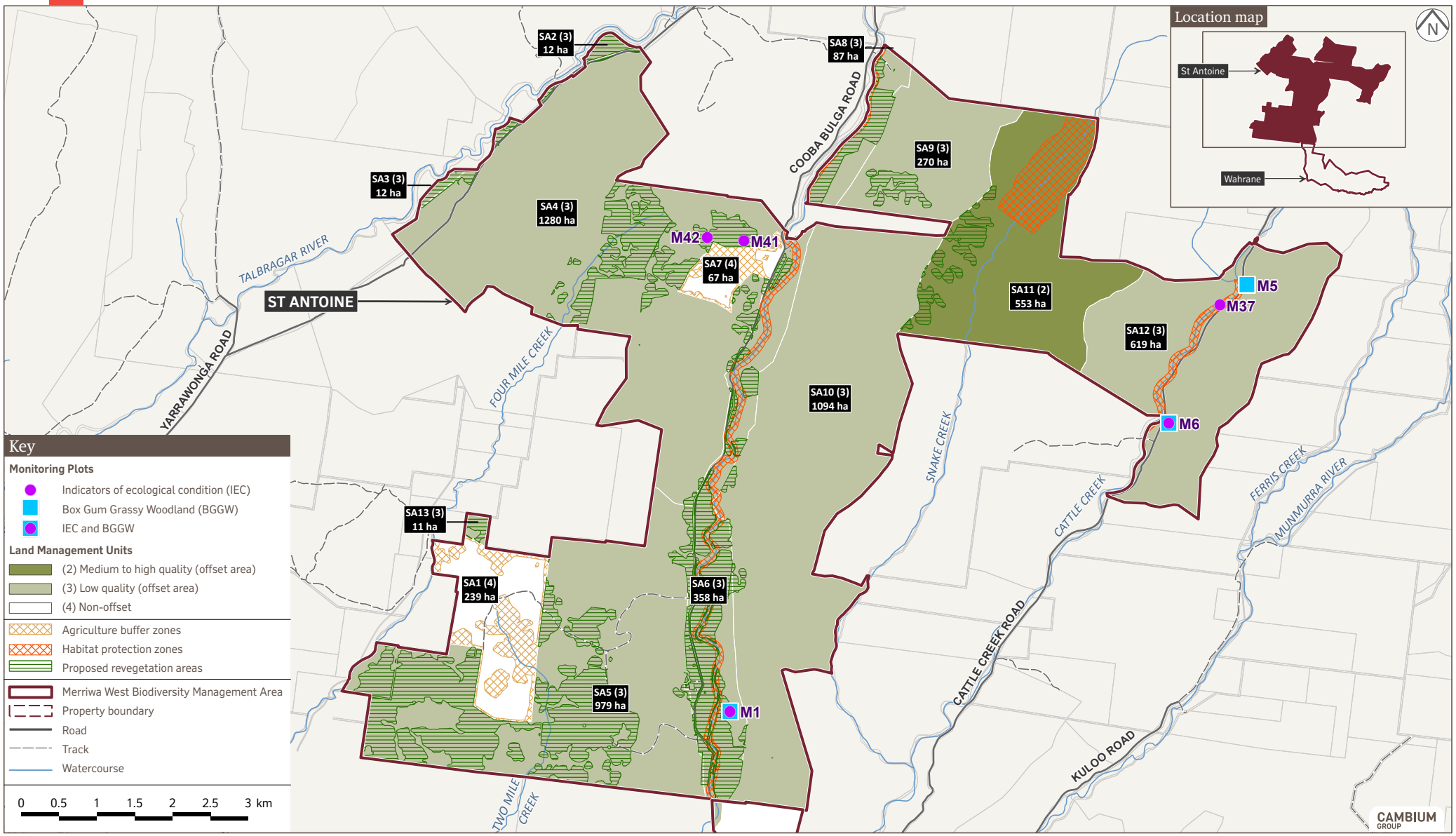
MACHEnergy

CAMBIUM GROUP

St Antoine Land Management Units, Habitat Protection Zones, Proposed Re-vegetation Areas and Monitoring Plots

Offset Management Plan

Figure 7c

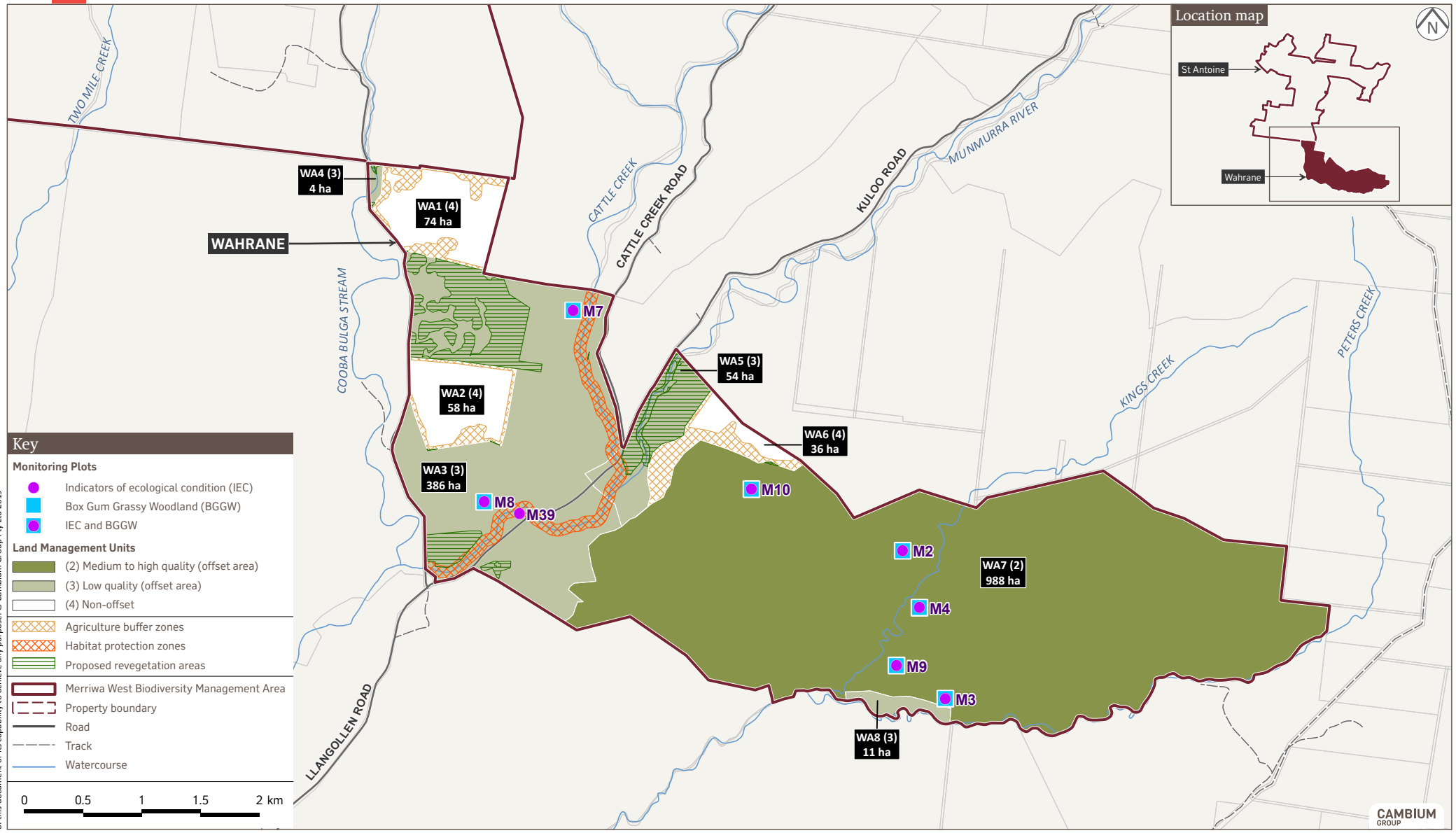


MACHEnergy

Wahrane Land Management Units, Habitat Protection Zones, Proposed Re-vegetation Areas and Monitoring Plots

Offset Management Plan

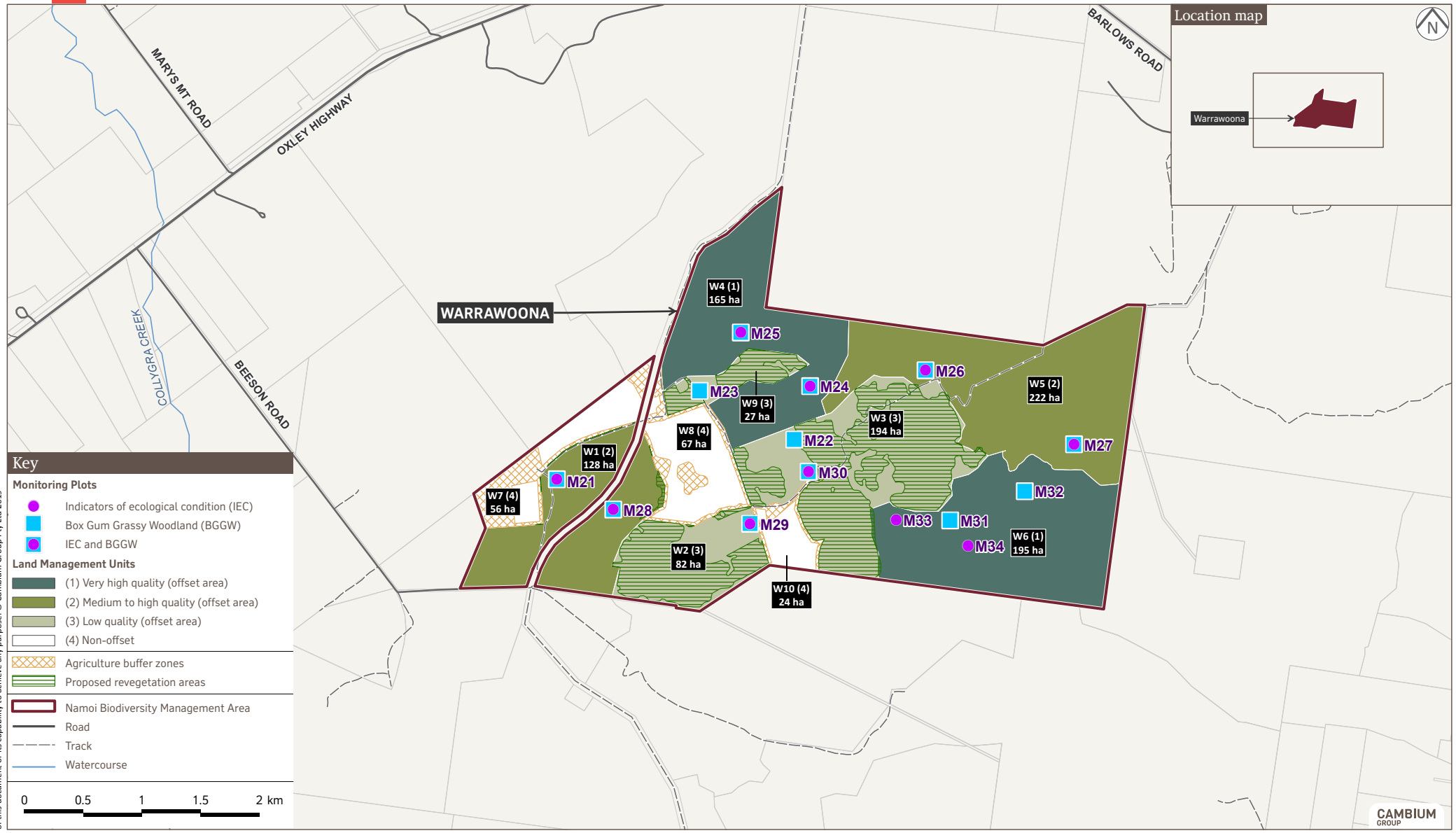
Figure 7d



Warrawoona Land Management Units, Proposed Re-vegetation Areas and Monitoring Plots

Offset Management Plan

Figure 7e



2.4.1 Ecological Communities Within Land Management Units

On a practical level, these broad LMU categories contain varying proportions of the five ecological communities. However, LMU1 will always contain the highest proportion of very high quality Box Gum Grassy Woodlands and LMU4 will always contain the greatest proportion utilised for Agriculture. Table 5 shows the area of each ecological community within each LMU category and within the Offset Area, based on the survey data collected in 2012. Figure 8 summarises this data providing a baseline of the percentage of each ecological community within each LMU category at 2012. It is anticipated that overtime, through the implementation of the conservation strategies detailed in this OMPRP and the proposed restoration of up to a maximum 1,420 ha of agricultural areas, there will be a net increase in Box Gum Grassy Woodland from those currently mapped as Derived Native Grassland, Low Quality Derived Native grassland and agriculture. This same process is anticipated to increase the area of Other Woodland, which is primary riparian forest along the creeks within the BMAs. The monitoring programme detailed in Section 5 will collect data to verify this trend. The Re-establishment Plan details the active restoration of the agriculture areas to "self-sustaining" function ecological communities, and includes details of the restoration activities and the monitoring programme. Tables 6 and 7 identify the areas to be protected within the Offset Area to satisfy the requirements of Approval Condition 2. The implementation of the OMPRP, as proposed, will provide a 'net gain' in the area of Box Gum Grassy Woodland and suitable habitat for the Regent Honeyeater, Swift Parrot, Spotted-Tail Quoll and Corben's Long-eared Bat.

Table 5
Area of Each Ecological Community within each Land Management Unit and Offset Area

Ecological Community	LMU1 (ha)	LMU2 (ha)	LMU3 (ha)	Total Within Offset Area	LMU4 (ha)	Total (ha)
Box Gum Grassy Woodland (CEEC)	261	4,173	3,359	7,793	242	8,035
Derived Native Grassland (CEEC)	49	1,296	2,249	3,594	213	3,807
Low Diversity Derived Native Grassland	-	107	251	358	155	514
Other Woodland	45	50	141	236	7	243
Revegetation Area (Agriculture)	1	88	1,331	1,420	-	-
Agriculture	-	-	-	-	1,471	3,011
Infrastructure	-	-	-	-	-	34
Total	356	5,714	7,331	13,401	2,087	15,488

Table 6
Area of Each Ecological Community to be Protected within Offset Area

Ecological Community	Area Required (ha)	Box Gum Grassy Woodland (ha)	Derived Native Grassland (ha)	Low Diversity Derived Native Grassland (ha)	Total (ha)	Revegetation Area (ha)	Future Area (ha)
White Box – Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland	12,875	7,793	3,594	358	11,745	1,420[1]	13,165

[1] Only the portion of the 1,420 ha required to satisfy the total 12,875 ha would be secured in perpetuity. Any additional land revegetated to the threatened community would be retained for use as an offset or to generate offset credits for other projects.

Table 7
Area of Suitable Habitat to be Protected within Offset Area

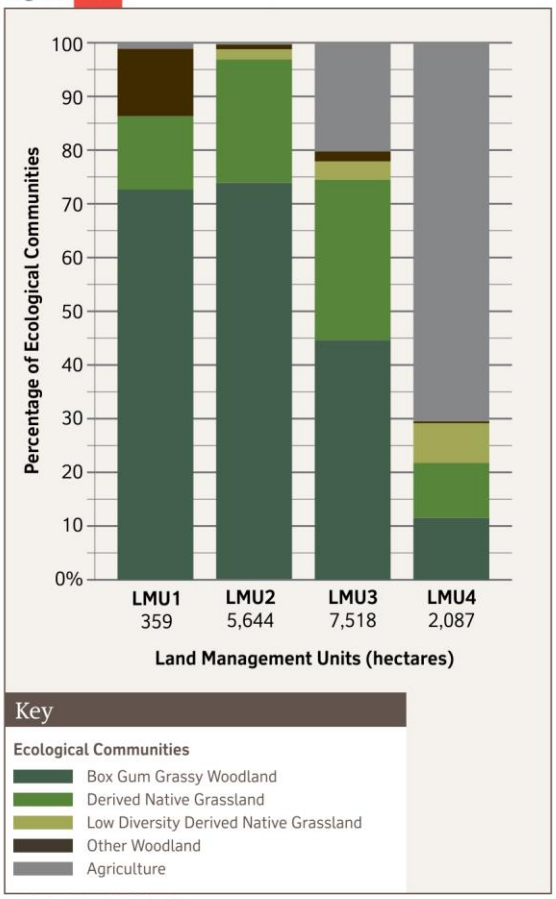
Species	Area Suitable habitat required (ha)	Habitat preferred	Box Gum Grassy Woodland (ha)	Derived Native Grassland (ha)	Other Woodland (ha)	Total (ha)	Revegetation Area (ha)	Future Area of Suitable habitat (ha)
Regent honey-eater	8,475	Box-Ironbark Forest and Woodland; Drainage lines	7,793	3,594	236	11,623	1,420	13,043
Swift parrot	8,475	Box-Ironbark Forest and Woodland; Drainage lines	7,793	3,594	236	11,623	1,420	13,043
Spotted-tail quoll	8,475	Den sites in hollow logs, tree hollows, latrine sites – rocky creek beds (Plate 6), base of cliffs	7,793	3,594	236	11,623	1,420	13,043
Corben's long-eared bat	8,475	Woodland or moist forest	7,793		236	8,029	1,420	9,449

Plate 6: Rocky gorge, Blackrock, Merriwa East BMA (DnA Environmental, 2011)

Percentage of Ecological Communities within each Land Management Unit Category

Offset Management Plan

Figure 8



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In 2014, AECOM completed the MNES survey for the birds and mammals; although the survey did not locate these species across the BMAs, they identified the areas contained suitable habitat and indicated the proposed management of the areas under OMPRP would increase the habitat suitability. The following excerpts from the AECOM report provides the Summary Discussions from the report, supports the premise that all three BMAs include suitable habitat and the implementation of the OMPRP should improve the condition and extent of suitable habitat.

Summary discussion- Regent Honeyeater and Swift Parrots

The monitored grasslands support a lower diversity of bird species than the woodland sites. The grassland sites were generally degraded and there was a stark absence of grassland specialists including larks, pipits, partridges and birds of prey usually associated with such open habitats. Many of these species are ground nesting birds and it is unclear why they were not observed. It is possible that previous disturbance and predators, such as the Red Fox have impacted on these grassland specialists.

Whilst Regent Honeyeater and Swift Parrot were not recorded at any of the three BMAs, each contains areas of suitable habitat. Habitat management and enhancement through planting and weed control will further increase the suitability of sites for these species and general bird assemblages.

Summary discussion- Spotted-tail Quoll

Whilst the species was not recorded from the 20 monitoring points across the two Merriwa BMAs, results provided a good insight to the level of feral animals requiring control, as targeted in the sites OMPRP. Sites where cameras were set were considered to be the most likely habitat where Spotted-tail Quoll would utilise if present on the site, in terms of resources for foraging, cover and shelter. The continuation of camera trapping over longer periods of time, as proposed in the OMPRP, in association with habitat and feral animal control, especially foxes and cats, will provide more information on the status of the species at the three BMAs. Surveyors were told of anecdotal evidence by a local of a sighting of the species to the east of the Merriwa West BMA and it is possible that this was a positive sighting, based on location and the dense forested hill habitats where it is alleged to have been seen. If this is correct, conservation management of the BMAs will increase their suitability for the species in the future.

Summary discussion- Corben's Long-eared Bat

Nyctophilus bat species were detected at four monitoring locations (three at Namoi and one at Merriwa East) and potentially at another two located in the Merriwa BMAs. All these locations were situated in areas of extensive forest/woodland which is a preferred habitat for many of the Long-eared bat species for roosting and foraging. The presence of *Nyctophilus* bat species could indicate the presence of the rare Corben's Long-eared Bat. The Cypress Pine woodland is a known favoured habitat of the species and this was abundant at the Namoi BMA. This BMA was considered to be the most likely BMA of the three to support Corben's Long-eared Bat based on habitat type and condition. The forest and woodland habitat at Namoi supported a good structural diversity of vegetation that provides cover for roosting and hunting bats and their prey. The proposed enhancement of the shrub and understorey layers at the woodlands and forests in Merriwa East and West BMAs will improve the suitability of the habitats for Long-eared bats and other microbat species.

2.5 BASELINE ECOLOGICAL CONDITION

Baseline ecological monitoring surveys for Indicators of Ecosystem Condition (IEC) and MNES – Box Gum Grassy Woodlands were completed in October and November 2013, in accordance with the methods described in Chapter 5. Thirty-two IEC and MNES plots were established across the BMAs. The locations of these plots are shown in Figure 7 (a) to (e). The monitoring plots were established to capture data on all habitat types in the BMAs and have been strategically located to best represent the condition class and habitat type. The data collection techniques have been designed to be repeatable and allow statistical analysis of the future data to measure the key performance criteria described in the following Section.

The complete *Baseline Flora, Fauna and Soil Assessment* report prepared by Cumberland Ecology (2013) is provided in Appendix E and can be accessed on the Biodiversity Offsets Portal and is summarised below. Further baseline monitoring for MNES – Birds and MNES – Mammals will be undertaken and is described in Section 5.2.

2.5.1 Summary of Baseline Ecological Monitoring 2013 Results

The seasonal climatic conditions at the time of the survey were dry and, despite widespread rain showers during the third week of the survey, the region had below average rainfall for the preceding four months. On Saturday 9 November 2013, post survey, a large proportion of the Namoi BMA was impacted by a 2,000 ha scrub fire (Plate 7). Of the 14 monitoring plots established at the Namoi BMA, only one site was not affected.

The data collected for the baseline monitoring of IEC and Box Gum Grassy Woodlands provides a snapshot of the condition of the BMAs at that time, and the impacts of prior land management practices on fauna assemblages, habitat features and vegetation structure/floristics. The baseline monitoring data was also used to inform the assignment of the land management units and develop the conservation management strategies (Section 4).

Plate 7: Grassland before and after the fire, Warrawoona, Namoi BMA (Cumberland Ecology 2013)

Indicators of Ecological Condition

Fauna habitat features differed among habitats as expected with habitat features such as tree hollows and fallen logs being present within woodland habitats (Box Gum Grassy Woodland, Callistris-Ironbark Woodland and Riparian) and absent or in lower abundance in grassland habitats (Derived Native Grassland and low diversity Derived Native Grassland). There was a higher percentage cover of leaf litter in LMU1 woodlands, compared with lower LMU woodland categories, primarily driven by the high percentage cover litter in the Callitris-Ironbark Woodland at the Namoi BMA.

Ninety-four bird species were observed including five species currently listed as Vulnerable under the BC Act, namely:

- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- Speckled Warbler (*Chthonicola sagittata*);
- Painted Honeyeater (*Grantiella picta*);
- Grey-crowned Babbler (*Pomatostomus temporalis*); and
- Diamond Firetail (*Stagonopleura guttata*).

Bird assemblages were similar across BMAs and LMUs. Riparian habitats tended to support higher species richness, which may reflect the dry conditions prior to surveys and the limited availability of flowering /feed trees outside the riparian zone.

Nine species of reptile were recorded during the surveys, which are all common throughout the region. The low diversity of reptile species may be attributable to the dry conditions prior to the surveys. There were no differences in reptile assemblages among habitats or LMU categories.

Box Gum Grassy Woodlands

As expected, Box Gum Grassy Woodland and Derived Native Grassland were easily distinguished by the presence or absence of structural elements (canopy cover) and habitat features (logs and trees with hollows) in woodland and grassland respectively. Native plant species richness (total) was also higher in Box Gum Grassy Woodland compared with Derived Native Grassland. This is a clear reflection of the impact of clearing and long-term grazing on these habitats.

The percentage cover of the canopy in Box Gum Grassy Woodland decreased in line with the LMU categories such that the highest percentage canopy cover was recorded in LMU1, and the lowest in LMU3. This pattern was also observed for the mid-storey, although less pronounced in the species richness of the mid-storey, this was higher in LMU1 than LMU 2 and LMU3 categories. The percentage cover of shrubs in the ground cover was higher in LMU1 compared with the lower LMU categories while exotic species were less abundant in the LMU1. The total length of fallen logs was low in LMU3 compared with LMU2 and LMU1. These findings are consistent with the State and Transition model descriptions of States 1-3 which have been assigned to LMUs 1-3 respectively.

Analysis of soil characteristics showed a distinct separation of the Namoi BMA from the Merriwa BMAs which is likely due to a difference in the previous farming practices and the spatial separation of the BMAs.

2.5.2 Monitoring Transition from Grassland to Woodland Habitats

The data collected demonstrate existing and measurable differences among habitats (grassland, woodland, riparian) for a suite of habitat features and floristic variables. These variables are therefore appropriate for demonstrating transition of the grassland habitats to woodland in accordance with the State and Transition Model. Furthermore, the nature and extent of current differences in vegetation condition between habitats has been quantified as the baseline condition. Future monitoring can now be interpreted against this baseline condition to assess the rate and direction of this transition through time.

2.5.3 Monitoring Restoration within Habitats (Transition up LMU Categories)

The baseline monitoring data did not provide a clear and consistent distinction between LMUs 2 and 3. This result is not unexpected given the large area of the BMAs and the incorporation of existing management infrastructure into this process of assigning LMUs categories. The suitability of LMU2 as a reference condition for restoration of LMU3 vegetation/habitats as initially proposed will become clearer with subsequent monitoring events.

Some differences between LMU1 and the lower quality LMU categories were detected in the data. LMU1 could therefore be used as a description of the reference condition to track improvement in quality of the lower LMU categories. However, LMU1 vegetation only occurs on the Namoi BMA and environmental differences exist between Namoi and the Merriwa BMAs (as have been demonstrated e.g. in soil characteristics). It is therefore possible that these intrinsic differences between the Namoi and Merriwa landscapes reduce the usefulness of LMU1 as a reference condition for Merriwa vegetation/habitats. In addition, the Beeson's Rd fire that occurred at the Namoi BMA after the monitoring event further limits the suitability of the LMU1 vegetation as a reference condition for the Merriwa BMAs. It is therefore proposed that ongoing monitoring also refer to the published reference condition for Box Gum Grassy Woodlands and Derived Native Grassland, in particular the Biometrics Vegetation Condition Benchmarks (OEH, 2008).

An analysis of the baseline data against the benchmark values is provided in Appendix F. This analysis demonstrates that the Box Gum Grassy Woodlands are within or close to the benchmark values and this is most consistently the case for LMU1. For all LMU categories, the abundance of native grasses in the ground layer is at the high end of, or exceeding, the benchmark range. However, the other structural layers which are at the low end of, or below, the benchmark range such as native ground cover (shrubs), native ground cover (other) and native mid-storey cover. The length of fallen logs also drops off well below the benchmark value within LMU3.

The Derived Native Grasslands are, as expected, missing some key structural layers and habitat features (canopy cover, trees with hollows and fallen logs) and therefore are below benchmark values for these features. Native plant species richness also remains below the benchmark value while the percentage cover of native grasses is high. Native mid-storey and native ground cover (shrubs) is absent in LMU3 but present (although low) in LMU2.

These benchmark values will provide a useful reference condition to assess changes in vegetation structure, floristics and habitat features as the conservation management strategies are implemented. Future monitoring results will be interpreted against this baseline condition to assess the extent of change and against the benchmark values to assess direction of change (towards benchmark) through time.

3 CONSERVATION OBJECTIVES AND KEY PERFORMANCE INDICATORS

3.1 CONSERVATION OBJECTIVES

The primary conservation objectives for this OMPRP are to:

- improve biodiversity values across the BMAs;
- increase the total area, connectivity and condition of remnant patches of Box Gum Grassy Woodland, Derived Native Grassland and Other Woodland; and
- enhance habitat and foraging opportunities for the Regent Honeyeater, Swift Parrot Spotted-tailed Quoll and Corben's Long-eared bat.

The conservation management strategies described in the following Chapter 4 outline management activities to be implemented within the BMAs and Offset Area to achieve the conservation objectives.

The methods to monitor the attainment of these objectives, and inform adaptive land management, are described in Chapter 5.

3.2 KEY PERFORMANCE INDICATORS

The Key Performance Indicators are aligned with the biodiversity values of the BMAs. The key biodiversity values across all the BMAs are the ecological communities. Importantly, these communities support a range of "nested" conservation values that include:

- endangered flora and fauna;
- habitat (watercourses/ riparian vegetation/rocky outcrops); and
- cultural heritage.

Table 8 to Table 10 list the key biodiversity values and the nested conservation values for each BMA, with their corresponding baseline description and key performance indicators. Note that the baseline metric has been developed using the rapid condition assessment, fauna surveys and vegetation surveys undertaken from 2010 to 2012, as well as the aerial images captured from May to September 2012. The first year of the ecological monitoring programme, outlined in Section 5.2, compiled the baseline ecological data sets and descriptions of baseline biodiversity values.

Table 8
Merriwa East BMA: Biodiversity Values and Key Performance Indicators

Biodiversity Value	Nested Conservation Values	Description and Baseline Metric November 2012	Key Performance Indicator
Box Gum Grassy Woodland	BGGW	Total area: 3,998 ha. LMU2: 2,800 ha / LMU3: 1,009 ha / LMU4: 190 ha	A statistically significant increase in woodland area, connectivity and condition by 2030.
	Fauna Habitat	Low to Medium quality potential habitat for: Spotted-tailed Quoll (no observation); Swift Parrot (no observation); and Regent Honeyeater (no observation).	A statistically significant increase in the condition and extent of habitat for listed fauna by 2030.
Derived Native Grassland	BGGW and DNG	Total area: 1,701 ha LMU2: 863 ha / LMU3: 646 ha / LMU4: 5 ha	Derived Native Grassland transitions to Box Gum Grassy Woodland and Low Diversity Derived Native Grassland transitions to Derived Native Grassland.
	Fauna Habitat	Low quality potential habitat for: Spotted-tailed Quoll (no observation); Swift Parrot (no observation); and Regent Honeyeater (no observation).	A statistically significant increase in the condition and extent of habitat for listed fauna by 2030.
Other Woodland (River Oak forest)	River Oak forest	Total area: 74 ha LMU2: 35 ha / LMU3: 35 ha / LMU4: 4 ha	A statistically significant increase in the area, condition and connectivity of River Oak forest by 2030.
	Fauna Habitat	Low quality and fragmented potential habitat for: Spotted-tailed Quoll (sighting at Black Rock); Swift Parrot (no observation); Regent Honeyeater (no observation); and Corben's Long-eared Bat (no observation).	A statistically significant increase in the condition and extent of habitat for listed fauna by 2030.
	Watercourse	No protection zone along: Krui River, Black Rock; Lorimer Creek, Black Rock; Half Moon Creek, Black Rock; Dry Creek, Black Rock; or Bobialla Creek, Gum Ridge.	Habitat Protection Zones established. A statistically significant improvement in vegetation condition and stream bank stability by 2030. Increase habitat connectivity by reconnecting existing areas of habitat along watercourses.

Table 9
Merriwa West BMA: Biodiversity Values and Key Performance Indicators

Biodiversity Value	Nested Conservation Values	Description and Baseline Metric November 2012	Key Performance Indicator
Box Gum Grassy Woodland	BGGW	Total area: 3,512 ha LMU2: 1,155 ha / LMU3: 2,311 ha / LMU4: 47 ha	A statistically significant increase in woodland area, connectivity and condition by 2030.
	Fauna Habitat	Low quality potential habitat for: Spotted-tailed Quoll (sighting at St Antoine); Swift Parrot (no observation); and Regent Honeyeater (no observation).	A statistically significant increase in the condition and extent of listed species habitat by 2030.
	Rocky Outcrop / Caves	No protection zone around rocky outcrops, potential habitat for endangered fauna and flora	Habitat Protection Zones established. A statistically significant improvement to habitat condition by 2030.
	Llangollen woolshed – European heritage	No protection zone	Habitat protection zone established to reduce risks of damage from fire within five years.
Derived Native Grassland	BGGW and DNG	Total area:1,894 ha LMU2: 309 ha / LMU3: 1,582 ha / LMU4: 3 ha	Derived Native Grassland transitions to Box Gum Grassy Woodland and Low Diversity Derived Native Grassland transitions to Derived Native Grassland.
	Fauna Habitat	Low quality potential habitat for: Spotted-tailed Quoll (no observation); Swift Parrot (no observation); and Regent Honeyeater (no observation).	A statistically significant increase in the condition and extent of habitat for listed fauna by 2030.
Other Woodland (River Oak forest)	River Oak forest	Total area:123 ha LMU2: 15 ha / LMU3: 106 ha / LMU4: 2 ha	A statistically significant increase in the area, condition and connectivity of River Oak forest by 2030.
	Fauna Habitat	Low quality potential habitat for: Spotted-tailed Quoll (no observation); Swift Parrot (no observation); Regent Honeyeater (no observation); and Corben's Long-eared Bat (no observation).	A statistically significant increase in the condition and extent of habitat for listed fauna by 2030.
	Watercourse	No protection zone along: Cooba Bulga Stream, St Antoine (Plate 8); Cattle Creek, St Antoine and Wahrane; or Talbragar River, St Antoine.	A statistically significant improvement in vegetation condition and stream bank stability by 2030. Increase habitat connectivity by reconnecting existing areas of habitat along watercourses.

Table 10
Namoi BMA: Biodiversity Values and Key Performance Indicators

Biodiversity Value	Nested Conservation Values	Description and Baseline Metric November 2012	Key Performance Indicator
Box Gum Grassy Woodlands	BGGW	Total area: 524 ha LMU1: 261 ha / LMU2: 219 ha / LMU3: 39 ha / LMU4: 5 ha	A statistically significant increase in woodland area, connectivity and condition by 2030. Increase connectivity between high quality vegetation within LMU1.
	Fauna Habitat	Medium quality potential habitat for: Spotted-tailed Quoll (no observation); Swift Parrot (no observation); Regent Honeyeater (no observation); and Corben's Long-eared Bat (no observation).	A statistically significant increase in the condition and extent of habitat for listed fauna by 2030. Observe or collect evidence of Corben's Long-eared Bat presence.
Derived Native Grassland	BGGW and DNG	Total area: 211 ha LMU1: 49 ha / LMU2: 124 ha / LMU3: 22 ha / LMU4: 17 ha	Derived Native Grassland transitions to Box Gum Grassy Woodland and Low Diversity Derived Native Grassland transitions to Derived Native Grassland
	Fauna Habitat	Low quality potential habitat for: Spotted-tailed Quoll (no observation); Swift Parrot (no observation); Regent Honeyeater (no observation); and Corben's Long-eared Bat (no observation).	A statistically significant increase in the condition and extent of habitat for listed fauna by 2030
Other Woodlands	Other Woodlands	Total area: 45 ha LMU1: 45 ha	A statistically significant increase in other woodland area, connectivity and condition by 2030.
	Fauna Habitat	Low to Medium quality potential habitat for: Spotted-tailed Quoll (no observation); Swift Parrot (no observation); Regent Honeyeater (no observation); and Corben's Long-eared Bat (no observation).	A statistically significant increase in the condition and extent of habitat for listed fauna by 2030

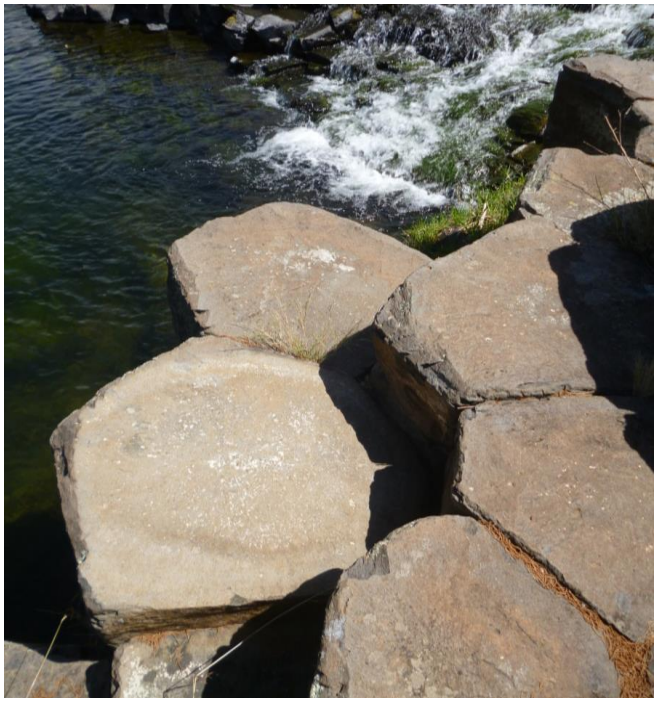


Plate 8: Cooba Bulga Stream, rock formations, St Antoine, Merriwa West (RTCA, 2013)

4 CONSERVATION MANAGEMENT STRATEGIES

This chapter outlines the management activities and methods to protect and enhance the biodiversity values of the BMAs. It will focus on addressing the key threatening processes identified in the following recovery plans (or listing advice where a recovery plan is not available):

- "*White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan*" (DECCW, 2011);
- "*National Recovery Plan for the Swift Parrot*" (Saunders, 2011);
- "*National Recovery Plan for the Regent Honeyeater (Anthochaera Phrygia) 2016* (Commonwealth of Australia 2016)";
- "*National Recovery Plan for the Spotted-tail Quoll Dasyurus maculatus* (Department of Environment, Land, Water and Planning, 2016); and
- Conservation Advice: *Nyctophilus corbeni* South-eastern long-eared bat (Threatened Species Scientific Committee, 2015).

More specialised advice on the practical implementation of the management strategies may be sought from "A Guide to Managing Box Gum Grassy Woodlands" (Rawlings, 2010).

4.1 CONTROLLED ACTIVITIES

The Offset Area (land within LMU1 to LMU3) will be protected under a conservation covenant (or alternate agreed legally binding mechanism). The Offset Area includes areas with the highest biodiversity and conservation values and will have legal protection. All Leaseholders, contractors, consultants and visitors must be aware of their responsibilities when entering the BMAs and Offset Areas.

The following activities will be prevented within the Offset Area:

- littering or dumping of waste;
- removal of firewood, native plants or animals;
- removal of rocks, sand or gravel (Note, an exemption applies to the existing quarries on the St Antoine property in the Merriwa West BMA and the Blackrock property in the Merriwa East BMA for the supply of gravel to the Upper Hunter Shire Council. These quarries are excluded from the Offset Area and are not subject to the requirements of this OMPRP);
- clearing or destruction of native vegetation (some exemptions for construction and maintenance of infrastructure, see Section 4.6);
- hunting;
- baiting (unless permission is granted for control of pest animals);
- trapping or shooting (unless controlling pest animals);
- use of fertilisers, unless otherwise agreed with the Upper Hunter Weeds Authority and/or the relevant LLS authority (i.e. Hunter LLS for Merriwa East and West BMAs, and the North West LLS for the Namoi BMA);
- aerial application of herbicide from manned or unmanned planes, or helicopters or drones (includes LMU4), unless otherwise agreed by the Department and/or subject to appropriate permits (e.g. permits from the Australian Pesticides and Veterinary Medicines Authority);
- continuous grazing in LMU1, LMU2 and Habitat Protection Zones;

- use of livestock feed in LMUs 1 to 3;
- keeping of European bee hives and domestic cats; or
- uncontrolled camp fires.

Farm dogs can be used for mustering purposes but are not permitted to roam uncontrolled or be used for hunting. They are to be humanely and securely housed when not working to reduce the risk of predation.

Vehicles may cause soil compaction, dispersal of weeds and vegetation disturbance. To minimise the impact vehicles on the BMAs, vehicle access will be restricted to authorised personnel only. Wherever possible existing access tracks will be used and vehicle speed will not exceed a maximum of 40 km/h.

Access to the BMAs will continue to be controlled through locked gates and fences and signs at main access points to inform all visitors they are entering a protected area.

4.2 WEED CONTROL

Control of weed species is critical to restoring the natural composition, diversity and structure of the ecological communities across the BMAs. Weeds are typically non-indigenous plants which invade areas after significant disturbance, such as land clearing or over-grazing. They exclude native species from the landscape, leading to a change in the composition and structure of plant communities and degrade the condition and function of the ecosystems.

The significant impact of weeds on the Box Gum Grassy Woodland has been recognised by the commitment to fund the development of the Weed Project Plan.

MACH Energy was responsible for the development of the *Weed Project Plan Priority Weed Management in Box-Gum Grassy Woodland on the Merriwa Plateau 2017* (Hunter Local Land Services, 2017) (Weed Project Plan) in consultation with the Hunter Local Land Services. The Weed Project Plan was developed to fund priority activities identified in the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan*" (DECCW, 2011). The objectives of the Weed Project Plan are to:

- Improve and monitor weed control and grazing activities (that minimize weed threats and enhance native species) on and adjacent to Box-Gum Grassy Woodland sites over the long term.
- Develop property scale Weed and Grazing Management Plans with landholders.
- Undertake pasture assessments and develop grazing management plans to assist in managing and containing weed spread and improving the condition of Box-Gum Grassy Woodland.
- Engage targeted landholders through incentives programs to undertake weed control, habitat protection and sustainable grazing practices in target investment area/s.
- Assess effectiveness of biological control for St John's Wort in the Upper Hunter.
- Incentive Funds: Engage targeted landholders through incentives programs to undertake weed control, habitat protection and sustainable grazing practices in target investment area/s.
- Monitor condition changes under varying management regimes.
- Increase lessee and general community awareness on control and prevention of spread of high priority weeds of the Merriwa plateau through field days/ workshops/ training/ media.
- Share relevant information, research findings for land managers and other organisations overseeing Box-Gum Grassy Woodland Projects.

Weed control will focus on species that exclude or have the potential to exclude, native species, disrupt recruitment of native species or impede ecological processes. Priority will be given to weed species listed in Table 11 and those identified in the relevant region strategic plan.

The *Hunter Region Strategic Weed Management Plan 2017-2022*[1] (DPI, 2017a) is applicable to the Merriwa East and West BMA and the *North West Regional Strategic Weed Management Plan 2017-2022*[2] (DPI, 2017b) is applicable to the Namoi BMA.

Table 11
Target Weed Species

Common Name	Scientific Name	State/Regional Priority
St. John's Wort	*Hypericum perforatum*	Additional Species of Concern#
African Boxthorn	*Lycium ferocissimum*	State Priority Weed Objective – Asset Protection, Additional Species of Concern#
Blackberry	*Rubus fruticosus (spp. agg.) except named culitvars*	State Priority Weed Objective – Asset Protection, Regional Priority Weed Objective – Asset Protection
Sweet Briar	*Rosa rubiginosa*	Additional Species of Concern **
Bathurst Burr	*Xanthium spinosum*	Additional Species of Concern*
Noogoora Burr	*Xanthium occidentale*	State Priority Weed Objective – Asset Protection
Prickly Pear	*Opuntia species* except *O. ficus-indica*	State Priority Weed Objective – Asset Protection
Willows	*Salix spp.* except *S. babylonica, S. x calodendron, S. x reichardtii*	General Biosecurity Duty
Bathurst Burr	*Xanthium spinosum*	
Cobblers Peg	*Bidens pilosa*	
Fleabane	*Conyza sp.*	
Saffron Thistle	*Carthamus lanatus*	
Star Thistle	*Centaurea calcitrapa*	
Spear Thistle	*Cirsium vulgare*	
Stinking Roger	*Tagetes minuta*	
Tree-of-Heaven	*Ailanthus altissima*	

* Namoi BMA

** Merriwa East BMA and Merriwa West BMA

Merriwa East BMA, Merriwa West and Namoi BMA.

4.2.1 Management Objective

To achieve a decline in the abundance of weeds across the BMAs over a period of five years, and to maintain weed abundance at or below the reduced levels for the duration of this OMPRP.

4.2.2 Method

The aim is to implement a variety of control methods and reduce the reliance on herbicides. This integrated weed management strategy will use of a range of suitable chemical and non-chemical control methods.

1 https://hunter.lls.nsw.gov.au/__data/assets/pdf_file/0010/806509/Hunter_rswmp_final.pdf

2 http://northwest.lls.nsw.gov.au/__data/assets/pdf_file/0010/722917/North-West-Regional-Weed-Mgmt-Plan-web-version.pdf

It is important to keep un-infested areas clear of weeds. Outbreaks in these areas will be a priority for intensive weed eradication and will be closely monitored to identify re-infestation or spread. Containment zones will be established around areas with high levels of infestation. Along with intensive control, containment zones of 50 m in width are to be maintained along roadsides, property boundaries and watercourses (where appropriate) to prevent dispersal.

The preferred control methods are described in Table 12. The detailed prescription for implementation of control methods is developed in consultation with the Leaseholder and the relevant agency responsible for administering the *Biosecurity Act 2015*. For the Merriwa East and West BMA, this is the Upper Hunter Weeds Authority (Now Hunter Local Land Services) and the Gunnedah Shire Council (Now North West Local Land Services) for the Namoi BMA.

Table 12
Weed Control Methods

Control Method	Potential Use in Control Regime
Biological Control – is a long term control technique and may require several years to become effective. This is a complementary strategy and alone it may not eradicate the weed.	At Merriwa West and East BMA the use of: Chrysolina beetles or St John's Wort mite for control of St John's Wort and Blackberry Rust for blackberries. Namoi BMA use of Cochineal and Cactoblastis for Prickly Pear.
Herbicide Control – is the application of chemical to kill the weed by interfering in the plants growth processes.	**Land based control:** Spot application of herbicide is the preferred method of application. Boom spray application is permissible in LMU3 as part of ground preparation for revegetation and in LMU4 for pasture establishment. **Herbicides:** Only registered herbicides will be used for the control of the weed species and used in accordance with the directions on the label. Users have a legal obligation to read and follow the instructions on the label. Selective herbicides will be used to minimise impacts on native vegetation. **Handling and application:** Herbicides must be handled and applied with consideration of their toxic nature and potentially harmful effects on human health, livestock and the environment. Only accredited and trained operators are permitted to apply herbicides. During application weather condition, nozzles, equipment and operator are to be closely monitored throughout application to reduce the risk of drift and subsequent off- target damage. Coarse to very coarse nozzles will be used to increase droplets size. Suitable weather conditions for spraying are extremely important. <u>Weather guidelines</u> • Read the product label and follow all label instructions. • Spray when wind is steady and ideally 3–15 km/h. • Avoid variable or gusty wind conditions. • Avoid calm conditions - small droplets may remain suspended for long periods. • Spray when wind blows away from sensitive areas. • Avoid spraying in temperatures above 28 °C. • Aim to spray when Delta T is between 2 and 8 and not greater than 10. • Do not spray when inversion conditions exist. • Aim to spray when the atmosphere is neutrally stable. • Most chemicals require a rain free period – check the label. • Be aware of local topographic and convective influences on wind speed and direction. • Record on-site weather conditions at spray time. For more detail please refer to www.bom.gov.au/info/leaflets/Pesticide-Spraying.pdf.

Table 12 (Continued)
Weed Control Methods

Control Method	Potential Use in Control Regime
Herbicide Control – is the application of chemical to kill the weed by interfering in the plants growth processes (continued).	**Reporting:** The Pesticides Regulation 2017 requires all commercial, agricultural or occupational pesticide users (that includes farmers, leaseholders and spray contractors) to keep records on their pesticide application. **Alternate Methods:** Aerial based application may be undertaken in certain circumstances. This may include where access makes land based options not feasible and/or it cannot be undertaken safely. Aerial application of herbicide may be undertaken subject to approval by the Department and/or obtaining relevant permits (e.g. permits from the Australian Pesticides and Veterinary Medicines Authority).
Land Management – good land management practices can reduce the incidence and impact of weeds.	**Grazing Management:** Across all LMUs strategic grazing will be used to encourage desirable native grass and forb species. Annual weed establishment will be reduced by maintaining high groundcover levels and strong perennial plant cover. Over grazing will be avoided through the implementation of monthly reporting by leaseholders and the biodiversity and agriculture auditors reporting. **Pasture Management:** In LMU3 and LMU4, weeds will be controlled through encouraging vigorous pastures to out compete weed species. The use of selective herbicide may be required to further suppress weed competition. **Weed hygiene:** If deemed necessary, machinery and vehicles is to be cleaned and washed down to reduce the spread of weed seed. Control traffic and drive on formed tracks and quarantine areas to control the spread of weeds. Any sources of infestation around a weed free site will be removed. Only weed-free seed is to be sown. New livestock being introduced to a property will be quarantined for several days, so any potential weed seeds can pass through their system in a known area and be treated later. **Weed Identification:** Leaseholders and other key stakeholders visiting the BMAs will be required to report any new infestation of weeds.
Manual removal – removal of the weed plant and roots from the site.	Physical removal of new weeds in LMU1, unearthing of root systems and containment and removal of seed.

As part of its weed control activities, MACH Energy will have regard for the *New South Wales Weed Control Handbook – A guide to weed control in non-crop, aquatic and bushland situations*[3] (DPI, 2018) and *Best management practice guide for environmental weeds: St John's Wort*[4] (CRC Weed Management, 2008).

4.2.3 Implementation and Reporting

Control of weeds (including state and regional priority weeds) is the responsibility of the Leaseholder and MACH Energy. Weed control activities have commenced and will continue to control environmental weeds (including state and regional priority weeds) across all BMAs, including maintaining containment zones.

[3] https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0017/123317/weed-control-handbook.pdf

[4] www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/347995/bpmg-stjohn-wort.pdf

Annual weed control programmes will be developed and implemented in conjunction with the leaseholder and will detail prescriptions, such as the introduction of biological controls and location of containment zones. Leaseholders will be required to report all new instances of state and regional priority weeds and control these using the appropriate method.

All control activities are to be reported to MACH Energy, including locations, method, date, duration and type and quantity of herbicide applied. This information will be stored and accessed by the Biodiversity Offsets Portal.

The impact of weeds will be observed through the monitoring programmes. This information will be used to monitor the success of the control methods.

4.3 PEST ANIMAL CONTROL

Many pest (or feral) animals pose a threat to native fauna through competition for habitat resources, degradation of habitat and direct predation. The recovery plans for Swift Parrot, Regents Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat list the following key threatening processes, which are relevant to the pest animal control across the BMAs:

- competition and grazing by the European rabbit;
- competition and habitat degradation by feral goats;
- competition from feral honey bees;
- environmental degradation caused by feral deer;
- predation by feral dogs;
- predation by the European red fox;
- predation by the feral cat; and
- competition from starlings.

In addition there are legal obligations to control pest animals under the *Local Land Services Act 2013*. Listed animals for control observed across all BMAs include:

- feral pig;
- European rabbit; and
- feral dog.

The *Game and Feral Animal Control Act 2002* requires the control of feral deer, which are known to occur in the Merriwa West and East BMA's.

4.3.1 Management Objective

To achieve a decline in the abundance of feral animal populations and evidence of damage across the BMAs over a period of five years, and to maintain feral animal populations and evidence of damage below baseline conditions.

4.3.2 Method

An annual pest animal control programme was developed by MACH Energy in conjunction with the Leaseholder and the relevant LLS (Hunter) for all properties across the BMAs. The target pest species include feral: pigs, goats, dogs, deer, cats and rabbits.

A variety of control methods can be utilised provided they are:

- species specific (wherever possible);
- cause no or little damage to the natural environment;
- are humane;
- meet relevant Work, Health, Safety and Environment regulatory requirements; and
- are regularly monitored.

4.3.3 Implementation and Reporting

The control of pest animals will be the responsibility of the Leaseholder. MACH Energy will support participation in regional control programmes.

Pest animal control management activities commenced immediately following the approval of this plan, including participation in regional control programmes coordinated by the LLS and control by current tenants.

All control activities are to be reported to MACH Energy, including locations, method, date, duration and estimate of number of target pest animal controlled. This information will be stored on, and can be accessed at any time on the Biodiversity Offsets Portal.

Pest management will be guided by regular observation by the Leaseholders and information gathered through the monitoring programmes.

4.4 STRATEGIC GRAZING

Strategic grazing will be used as a management tool to enhance Box Gum Grassy Woodlands and Derived Native Grasslands by promoting regeneration, controlling weeds and erosion, and reducing excessive fire fuel loads. The strategic grazing principles and targeted strategic grazing regimes outlined in this section have been developed in consideration of the rationale for grazing management and key principles within the CSIRO's *Managing & Conserving Grassy Woodlands* (McIntyre, McIvor & Heard [Editors], 2002).

Strategic grazing is preferred because the short duration and intensive regimes prevent or minimise selective grazing and thereby ensure that overall gains in biodiversity can be achieved. Approval Condition 9 requires a minimum sward height of 10 cm and 70% ground cover to be maintained at all times on at least 50% of the area to be grazed.

The principles to guide strategic grazing across the BMAs include:

- plants need adequate rest, and rest periods are derived to suit the recovery needs and growth rates of the desirable plants;
- stocking rates are regularly adjusted to match the current carrying capacity of the available landscape;
- grazing plans are proactive and require continual monitoring and control;
- periods of grazing should be as short as practical; and
- to increase species diversity amongst plants, animal and soil biology.

The BMAs have an extensive grazing history and will require careful management to avoid negative impacts on biodiversity values. Strategic grazing regimes will be matched to the site conditions and management outcomes, and will use trigger points to commence and cease grazing. The trigger points will be based on estimates of grassland condition and ground cover, which will be assessed on a monthly basis by the Leaseholder and on a quarterly basis during the Agricultural Audits (refer Sections 4.4.2 and 5.3).

The ecological monitoring programme (in Section 5.2) will observe, in detail, the impact on indicators such as native plant recruitment and weed abundance. In addition, quarterly Agricultural Audits (Section 5.3.1) will monitor the impacts of the grazing regimes.

Beef cattle will be the approved livestock used for strategic grazing as they are less selective in their grazing. They are able to graze many of the taller and more fibrous native grasses in the area and can effectively graze paddocks dominated by Plains Grass (*Austrostipa aristiglumis*).

In LMU3 and LMU4 continuous grazing of paddocks will be avoided, as it results in the elimination of the more palatable species of native grasses and forbs, including lilies and orchids. Continuous grazing will also be prevented in LMU1, LMU2 or Habitat Protection Zones.

Recruitment of native plants will be enhanced by timing strategic grazing to avoid periods when native plants are in flower and setting seed. Native and exotic grasses vary in their time of maximum growth, flowering and seeding. Hence it is critical to know what species are present when planning a strategic grazing regime. Therefore management is to be based on observation and experience rather than strict prescription.

The amount of stock feed available will influence stocking rates and duration of grazing. This may vary from one grazing period to the next. In a general sense a strategic grazing regime will take into account:

- timing of grazing;
- intensity of grazing;
- frequency of grazing; and
- duration of grazing.

4.4.1 Management Objective

To manage grazing regimes across the BMAs so that native species diversity and regeneration increases and groundcover levels, required by Condition 9 of EPBC Approval 2011/5795, are maintained and to assist with weed control and erosion prevention. Condition 9 of EPBC Approval 2011/5795 requires a minimum sward height of 10 cm and 70% ground cover to be maintained at all times on at least 50% of the area to be grazed.

4.4.2 Method

Quarterly Audits will be undertaken in consultation with the Agricultural Auditor and Leaseholder. Audits will also inform the Leaseholder of the success of the selected strategic grazing regimes (Section 5.3) and as mentioned above, implementation of strategic grazing will be supported by information from the monitoring programmes. The intention of the Audits is to provide Leaseholders with grazing constraints and assist them in estimating carrying capacities.

Additionally, in LMU2 and LMU3 areas, informal, simple paddock assessments conducted by the Leaseholder will provide a site-specific condition assessment. All paddock assessment reports are provided on the Biodiversity Offsets Portal, and can be accessed by authorised stakeholders at any time. This site condition information will inform the timing of stocking and destocking, based on trigger values contained in this plan.

The total area of each LMU by property is shown in Appendix D. Within the LMU, the strategic grazing regime will be applied on a paddock by paddock basis, promoting patchiness and subsequent diversity.

Strategic grazing will only be permitted in LMU1 to control biomass for fire fuel reduction. Where grazing has been excluded or where there is a Habitat Protection Zone, biomass may increase to levels that create an unacceptable fire risk. In these circumstances grazing may be used to reduce risk.

4.4.3 Targeted Strategic Grazing Regimes

Three targeted strategic grazing regimes have been developed for LMUs 2 and 3 (Table 13). The regimes define the:

- management outcomes;
- location i.e. which LMUs;
- trigger points to indicate when the paddock can be stocked and when it must be destocked; and
- seasonal management objectives.

Trigger points are defined by an estimate of ground cover and grassland condition.

The method to assess ground cover is provided in Section 5.3. Ground cover is an estimate of the proportion of the ground that is not bare soil and includes the area covered by the plant base, stem and leaf material that is spreading from the base, dead leaf litter, manure, branches, cryptogams and rocks that are lying on the soil surface. The amount of ground cover has an important role in soil protection, by reducing raindrop impact, reducing the speed of water flow over soils and increasing water infiltration, and is an important indicator of site condition.

Grassland condition is to be estimated by kilograms of Dry Matter per hectare using the *Meat and Livestock Australia Pasture Ruler* (Lodge, 2011).

Table 13
Targeted Strategic Grazing Regimes

Management Outcomes	Targeted Strategic Grazing Regime
Reduce Exotic Grasses and Weeds	**LMU2 and LMU3** **Trigger point for strategic grazing:** Observed pasture condition in spring has an exotic weed component greater than15% of ground cover and perennial native grass component less than 40% of ground cover. **Summer** Maintain a minimum of 90-100% ground cover (composed of a minimum 40% native grass cover and 15% maximum exotic species cover), with plant residue levels of between 2,000 and 3,000 kg Dry Matter/ha (sward height 10-20 cm). **Trigger point for removal of stock:** Ground cover ≤90% and sward height ≤10cm.

Table 13 (continued)
Targeted Strategic Grazing Regimes

Management Outcomes	Targeted Strategic Grazing Regime
Reduce Exotic Grasses and Weeds (continued)	**Late Summer/Early Autumn** Retain minimum of 90% ground cover, including dry standing residue and litter to minimise the bare ground that favours annual grass/weed germination and to reduce the risk of erosion from high intensity storms. Allow a minimum 8-week recovery (no grazing) to allow setting of native grass seeds, in paddocks on a rotational basis at least every second year. **Trigger point for removal of stock:** Ground cover ≤90% and sward height ≤10cm. **Autumn** Keep grazing pressure low or defer grazing until late winter/spring to crowd out germinating annual grasses/weeds. **Trigger point for removal of stock:** Ground cover ≤90% and sward height ≤10cm. **Winter** Increase frequency of grazing. Retain minimum of 90% ground cover. Note: during winter St John's Wort is less toxic to livestock. **Trigger point for removal of stock:** Ground cover ≤90% and sward height ≤10cm. **Spring** Use short–term high density grazing to control annual grass/weed growth and restrict seed set. Graze to 1,500 -2000 kg Dry Matter/ha (sward height 5-10 cm). **Trigger point for removal of stock:** Ground cover ≤90%, sward height ≤5cm and when stem elongation of native grasses commences.
Encourage Perennial Native Grasses	**LMU2 and LMU3** **Trigger point for strategic grazing:** Observed pasture condition of perennial native grass component greater than 40% of ground cover and desired native species presence less than 7 plants per square metre (low diversity). **Summer** Maintain a minimum of 90-100% ground cover (composed of a minimum 40% native grass cover and 15% maximum exotic species cover), with plant residue levels of between 2,000 and 3,000 kg Dry Matter/ha (sward height 10-20 cm). **Trigger point for removal of stock:** Ground cover ≤90% and sward height ≤10cm. **Late Summer** Retain high plant litter levels to minimise the bare ground that favours annual grass/weed germination. **Trigger point for removal of stock:** Ground cover ≤90% and sward height ≤10cm. **Late Summer/Early Autumn** Retain minimum of 90% ground cover, including dry standing residue and litter. Good ground cover is needed to reduce the risk of erosion from high intensity storms. Allow a minimum 8 week recovery (no grazing) to allow setting of native grass seeds, in paddocks on a rotational basis at least every second year. **Trigger point for removal of stock:** Ground cover ≤90%, sward height ≤10cm and when stem elongation of native grasses commences.

Table 13 (continued)
Targeted Strategic Grazing Regimes

Management Outcomes	Targeted Strategic Grazing Regime
Encourage Perennial Native Grasses (continued)	**After Autumn Break** Monitor and assess establishment of native grass seedlings. Graze to residue of 2,000 kg Dry Matter/ha (sward height 10 cm) to protect seedlings. **Trigger point for removal of stock:** Ground cover ≤90% and sward height ≤10cm. **Winter** Reduce grazing interval (increase recovery period) to match plant growth. **Trigger point for removal of stock:** Ground cover ≤90% and sward height ≤10cm. **Spring** Shorten grazing intervals to match growth rates. Additional grazing pressure may be needed where exotic annuals dominate. Graze to 2,000 kg Dry Matter/ha (sward height 10 cm). Prevent annual weeds from seeding during spring. If adequate native grass seed heads emerge in the late spring, rest to increase seed production of the native species, as well as replenishing energy reserves prior to summer. **Trigger point for removal of stock:** Ground cover ≤90%, sward height ≤10cm and when stem elongation of native grasses commences.
Assisted Natural Regeneration	**LMU3** **Trigger point for removal of stock:** Observed absence of native regeneration. **Late Summer/Autumn** "Crash" grazing to minimum 40% native grass cover and maximum 15% exotic ground cover. Reduce to 1,000 kg Dry Matter/ha (sward height 5 cm). Promote regeneration of eucalypts and other native forbs. **Trigger point for removal of stock:** Ground cover ≤90%, sward height ≤5cm and when there is evidence of native tree seedlings. **Autumn/Winter** Limit grazing to allow seedling establishment for 6 months, in paddocks on a rotational basis at least every second year. **Trigger point for removal of stock:** Evidence of native tree seedlings / regeneration, identify paddock(s) and rest for 6 months, monitor growth / recruitment and rest paddock biannually until native regeneration extends beyond stock grazing impacts. Then implement removal of stock when ground cover ≤90% and sward height ≤10cm. **Spring/Early Summer** Monitor seedling recruitment. If recruitment is adequate; exclude grazing for an extended period. If recruitment inadequate, graze to retain 1,500 -2,000 kg Dry Matter/ha, and repeat "crash" grazing in following autumn. If recruitment is adequate, exclude grazing again for an extended period. If recruitment remains inadequate, consider replanting in consultation with Agricultural Auditor. **Trigger point for removal of stock:** Ground cover ≤90%, sward height ≤5-10cm and when there is evidence of native tree seedlings.

4.4.4 New Infrastructure

Stock aggregation into larger mobs for 'crash' grazing may be needed seasonally (e.g. in spring to suppress annual weeds and grasses such as annual ryegrass and soft brome). Subdivision of larger paddocks may be required to enable high enough stock densities to control ground cover. When high stocking densities are required temporary electric fencing may be required.

New livestock watering systems may be required to protect the riparian vegetation and stream banks within the habitat protection zones.

Pasture Improvements

Artificial fertiliser will be prohibited in LMU1, LMU2 and LMU3. Soil tests will be used to monitor soil fertility and determine fertiliser requirements for pastures and crops in LMU4.

Livestock Feeding

Livestock can be fed supplements to address nutritional deficiencies. They may be required to encourage livestock to graze unpalatable plants to reduce fire hazard or to control weeds. Supplements will need to be approved by the MACH Energy representative prior to use.

Livestock feed, such as hay, may only be used and/or stored within LMU4.

4.4.5 Implementation and Reporting

Any new infrastructure for sub division of paddocks or installation of Habitat Protection Zones will be developed in conjunction with the Leaseholder. Infrastructure improvement plans will be developed for each property across the BMAs as considered necessary.

In conjunction with data from the ecological monitoring programmes, the effects of the strategic grazing regimes will be closely monitored and adapted where required. This information will be stored and accessed by the online Biodiversity Offsets Portal.

4.5 RE-ESTABLISHMENT PLAN

To achieve an increase in the extent and the condition of the ecological communities, a range of revegetation techniques will be implemented including assisted natural regeneration, planting and regrowth management.

Targeted Revegetation Areas have been identified across the BMAs to increase connectivity. These areas are located within LMUs 2 and 3 with the indicative area totalling 1,420 ha (Table 5) (Figures 7a to 7e).

A Re-establishment Plan has been developed in accordance with the requirements of Conditions 11 to 14 of EPBC Approval 2011/5795 to guide the implementation of revegetation activities within the BMA Re-establishment Areas and is provided in this section. The Re-establishment Plan includes details of the methods to be used to revegetate these areas and the monitoring program that will be undertaken to measure revegetation performance against the Re-establishment Plan's performance and completion criteria.

4.5.1 Re-establishment Plan Objectives

Consistent with the requirements of Condition 12 of EPBC Approval 2011/5795, the objectives of this Re-establishment Plan are to:

- within the BMAs, increase the spatial extent and improve the condition of existing remnant woodlands by at least 677 ha within timeframes specified under Condition 12 of the EPBC Approval 2011/5795; and
- establish self-sustaining functional remnant vegetation communities with the capacity to provide habitat for the species in Condition 2 of EPBC Approval 2011/5795.

4.5.2 Re-establishment Plan Requirements

MACH Energy's statutory obligations relevant to the Re-establishment Plan are contained in Conditions 11 to 14 of EPBC Approval 2011/5795.

Table A-1 in Appendix A if this OMPRP outlines where the requirements of these Conditions are addressed in the RP.

4.5.3 Re-establishment Areas Overview and Environmental Values

Re-establishment Areas

Re-establishment Areas have been identified within LMUs 2 and 3 (Figures 7a to 7e) which are agricultural areas that will be rehabilitated to 'self-sustaining' ecological communities to provide a 'net gain' in Box Gum Grassy Woodlands and suitable habitat for the Regent Honeyeater, Swift Parrot, Spotted-tail Quoll and Corben's Long-eared Bat. These areas are the 'Re-establishment Areas' required under Conditions 12 to 14 of EPBC Approval 2011/5795. Areas surrounding the Re-establishment Areas will also be subject to a low level of management intervention to encourage and support natural regeneration processes to further assist with re-establishment of self-sustaining ecological communities. The location of the Re-establishment Areas will also contribute to improving connectivity across the BMAs.

Table 14 shows the area of Re-establishment Areas within each LMU category of each BMA property, including the area of ecological community, associated derived native grassland and other woodland.

Table 14
Area of Re-establishment Areas within each Land Management Unit

Ecological Community	Re-establishment Area (ha)	Box Gum Grassy Woodland (CEEC) (ha)	Derived Native Grassland (CEEC) (ha)	Low Diversity Derived Native Grassland (ha)	Other Woodland (ha)
Merriwa East BMA					
Blackrock					
LMU 1	0	0.0	0.0	0.0	0.0
LMU 2	42.95	1166.2	440.3	48.3	34.8
LMU 3	93.03	734.9	425.1	8.1	35.0
Clare Park					
LMU 1	0	0.0	0.0	0.0	0.0
LMU 2	0	301.3	67.1	0.0	0.0
LMU 3	0.20	20.7	27.2	0.0	0.0
Gum Ridge					
LMU 1	0	0.0	0.0	0.0	0.0
LMU 2	1.39	1332.4	355.6	4.7	0.0
LMU 3	101.73	252.9	193.2	0.2	0.0

Table 14 (continued)
Area of Re-establishment Areas within each Land Management Unit

Ecological Community	Re-establishment Area (ha)	Box Gum Grassy Woodland (CEEC) (ha)	Derived Native Grassland (CEEC) (ha)	Low Diversity Derived Native Grassland (ha)	Other Woodland (ha)
Merriwa West BMA					
St Antoine					
LMU 1	0	0.0	0.0	0.0	0.0
LMU 2	41.76	325.6	157.5	54.3	15.0
LMU 3	817.52	2172.3	1381.9	243.0	69.7
Wahrane					
LMU 1	0	0.0	0.0	0.0	0.0
LMU 2	0.11	829.2	151.7	0.0	0.0
LMU 3	102.23	131.5	198.1	0.0	35.0
Namoi BMA					
Warrawoona					
LMU 1	0.97	49.0	49.0	0.0	45.0
LMU 2	2.01	218.6	123.6	0.0	0.0
LMU 3	215.91	39.5	21.8	0.0	0.0
Total	1,420				

It is anticipated that over time, through the implementation of the conservation strategies detailed in Section 4 and the proposed revegetation of 1,420 ha of agricultural areas, there will be a gradual net increase in Box Gum Grassy Woodland through the passive and active revegetation of key species into the Derived Native Grassland and Low Quality Derived Native grassland. This same process will increase the area of Other Woodland, which is primary riparian forest along the creeks within the BMAs and will provide a 'net gain' in the area of suitable habitat for the Regent Honeyeater, Swift Parrot, Spotted-Tail Quoll and Corben's Long-eared Bat across the BMAs, as demonstrated in Tables 4 and 5. The monitoring programme described in Section 5 will collect data to verify this trend.

This 1,420 ha of Re-establishment Areas exceeds the 677 ha requirement of Condition 12 of EPBC Approval 2011/5795.

Environmental Values

As described above, the Re-establishment Areas are agricultural areas within LMUs 2 and 3. A description of the characteristics of these LMUs is provided in Table 4.

A description of the baseline ecological condition of MNES Box Gum Grassy Woodlands and fauna habitat as measured by IEC is provided in Section 2.5.

Matters of National Environmental Significance

EPBC Approval 2011/5795 requires the enhancement of the ecological communities across the BMAs to improve habitat for the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat. To date, only the Spotted-tail Quoll and Corben's Long-eared Bat have been observed within the BMAs. The future management of the BMAs intends to improve habitat condition and reconnect fragmented remnant vegetation to support species dispersal, foraging and, in some cases, breeding.

A detailed description of these species, their habitat preferences and distribution, and habitat available within the BMAs for these species is provided in Section 2.3.

As described in Section 5, the monitoring program for the Offset Areas includes targeted surveys for the above MNES species.

4.5.4 Revegetation Strategies

4.5.4.1 Revegetation Species

For Box Gum Grassy Woodland Re-establishment Areas, the revegetation species list will be derived from the 'important' species listed in Appendix 1 of the *National Recovery Plan White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland A Critically Endangered Ecological Community* (Department of Environment, Climate Change and Water [DECCW], 2011) (provided in Appendix G of this OMPRP) (subject to availability) and key species associated with local Box Gum Grassy Woodland CEEC areas within the BMAs.

For other woodland Re-establishment Areas, the revegetation species used will be species that comprise the target vegetation communities as issued by the NSW Scientific Committee or NSW government description of that vegetation community. Revegetation species lists will include key vegetation species that provide habitat for the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat as provided in the National Recovery Plans for these species. Table 15 summarises target revegetation species for the Swift Parrot and Regent Honeyeater.

Table 15
Target Revegetation Species for the Swift Parrot and Regent Honeyeater

Relevant EPBC Act Listed Species	Target Revegetation Species
Swift Parrot	Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark, White Box, Western Grey Box, Coastal Grey Box and Blackbutt.
Regent Honeyeater	Key eucalypt species include Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Secondary species include Coastal Grey Box, Narrow-leaved Ironbark, Silvertop Stringybark, Spotted Gum and Rough-barked Apple. Mistletoe species would also be included e.g. *Amyema miquelii, Amyema pendula* and *Amyema cambagei* to provide nectar and fruit for foraging.

The Spotted-tail Quoll forages across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. The habitat critical to the survival of this species has been described as land that contains large patches of forest with adequate denning resources and relative high densities of medium-sized mammalian prey (Belcher, 2000; Belcher & Darrant, 2006b; Glen & Dickman, 2006a-b in Australian Government Department of the Environment, 2016).

The Corben's Long-eared Bat inhabits a variety of vegetation types. It is most commonly found in closed eucalypt woodland, but also occurs in open forest, savannas and mallee-type habitats in arid and semi-arid areas. It has been recorded from a range of species associations including mallee, Bulloak and Box Eucalypt dominated communities, but it is distinctly more common in the extensive areas of structurally complex box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. In NSW, this species is restricted to larger remnants of native vegetation.

Implementation of this OMPRP will improve the condition of existing habitat and increase the extent of suitable habitat across the BMAs for both the Spotted-tail Quoll and Corben's Long-eared Bat. No target revegetation species, other than for the Box Gum Grassy Woodland CEEC and other Woodland, are considered applicable for these species.

Revegetation species will be selected to enhance the target vegetation communities with suitably structured understorey, mid-storey and tree canopy coverage. In order to enhance vegetation connectivity, species of the target vegetation communities will be seeded and/or planted adjacent or close to similar vegetation communities.

Species lists and the ratios of species within the seed mix or seedling/tubestock batch will be guided by a qualified and experienced ecologist to ensure Re-establishment Areas mimic the composition and structure of the target vegetation community in the locality and the minimum condition requirements for the Box Gum Grassy Woodland CEEC. Species lists and ratios of species within the seed mix or seedling/tubestock batch will be developed by the end of June 2021, prior to the commencement of revegetation activities (Section 4.5.4.4).

4.5.4.2 Seed/seedling Source and Provenance

Seeds and seedlings will be preferentially sourced from a local provider. In addition to this supply, the MPO operates an on-site Seed Harvesting Facility (Plates 1 and 2) to supplement seed supply. MACH Energy also undertakes ongoing seed collection programs on the MPO area and the BMAs. Seeds are stored in the Seed Harvesting Facility, or alternatively in a long-term seed storage facility, located off-site. Record sheets are used to track the collection, storage and utilisation of the MPO seed resource. A detailed description of the seed collection, seed management and propagation procedures using the on-site Seed Harvesting Facility is provided in the MPO's Biodiversity Management Plan.

Plates 1 and 2 – Seed Harvesting Facility

Where possible and commercially viable, tubestock will be propagated in a local nursery from locally sourced seed, preferably of Hunter provenance.

A seed/seedling supply plan will also be developed to ensure adequate quantities of seed/seedlings are available for each revegetation campaign, or if seed/seedlings will be required to be externally sourced.

4.5.4.3 Revegetation Methods

Revegetation will be undertaken using direct seeding and/or tubestock planting methods. Other techniques may also be used (e.g. hand-broadcasting, air seeding) if determined to be suitable.

The overarching consideration for the commencement of revegetation campaigns within the Re-establishment Areas will be the prevalence of adverse seasonal conditions (e.g. persistent drought conditions). The other key considerations for both direct seeding and tubestock planting are outlined below.

Direct seeding will include the application of selected seed directly to the soil surface. Key considerations for direct seeding include:

- The use of clean, weed-free seed.
- Seed collection from local provenance, and from multiple parent plants consistent with seed collection guidelines (e.g. FloraBank Guidelines [FloraBank, 1999] and Plant Germplasm Conservation in Australia (Australian Network for Plant Conservation [ANPC), 2009]).
- Timing of sowing prior to rainfall periods to assist germination rates, and imbibing seed prior to application. Seeding will be prioritised to occur when there is suitable soil moisture, preferably after 25 mm of rainfall, in spring or autumn, once conditions permit safe access. If observed to be required, ants would be controlled at the time of seeding.
- For overstorey species, consideration will be given to the number of seeds per gram for direct seeding, as Eucalypt seed sizes and weights are highly variable, and equal portioning of seed by weight alone can lead to significant imbalances in species composition.

Tubestock planting requires germinating and establishing plants past seedling stage in a nursery situation. The following will be undertaken when tubestock planting:

- Seed collection of local provenances and from multiple parent plants, consistent with seed collection guidelines (e.g. FloraBank Guidelines [FloraBank, 1999] and Plant Germplasm Conservation in Australia [ANPC, 2009]).
- Chemical control of weeds at least one week prior to planting. An area of at least 1 metre (m) diameter around each tree or seeding patch would be sprayed or mechanically weeded to remove all competition for site resources. Weed control will be continued for two years while native species are establishing.
- Cultivation for tubestock planting would be to a depth of 500 to 600 mm at least 6 months prior to planting and when soil moisture is low to improve sub surface soil shatter. Cultivation for direct seeding may include light soil scarification.
- If there are nutrient imbalances, amelioration will be undertaken to improve soil condition before commencing restoration.
- Planting will be prioritised to occur when there is suitable soil moisture, preferably after 25 mm of rainfall, in spring or autumn, once conditions permit safe access.
- Planting stock is to be at least 25 centimetres (cm) in height, with a well-established root system, in good condition and sun hardened.
- The tubestock root plug is to be saturated at the time of planting.
- All plants would be planted deep, with their root plug at least 50 mm below ground and gently firmed in to remove any air pockets in the soil.

- Where there is a chance of browsing by rabbits, macropods and other herbivores, sturdy tree guards would be utilised to allow tubestock to establish. Tree guards would only be removed once the tubestock has grown above the tree guard.
- Tube stocks will have weed mats installed at the time of planting to provide longer term control of competition.
- Watering is to occur at the time of planting or seeding, and if required for 6 months post planting.

Maintenance of Re-establishment Areas (direct seeded or tubestock planted areas) would be undertaken for at least 18 months to improve the long-term success/performance of the Reestablishment Areas. Maintenance activities may include weed and pest control, fertilizer application, watering if suitable water sources are available and re-planting and/or re-seeding if monitoring results indicate the requirement.

Regrowth Management

Very dense stands dominated by Eucalyptus saplings can occur within revegetated Box Gum Grassy Woodland areas, locking the vegetation community in an unnatural state (Rawlings et al., 2010). These stands prevent the recruitment of other species and are unlikely to achieve the biodiversity and conservation objectives in the longer term. Regrowth control or thinning of these stands will ensure that a diverse and sustainable woodland community is established with a similar structure, function and composition to the medium to high quality woodlands occurring within the BMAs.

Thinning of regrowth will be undertaken according to techniques specified in "A Guide to Managing Box Gum Grassy Woodlands" (Rawlings et al., 2010). Permits under the *Local Land Services Act 2013* will be required to for thinning activities. Prior to undertaking any thinning of regrowth, MACH Energy would engage a suitably qualified person to advise when and where thinning may be required based on Re-establishment Area monitoring program results.

4.5.4.4 Revegetation Planning and Scheduling

Subject to suitable climatic conditions prevailing, revegetation campaigns for the Re-establishment Areas will be targeted to occur annually in spring or autumn over the years 2021 to 2024. Prior to each revegetation campaign, an internal plan and schedule will be developed and will include details of:

- the Revegetation Area within each BMA to be the target for each campaign;
- the approximate extent/area of each revegetation campaign and mapping;
- anticipated timing for soil preparation/cultivation activities to be undertaken prior to seeding/planting;
- anticipated timing for seeding/tubestock planting;
- target vegetation communities and revegetation species lists to be used;
- ratios of species to be planted and/or seeded (developed by a suitably qualified person); and
- proposed revegetation method/s.

Revegetation species lists, and ratios of species, for the relevant vegetation communities to re-established will be developed by the end of June 2021, prior to commencement of the revegetation campaigns.

4.5.5 Threats to MNES and Proposed Management Measures

This section outlines the key threats to the relevant MNES fauna and the Box Gum Grassy Woodland CEEC and describes the management measures that will be implemented to manage and/or mitigate these threats.

Threats to MNES

The key threatening processes for the relevant MNES fauna and for the Box Gum Grassy Woodland CEEC summarised in this section are consistent with those identified in the following recovery plans (or listing advice where a recovery plan is not available):

- *National Recovery Plan for the Swift Parrot* (Saunders and Tzaros, 2011);
- *National Recovery Plan for the Regent Honeyeater (Anthochaera Phrygia) 2016* (Commonwealth of Australia 2016);
- *National Recovery Plan for the Spotted-tail Quoll Dasyurus maculatus* (Department of Environment, Land, Water and Planning, 2016);
- *Conservation Advice: Nyctophilus corbeni South-eastern long-eared bat* (Threatened Species Scientific Committee, 2015); and
- *National Recovery Plan White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (DECCW, 2011).

Swift Parrot

The *National Recovery Plan for the Swift Parrot* (Saunders and Tzaros, 2011) lists the following relevant major threats to this species:

- loss and alteration of foraging and nesting habitat through forestry activities and residential, industrial and agricultural development;
- competition for foraging and nesting resources;
- climate change;
- mortality from collisions with human-made objects; and
- Psittacine beak and feather disease.

Regent Honeyeater

The *National Recovery Plan for the Regent Honeyeater (Anthochaera Phrygia) 2016* (Commonwealth of Australia, 2016) identifies small population size, habitat loss and fragmentation, competition and degradation of remnant habitat as primarily threats to this species.

Spotted-tail Quoll

The *National Recovery Plan for the Spotted-tail Quoll Dasyurus maculatus* (Department of Environment, Land, Water and Planning, 2016) provides a list of known threats including:

- loss, fragmentation and degradation of habitat through clearing of native vegetation and subsequent development;
- loss of large hollow logs and other potential den sites due to timber harvesting;
- accidental poisoning during wild dog and fox control programmes;

- competition for food with introduced predators such as cats and foxes;
- predation by introduced predators such as foxes and cats;
- road mortality;
- bushfire and prescription burning;
- poisoning by Cane Toads (*Rhinella marina*);
- climate change; and
- persecution by humans following perceived predation on stock and poultry.

Corben's Long-eared Bat

The *Draft National Recovery Plan for the South-eastern Long-eared Bat (Nyctophilus corbeni)* (Schulz, 2010) highlights the main threats as:

- loss of remnant semi-arid woodland and mallee habitat;
- loss of hollow-bearing trees;
- changes in fire regimes;
- grazing; and
- application of pesticides in or adjacent to foraging areas.

Box Gum Grassy Woodland CEEC

The *National Recovery Plan White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (DECCW, 2011) provide the following ongoing threats to Box Gum Grassy Woodlands:

Land Use Management and Change:

- Agricultural and Horticultural Development (e.g. largely scale clearing for agricultural enterprise development and operation);
- Rural Residential and Urban Development (e.g. loss and fragmentation of native vegetation for urban development and rural residential subdivisions);
- Mining (e.g. exclusion from clearing controls allowing for severe and localised land clearing and subsequently poor rehabilitation); and
- Public Infrastructure (e.g. on-going infrastructure maintenance and upgrading, including road widening, and physical disturbances on adjacent land, including drainage works);

Conflicting Management Practices:

- Grazing Regimes and Pasture Management (e.g. selective grazing altering the floristic structure and composition of the ecological community);
- Firewood Collection and 'Tidying-up' (e.g. reduction of habitat value through removal of the materials and conditions needed for nutrient recycling, and the spread of weeds);
- Changed Fire Regimes (e.g. too frequent or extensive burning leading to disruption of the ecosystem and loss of biodiversity);
- Increased Soil Nutrients and Use of Chemicals (e.g. application of fertilisers and soil ameliorants);

- Mowing or Slashing Regimes (e.g. poor machinery hygiene and/or smothering of native species); and
- Revegetation Management (e.g. disturbance of soil and groundlayer in preparation for planting);

Degrading Landscape Processes:

- Weed Invasion (e.g. spread of perennial grasses and herbs, annual grasses, annual and biennial herbs, and woody weeds);
- Climate Change (e.g. changing climate patterns, including rising temperatures and decreasing rainfall);
- Salinity (e.g. widespread replacement of native trees and deep-rooted native perennial grasses with shallow-rooted annual crops and/or weeds allows more water to enter the soil profile, cause rise in water tables, mobilise naturally occurring salts in soil and subsequently carries them to the soil surface);
- Acid Soils (e.g. major acidification processes, including nitrate leaching); and
- Declining Tree Health and Regeneration (e.g. increased insect attack, changed soil nutrient and hydrological regimes and other impacts resulting directly or indirectly from human activity);

Other Potential Threats:

- Animal Pests (e.g. increased grazing pressure from introduce fauna species preventing regeneration of native flora and facilitating spread of weeds)
- Disease (e.g. introduced root-rot fungus, *Phytophthora cinnamomi*); and
- Collection/removal of Native Flora (e.g. harvest and propagation of native seeds for use in revegetation projects).

Management Measures

Condition 13 of EPBC Approval 2011/5795 requires the RP to include:

- *measures to address threats to MNES including but not limited to grazing pressure and damage by livestock and adverse impacts from feral animals and weeds;*
- *measures to provide fire management regimes appropriate for the MNES; and*
- *measures to manage the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community in accordance with the recommendations of the approved recovery plan for the ecological community.*

Condition 4(c) of EPBC Approval 2011/5795 requires the OMP to include:

- *details of the management actions that will improve the baseline condition (referred to in condition 2 (b)), of a minimum of 12,875 Ha within the Biodiversity Management Areas consistent with the State and Transition Model, listing advice and recovery plan for the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community*

The OMPRP conservation management strategies (Section 4) have been prepared to:

- address the key threatening processes for the Box Gum Grassy Woodland CEEC identified in the *National Recovery Plan White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland A Critically Endangered Ecological Community* (DECCW, 2011), and the key threatening processes for the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat as provided in their respective National Recovery Plans or listing advice; and

- be consistent with the 'Best Practice Site Management Practices for the Continued Existence of Box Gum Grassy Woodland' provided in Table 4 of the *National Recovery Plan White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland A Critically Endangered Ecological Community* (DECCW, 2011); and
- be consistent with the Conservation Advice provided in the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland listing Advice to the Minister (17 May 2006).

A summary of the 'Best Practice Site Management Practices for the Continued Existence of Box Gum Grassy Woodland' is provided in Table 16 below, including where each of these practices are addressed in this OMPRP.

Table 16
Best Practice Site Management Practices for the Box Gum Grassy Woodland CEEC

Box Gum Grassy Woodland National Recovery Plan - Best Practice Site Management Practices (DECCW, 2011)	Section of the OMPRP
Maintain or improve soil conditions	Section 4.1
Maintain or improve drainage conditions / existing hydrological regime	Section 3.2
Control exotic plant introductions	Section 4.2
Avoid inappropriate native tree planting	Section 4.5
Maintain or improve connectivity	Section 4.5
Avoid excessive shading	Section 4.5
Maintain or improve structural diversity	Sections 4.1, 4.5
Ensure adequate buffers are retained	Section 4.7
Minimise chemical use	Section 4.1
Implement strategic grazing	Section 4.4
Implement appropriate burning regimes	Section 4.8
Avoid inappropriate mowing / slashing	Section 4.2

The 'Conservation Advice' provided in the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland listing Advice to the Minister (17 May 2006) provides a list of priority recovery and threat abatement actions required for the community. These actions are listed in Table 17, along with where each of these actions are addressed in this OMPRP.

Table 17
Box Gum Grassy Woodland CEEC Conservation Advice Actions

Management Action	Section of the OMPRP
Protection of remnants of the listed ecological community through the development of conservation agreements and covenants	Section 1.1.2
Protection of remnants from weeds, particularly Coolatai Grass, by preventing soil disturbance in and around remnants, and the speedy eradication of any new invasion	Sections 4.2 and 4.8
Avoid the use of fertilisers in or near remnants	Sections 4.1 and 4.4.4
Avoid soil disturbance in or near remnants, such as ripping planting lines and road grading	Section 4.1
In very small derived grassland sites, avoid planting trees as they may reduce the floral diversity through competition for light, nutrients and water	NA (tree planting not proposed in DNG areas)

Table 17 (continued)
Box Gum Grassy Woodland CEEC Conservation Advice Actions

Management Action	Section of the OMPRP
Planting and other rehabilitation-focussed disturbance should focus on the edges of patches, expanding them, rather than within the patches	Section 4.5
Expansion and connection of existing remnants	Sections 4.5 and all Section 4 management actions
Exclusion of continuous grazing from remnants is important, coupled with weed management and control	Sections 4.1, 4.2 and 4.4
Use strategic grazing (incorporating rest at appropriate times) in areas still containing a diverse native understorey	Section 4.4
Burning or slashing if native tussock grasses have built up to a high level, to open intertussock spaces for tree seedlings, forbs and shrubs to establish	Section 4.8

Over time and during development/maturation of the Box Gum Grassy Woodland Re-establishment Areas, more specialised advice on management and maintenance strategies specifically for Box Gum Grassy Woodland areas will be sought from *A Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al., 2010).

4.5.6 Re-establishment Areas Monitoring Programme and Completion Criteria

The ecological monitoring programme (Section 5.2) will be used to measure the establishment and ongoing success of the Re-establishment Areas. High quality Box Gum Grassy Woodlands and other woodland (LMU2) on the BMAs will represent the target (reference) condition for vegetation and habitat restoration. As described in Section 5.2.2, seven monitoring sites have been established in Box Gum Grassy Woodland areas within LMU2. These sites will be used as the reference sites for the Re-establishment Areas for the purpose of determining that the Re-establishment Areas have achieved a 'self-sustaining' condition. In general, the Re-establishment Areas will be considered to have achieved a 'self-sustaining' condition when tree and dominant understorey species have achieved regeneration capacity by the production of seed or vegetative reproduction (Nichols, 2005), and the revegetated landscape requires maintenance consistent with that of surrounding remnant vegetation landscapes.

A completion criteria set will be developed by a suitably qualified person based on the reference site data and which reflect a self-sustaining functional vegetation community, using the ecological monitoring programme indicators outlined in Appendix H of this OMPRP. The completion criteria set will also include indicators that will enable MACH Energy to demonstrate whether the Re-establishment Areas have the capacity to provide habitat for the species identified in Condition 2 of EPBC Approval 2011/5795, i.e. the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat. MACH Energy will develop the completion criteria set by the end of 2022 and this OMPRP will be updated accordingly.

Once revegetation activities within a Re-establishment Area have been completed, permanent monitoring sites will be established in the area, and then included in the ecological monitoring programme (if a monitoring site has not already been established in that area). The Re-establishment Areas would be monitored annually for the first five years after planting, at which point a review would be undertaken to confirm if monitoring of the area can be included within the biennial ecological monitoring programme for Box Gum Grassy woodland areas.

4.5.7 Re-establishment Plan Performance Measures

As described in Section 4.5.1, the objectives of this RP are to provide commitments and activities that will be undertaken to:

- deliver the increase in the spatial extent and improvement in the condition of existing remnants by at least 677 ha within the BMAs; and
- establish self-sustaining functional remnant vegetation communities, with the capacity to provide habitat for the species identified in Condition 2 of EPBC Approval 2011/5795, i.e. the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat.

Performance measures have been developed to reflect these objectives and are provided in Table 18.

Table 18
Re-establishment Plan Performance Measures

Re-establishment Plan Objective	Performance Measure
To increase the spatial extent and improvement in the condition of existing remnants by at least 677 ha within the BMAs.	The spatial extent and condition of existing remnants is increased by at least 677 ha within the timeframe specified in Condition 12 of EPBC Approval 2011/5795.
Establish self-sustaining functional remnant vegetation communities, with the capacity to provide habitat for the species identified in Condition 2 of EPBC Approval 2011/5795, i.e. the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat.	1. By October 2035[1] Re-establishment Areas meet the completion criteria for a self-sustaining functional remnant vegetation community. 2. By October 2035[1] Re-establishment Areas provide habitat for the species identified in Condition 2 of EPBC Approval 2011/5795, are established. 3. Consecutive annual ecological monitoring programme results indicate the Re-establishment Areas meet, or are on a trajectory towards meeting, the completion criteria for a self-sustaining functional vegetation community and demonstrate, or are on a trajectory towards demonstrating, a capacity to provide habitat for the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat (as defined in Section 4.5.6).

1. Or alternate date if the "expiry date of approval" (EPBC Approval 2011/5795) is extended by the Minister administering the EPBC Act.

4.5.8 Risks to Revegetation Success and Corrective Measures

Table 19 outlines the potential risks to the success of the Re-establishment Areas and a description of corrective measures that would be used to mitigate these risks.

A Risk Management Matrix is also included in Section 6 of this OMPRP which identifies the key risks to implementation of the OMPRP, and provides corrective actions that address the identified risk. The Risk Management Matrix also identifies the key responsible person and the components of the OMPRP monitoring programme aimed to observe the presence or impacts of the risk.

Table 19
Risks to Revegetation Success and Corrective Measures

Risk Aspect	Risk	Corrective Measure
Bushfire	Bushfire has caused mortality and/or substantial damage to Re-establishment Areas.	• Re-plant/re-seed affected area with those species that do not naturally regenerate over a 2 year period post-fire (Pickup *et.al.*, 2012). • Review the adequacy of the fire management practices (Section 4.8) implemented prior to the bushfire.
Drought	Monitoring results indicate that ongoing drought conditions are likely affecting revegetation performance, but results continue to be trending towards completion criteria, yet on a slower trajectory.	• Maintain contingency supplies of seed. • Review capability of revegetation area to improve trajectory without intervention. • Consider requirement for additional tubestock planting or seeding or other management actions including whether watering is required. Assess potential water source/supply options and trials.
	Monitoring results indicates widespread revegetation failure as a result of drought conditions.	• Maintain contingency supplies of seed. • Engage suitably qualified person to inspect drought affected rehabilitation area and recommend appropriate management actions including whether re-planting/ re-seeding feasible option considering drought conditions.
Over grazing	Stock over grazing preventing natural regeneration or is causing damage to Re-establishment Areas.	• Reduce or remove stock temporarily, and review and modify strategic grazing regime including a review stocking rates.
Storms/high-rainfall events	Storms or high rainfall event causing erosion or flooding of Re-establishment Areas causing mortality in revegetation.	• Review Re-establishment Areas drainage and confirm requirement for measures to improve drainage. • Monitor Re-establishment Areas following storm or high rainfall event and replant/reseed as necessary. • Assess Re-establishment Areas prior to planting and design/locate plantings with consideration to drainage.
Incompatible soil properties	Chemical, physical and biological properties of soil incompatible with establishing Box Gum Grassy Woodland.	• Engage suitably qualified person to determine whether with time Box Gum Grassy Woodlands would be likely to develop or recommend appropriate management actions including whether re-planting/ re-seeding the area with a different vegetation community would be a more viable long-term option.
Pests	Overabundance of native (macropods) and/or non-native (rabbits, hares, deer etc) herbivores causing mortality or substantial reduction of trees and forbs in Re-establishment Areas.	• Implement additional pest control practices appropriate to the pest threat to bring threat under control. • Review adequacy of current pest control practices (Section 4.3) to confirm if more frequent pest control campaigns or different pest control methods are necessary.
	Insect attacks (e.g. locusts and beetles) leading to failure of Re-establishment Areas.	• Review appropriate control methods with Hunter LLS and North West and other neighbouring landholders and relevant regulatory agencies, and implement agreed control methods. • Avoid planting during insect prone periods where possible. • Use local provenance seed that are suited to localised insect predation (where practical).

Table 19 (Continued)
Risks to Revegetation Success and Corrective Measures

Risk Aspect	Risk	Corrective Measure
Weeds	New weeds brought in or new weed infestations created by unclean machinery and plant.	• Review adequacy of weed hygiene protocols for machinery and plant accessing Re-establishment Areas. Implement additional controls if Review indicates current practices are inadequate.
	Exotic weeds dominating Re-establishment Areas causing non-compliance with completion criteria.	• Undertake weed control as required, including the following as relevant: – Physical removal. – Herbicide application. – Removal of grazing pressure. – Scalping.
	Seed used in direct seeding contaminated with weeds.	• Review source of seed, and exclude supply until it is demonstrated that seed is weed free. • Review requirement for alternate seed suppliers. • Confirm that equipment used for seed collection was inspected to confirm weed seed free. • Confirm seed collections have occurred from relatively weed free paddocks, where possible.
Inadequate training/competency	Tubestock planting and direct seeding failure due to poor training or incompetency.	• Develop a training package for revegetation activities, including visual aids and in-field practical demonstrations to facilitate consistent execution of revegetation activities year after year. • Ensure site preparation, tubestock/seed procurement and planting/seeding are performed by trained, competent persons.
Re-establishment Areas completion criteria	Consecutive annual ecological monitoring programme results indicate the Re-establishment Areas are not on a trajectory towards meeting the completion criteria for a self-sustaining functional vegetation community and demonstrate a capacity to provide habitat for the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat.	• Engage suitably qualified ecologist/specialist to determine appropriate contingency measures. Measures may include thinning, or supplementary planting of key vegetation species. • Review Conservation Management Strategies (Section 4) that have been implemented in the affected area to determine appropriate contingency measures (e.g. review OMPRP land management practices [such as grazing regime and use of ecological sensitive burns including cultural burning practices and weed and pest control practices]).

Table 19 (Continued)
Risks to Revegetation Success and Corrective Measures

Risk Aspect	Risk	Corrective Measure
Inadequate planning	Insufficient provision of financial, human and equipment resources leading to failure to meet completion criteria, including increased maintenance costs and timeframe.	• Undertaken review of budget and resourcing allocation and allocate sufficient and available resources to cover requirements to implement RP objectives.
Uncertainty	Failure to achieve an increase in spatial extent and improvement in the condition of existing remnants by at least 677 ha within the BMAs within 5 years of the commencement of construction.	• Request a variation to the timing of Condition 12 of EPBC Approval 2011/5795. • Undertake a review of performance of Conservation Management Strategies to determine measures which require improvement or more frequent or reduced implementation.
	Failure to establish self-sustaining functional remnant vegetation communities, with the capacity to provide habitat for the species identified in Condition 2 of EPBC Approval 2011/5795, i.e. the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat.	• Engage suitably qualified person to review OMPRP measures and provide recommendations for achieving self-sustaining functional remnant vegetation communities, with the capacity to provide habitat for the species identified in Condition 2 of EPBC Approval 2011/5795, i.e. the Swift Parrot, Regent Honeyeater, Spotted-tail Quoll and Corben's Long-eared Bat. Implement recommended measures.

4.5.9 Re-establishment Plan Reporting and Responsibilities

Details of the reporting that will be undertaken relevant to the OMPRP, and the MACH Energy representatives responsible for implementation of this plan is provided in Section 1.2.4.

4.6 INFRASTRUCTURE IMPROVEMENT

Construction of new or maintenance of existing infrastructure will be required to implement strategic grazing and habitat protection zones and to provide safe access for Leaseholders, consultants, contractors and MACH Energy personnel. Construction activities may cause localised site disturbance. To protect biodiversity and cultural heritage values a ground disturbance permit checklist will be adopted. This will ensure compliance with all legal and environmental protection measures, such as the *Local Land Services Act 2013* and *Biodiversity Conservation Act 2016*.

4.6.1 Management Objective

To maintain and construct infrastructure that support the implementation of the OMPRP, with minimal impact on biodiversity values and compliance with all regulatory requirements and erosion control measures.

4.6.2 Method

The following are the permissible actions and guidelines for the construction or maintenance of infrastructure, such as access/fire trails, fences, stockyards, water troughs and pipes:

- Vegetation clearing is permissible, as per the *Local Land Services Act 2013* for central regions.
- Constructed fences will be stockproof and native fauna friendly (no barb wire is to be used for the top two wire strands). This excludes boundaries between Offset areas and third parties. Five stranded barbed wire fencing is permitted where new fencing is installed at the boundary between offset areas and adjoining land).
- Fallen timber and any other obstructions can be removed to maintain access.
- Standing timber that poses an unacceptable safety risk can be felled.
- All works will be undertaken in a manner that minimises disturbance to soil and hydrological characteristics and avoids erosion.
- Old fences will be removed and unwanted tracks closed within the Offset Area.
- Site disturbance may be required to facilitate revegetation activities.

4.6.3 Implementation and Reporting

The MACH Energy Ground Disturbance Permit (GDP) checklist will be adopted to ensure compliance with all legal and environmental protection measures prior to any significant disturbance.

A description of the activity is to be provided to MACH Energy and work cannot commence until checklist is completed and approved.

The GDP checklist considers the impact of the disturbance on:

- cultural heritage – search relevant sources to determine their presence;
- land ownership and tenement – ensure action is located on land owned or managed by MACH Energy;
- environment – search relevant sources to identify presence of listed ecological communities, flora or fauna;
- regulatory approval – legal authority for the action;
- rehabilitation – requirement for rehabilitation; and
- water – potential water impacts and mitigation.

All infrastructure improvements will be recorded to MACH Energy via the quarterly audits undertaken by the Agriculture Auditor. All relevant information will be stored and revised geographic information layers will be accessed by the online Biodiversity Offset Portal.

Routine inspections and maintenance of infrastructure (access/fire tracks, fence lines and gates) will be undertaken to ensure they are to standard and fit for purpose.

4.7 SUSTAINABLE AGRICULTURE

Parts of the Agriculture Areas located on the Black Rock and Gum Ridge properties have historically been cropped on an annual basis to grow pasture crops, mainly oats.

The existing cropping areas on the Black Rock and Gum Ridge properties are highly modified due to their long history of cropping and have a limited capacity to naturally regenerate. Consequently, if not managed effectively, these areas and the surrounding buffer zones are likely to be colonised by weeds, which poses a risk of weed infestation to the surrounding Box Gum Grassy Woodland as well as other land management issues. Accordingly, in accordance with EPBC Approval Condition 5, a minimum buffer zone of 150 m will be established surrounding any cropping activity within the BMAs.

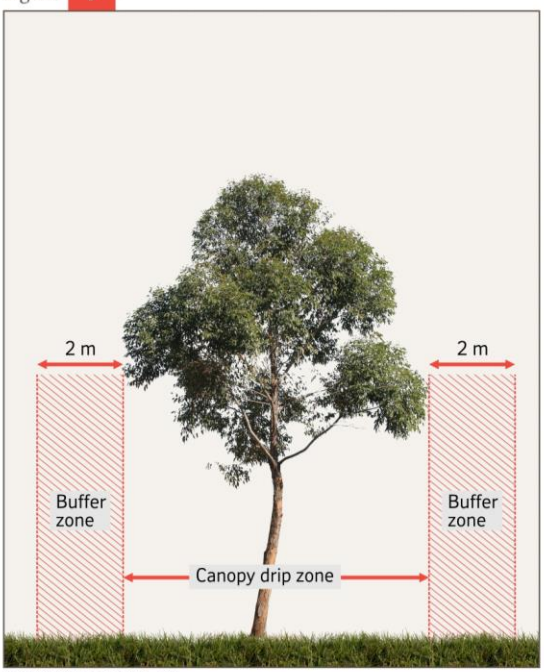
Cropping areas will be actively managed and select paddocks within the Offset areas will be converted into perennial pastures (Section 4.7.2) with the following conservation outcomes:

- maintenance of groundcover all year to reduce the risk of soil erosion and salinity;
- weed control to reduce the risk of infestation to surrounding Box Gum Grassy Woodland;
- increased diversity and resilience of ground cover to better manage soil health (increased soil organic matter) and reduce the impacts of drought; and
- creation of additional perennial pasture to support a grazing herd that will be used for strategic grazing (perennial pastures are more sustainable and productive than annual pastures because of their deeper root system and year-round ground cover [Industry and Investment NSW, 2009]).

Adequate buffer zones will be established and maintained to protect Offset Areas and MNES from activities undertaken in Agricultural areas (LMU4). Buffer zones of 25 m in width will apply along all internal Offset Area boundaries and any patch of remnant vegetation within LMU4. To ensure individual trees of all sizes are protected in the cropping areas, a 2 m buffer zone radiating out from the canopy drip zone will apply (Figure 9). This will meet or exceed the 10 m buffer required under Approval Condition 6.

Individual Tree Buffer Zone
Offset Management Plan

Figure 9



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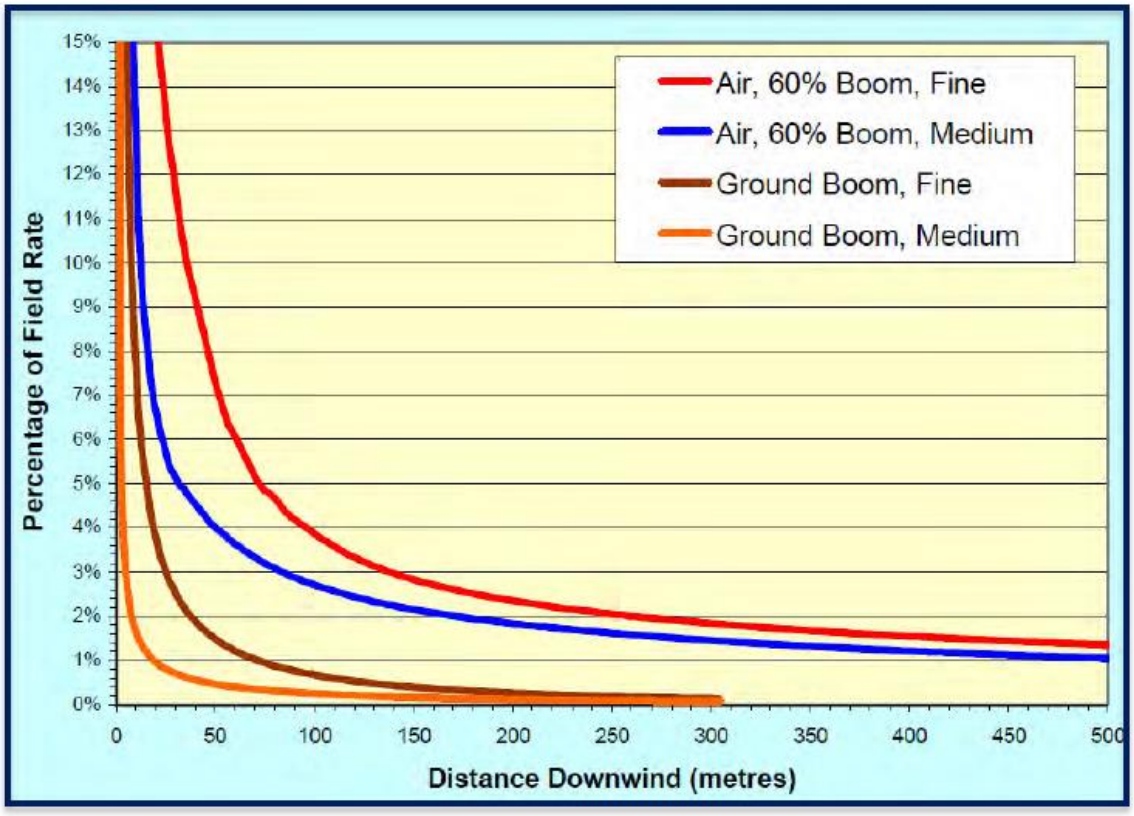
Buffer zones have been developed in the context of the recommendations outlined the *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan* (DECCW, 2011). This plan does not exclude cropping activities from neighbouring areas, but states that adequate buffers should be established. The size of adequate buffers is not defined; however, the Australian Pesticides and Veterinary Medicines Authority (APVMA) operating principles in relation to spray drift risk (APVMA 2008) provide a risk assessment and modelling to guide the width of appropriate buffer zones.

Figure 10 provides the examples of drift profiles from different application methods and illustrates that the deposit of active ingredient falls off rapidly downwind from the application, and more rapidly for medium droplet size. For example, for the ground boom with a medium droplet size (orange line), the curve indicates that less than 1% of the intended field rate is deposited at a distance of 25 m downwind from the downwind end of the application area. Therefore, the use of a 25 m buffer and the management controls detailed in Section 4.2 to monitor climatic conditions, operator and equipment is considered adequate protection for MNES and the Offset Areas, and reduce the percentage of field rate even further.

In addition, inspection of these areas has shown that MNES are presently unaffected by neighbouring cropping activity that have been undertake for many years with no buffer zone protection.

Figure 10 Example of Spray Drift Deposit Profiles from Computer Modelling (APVMA 2008)



The *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan* (DECCW, 2011) also supports the use of strategic grazing as management tool to enhance condition. Table 20 provides excerpts from the recovery plan confirming the use of strategic grazing and adequate buffer zones as a best practice management regime.

Table 20
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan (DECCW, 2011) Best Management Practices

Current Best Practice Site Management Practices for the Continued Existence of Box-Gum Grassy Woodland	
Implement strategic grazing	Ensure remnant areas are rested at appropriate times, for example when perennial native ground cover species are flowering and seeding. Limit grazing during drought periods. Grazing levels should not be increased above historical levels. Where a site has never before been grazed by livestock, an alternative (e.g. fire, no intervention) should be used for management. Maintain a minimum of 80% ground cover at all times and biomass at an appropriate level to the region and season. Monitor outcomes to determine effectiveness and adapt management efforts.
Ensure adequate buffers are retained	Protect areas of Box-Gum Grassy Woodland from adjacent land use (e.g. urban and agricultural development) that may potentially impact on its integrity.

4.7.1 Management Objective

Integrate agricultural and conservation management to support the rural community and deliver conservation outcomes by maintaining groundcover and increasing diversity of grass species.

4.7.2 Method

Areas to be actively converted into perennial pastures, the surrounding 25 m buffer zones and individual tree buffers are shown in Figures 11 (a) to (d).

Conversion of these areas will be a transitional process to ensure success and provide adequate periods of exclusion. These areas will be prepared and sown with a seed mix to establish a perennial native pasture. Table 21 lists the areas that have been or are scheduled to be converted to perennial pasture and the proposed timeframe.

Table 21
Areas and Timeframe for Conversion to Perennial Pastures

BMA	Property	Compartment ID	Conversion Area (Ha)	2015	2016	2017	2018[3]	2019[4]	2020[5]	2021
Merriwa East	Gumridge and Black Rock	GR2(4)[1]	148	54	54	40				
		BR3(4)	69		69					69
		BR4(4)	46		46					49
		BR6(4)	38		38					
		BR7(4)	219		101					
		BR15(4)	110			68[2]			68	
		BR16(4)	117	117						
Total			**746**	**171**	**207**	**210**	**0**	**0**	**68**	**115**

1 GR2(4) is subject to the native pasture regeneration trial which is monitored twice yearly in Autumn and Spring.

2 Due to drought conditions, the 68 ha sowed at BR15(4) failed.

3 No sowing was undertaken during 2018 due to drought conditions.

4 No sowing was undertaken during 2019 due to ongoing drought conditions. BR15(4) was cultivated/prepared for 2020 sowing.

5 BR3(4) and BR4(4) to be cultivated/prepared ready for 2021 sowing.

Annual cropping activities may occur prior to the establishment of the perennial pastures to control weeds and ensure the success of the establishment of the perennial pastures. The 25 m and individual tree buffer zones will apply to any annual cropping activities to protect the Offset Areas and MNES. In addition to:

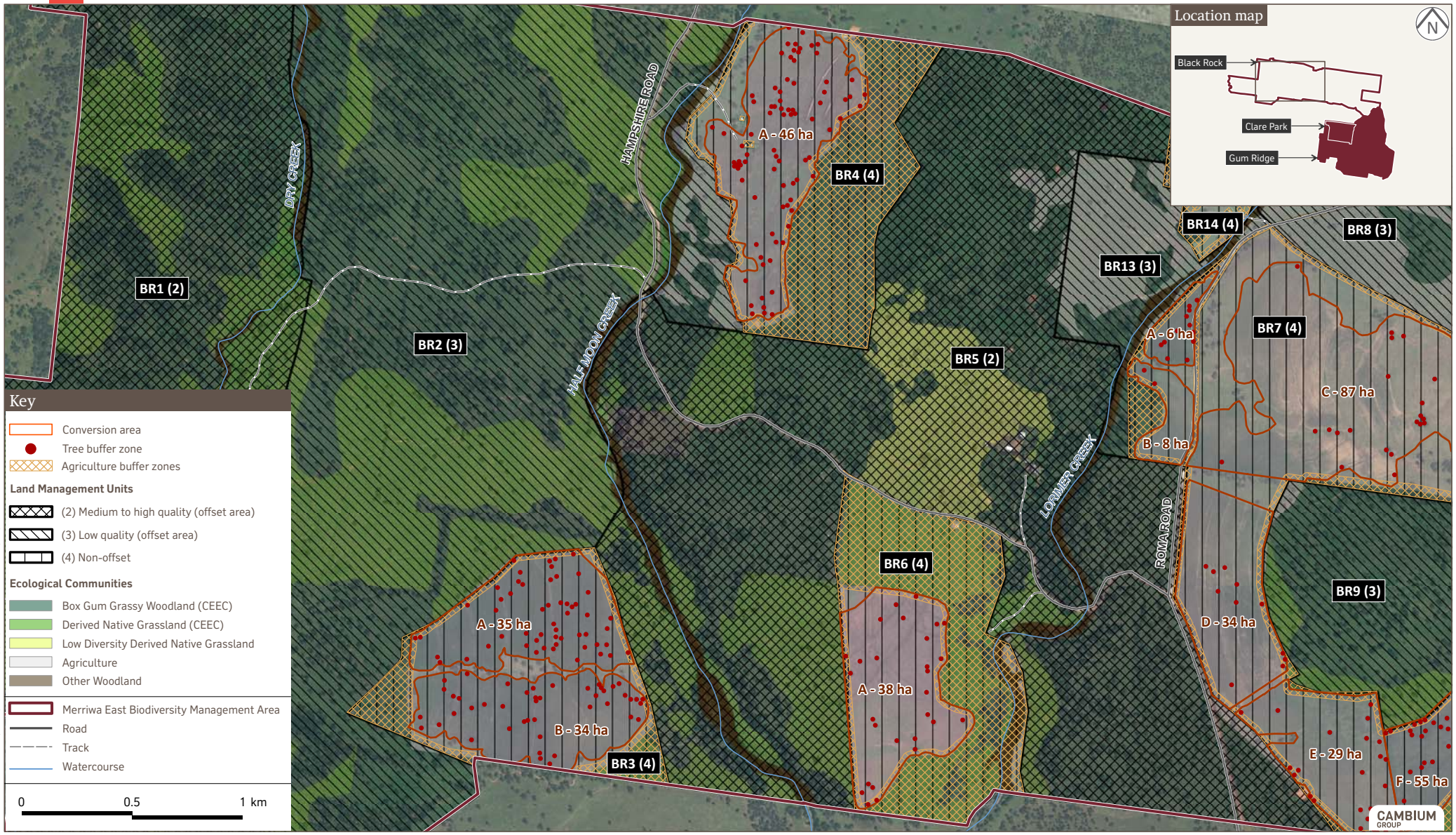
- Application of herbicide will adhere to the methods outlined Section 4.2, spraying of weeds within the buffer zones will permitted only by hand application;
- Minimum tillage practices will be used such as direct drilling of seed; and
- Leaseholder is required to seek approval prior to any cropping or perennial pasture establishment.

MACHEnergy

Black Rock (West) Areas for Conversion to Perennial Pasture and Tree Buffer Zones

Offset Management Plan

Figure 11a

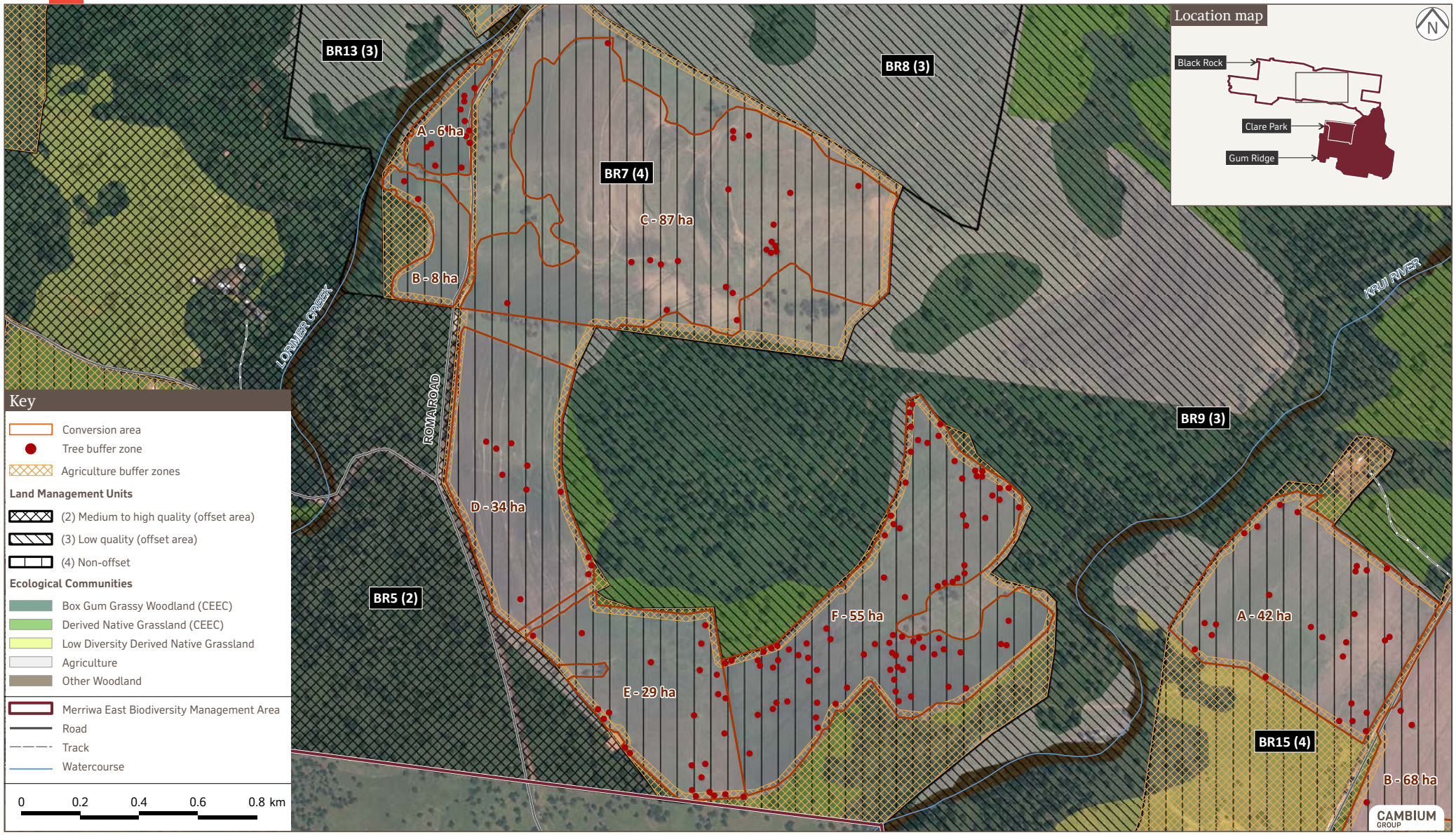


MACHEnergy

Black Rock (Centre) Areas for Conversion to Perennial Pasture and Tree Buffer Zones

Offset Management Plan

Figure 11b

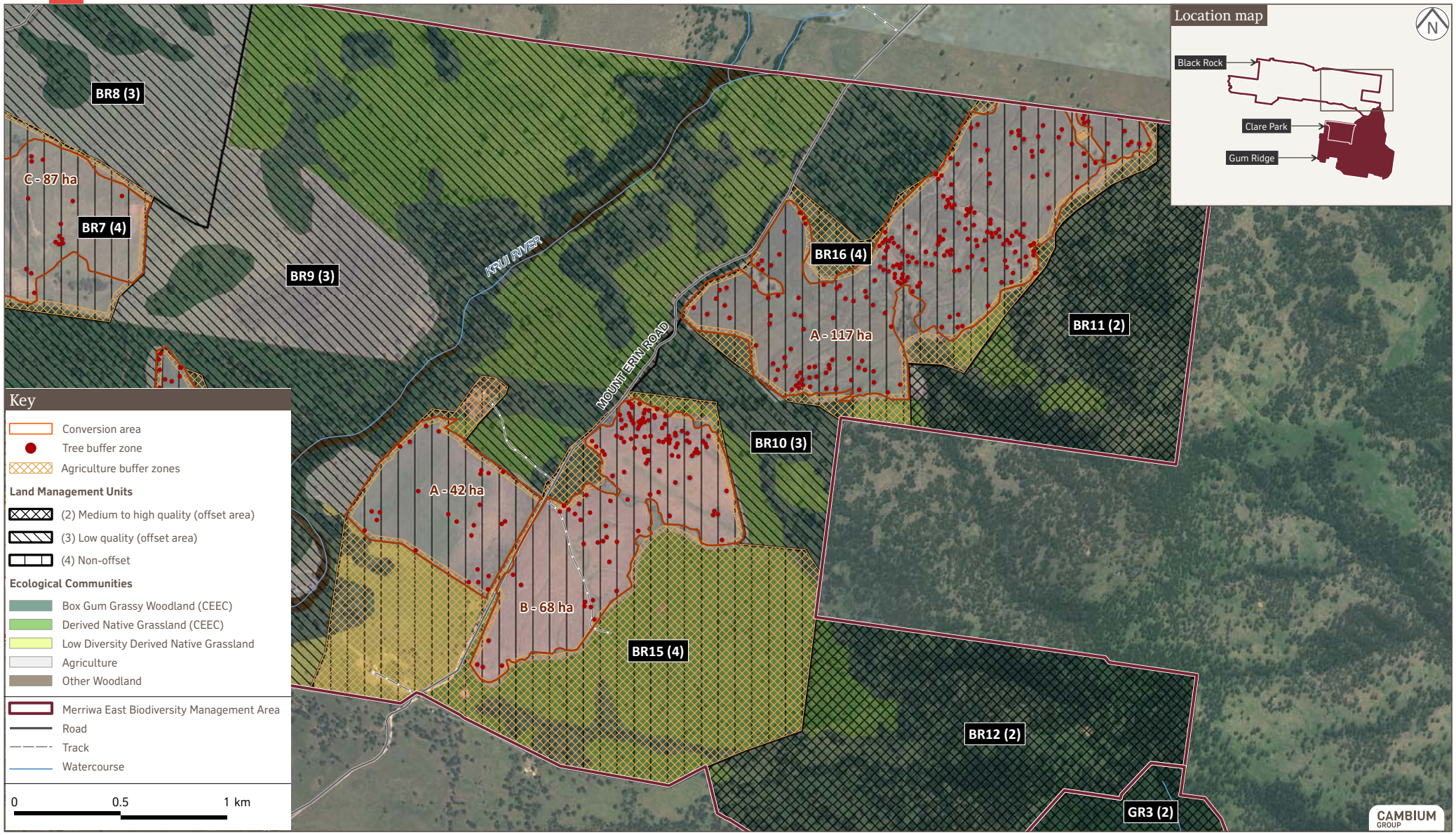


MACHEnergy

Black Rock (East) Areas for Conversion to Perennial Pasture and Tree Buffer Zones

Offset Management Plan

Figure 11c

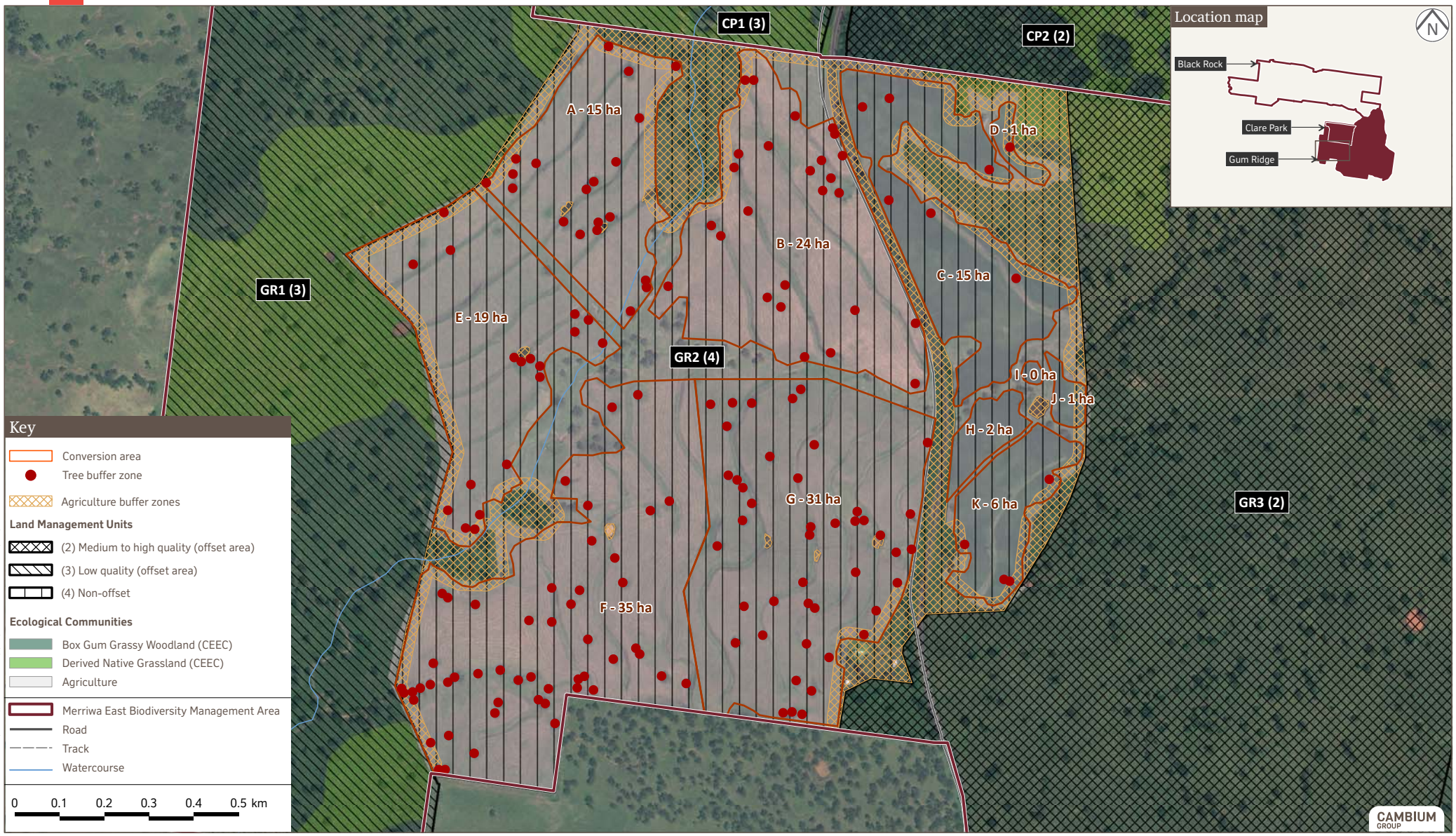


MACHEnergy

Gum Ridge Areas for Conversion to Perennial Pasture and Tree Buffer Zones

Offset Management Plan

Figure 11d



The following guidelines are to be followed as best practice in the establishment of perennial pastures (Industry and Investment NSW, 2009)

- Spray fallow using a non-selective herbicide in spring the year before sowing to kill annual grasses before they set seed (early October to early November).
- Keep the paddock well grazed through summer and autumn or use an herbicide to control summer weeds.
- Wait for good autumn rainfall (50-100 mm) and allow time for annuals to germinate. Once annuals have germinated, spray again with non-selective herbicide.
- Wait for another rainfall event or up to 7 – 10 days and direct drill perennial pasture species, use the suitable sowing depth for the seed being sown.
- After sowing, check the paddock regularly for weed and pests.
- Avoid grazing until the newly sown pasture has set seed in the first year.
- Graze the pasture in late summer, leaving at least 1500 kg DM/ha and then exclude grazing through autumn.
- Commence strategic grazing in winter.

Establishment of perennial pastures is dependent upon suitable climatic conditions and availability of suitable seed.

To achieve and maintain high to good quality perennial pasture the target pasture composition is as follows as well as suggest seed mix:

- Perennial grass composition > 50% (e.g. Wallaby grass (native) 40% and Phalaris 20%);
- Legumes 20 – 30% (e.g. Lucerne 20% and Sub-clover 10%); and
- Annual grasses <20% (e.g. Snail medic 10%).

Native Pasture Regeneration Trial

The Gum Ridge paddock GR2(4) of 148 ha is subject to a native pasture regeneration trial that is monitored twice yearly in autumn and spring by DnA Environmental. The trial involves monitoring of groundcover diversity and abundance and vegetation composition (including % cover of exotic and perennial annual grass, broadleaf grass, perennial grass, and other perennial species) at nine sites. Monitoring reports are provided on the Mt Pleasant Biodiversity Offset Portal.

DnA Environmental (2020) provides: *The monitoring data typically demonstrates that in GR2(4) the perennial pasture system has been naturally regenerating in the absence of significant management intervention* (i.e. sowing of perennial pastures)*, despite the drought conditions. Since spring 2018 the results of the pasture assessments have demonstrated a significant increase in total ground cover and cover provided by desirable perennial pasture species after exclusion from grazing in 2018*. DnA Environmental (2020) also identified that sowing and herbicide application and slashing may cause undue harm and degradation of the recovering pasture.

MACH Energy will continue to implement the native pasture regeneration trial on the Gum Ridge property to inform management practices on other historically cropped and native pasture conversion areas on the BMAs.

4.7.3 Implementation and Reporting

All cropping activities will be recorded to MACH Energy via the quarterly audits undertaken by the agriculture auditor. All relevant information will be stored and accessed by the online Biodiversity Offsets Portal.

4.8 FIRE MANAGEMENT

Bushfire prevention is required under the *Rural Fires Act 1997*. The absence of fire and the reduction of livestock grazing will lead to a build-up of fire fuel and risk of high intensity bushfire. Both MACH Energy, as the owner, and the Leaseholders, as the occupiers of the land, are required to take practicable steps to prevent the occurrence of bush fires on the land and minimise the spread of bushfire. MACH Energy, with assistance from the Liverpool Range Rural Fire Service, has prepared a Mount Pleasant Operation Biodiversity Offset Bushfire Management Plan which identifies fire risks, control measures and communication procedures.

The quick identification of a threatening bushfire, notification of the Rural Fire Service and suppression is the primary goal.

All Leaseholders will be required to have at least one occupier of the properties as a member of the Rural Fire Service. MACH Energy will provide maps and contact details of the properties to the Rural Fire Service.

4.8.1 Management Objective

To protect lives, biodiversity values and infrastructure assets from the impacts of bushfires.

4.8.2 Methods

Key control measures to be implemented include:

- documentation of access and water supply points for suppression activities;
- use of grazing to reduce fuel build-up along potential ignition sources, such as public roads, prior to the fire season;
- use of cool burns, or other indigenous method, (with any required approvals and/or permits from Rural Fire Service) to reduce fuel build-up to protect biodiversity and nested conservation values;
- establishment of asset protection zones around priority infrastructure (i.e. dwellings and associated infrastructure);
- investment in water and other fire suppression assets; and
- communication of Mount Pleasant Operation Biodiversity Offset Bushfire Management Plan and response procedures with key stakeholders, including Leaseholders, neighbours, consultants, contractors and employees.

In accordance with the Rural Fire Service (2006) *Planning for Bush Fire Protection* guideline, the Mount Pleasant Operation Biodiversity Offset Bushfire Management Plan involves establishment of asset protection zones around dwellings and associated infrastructure on the BMA properties. Within asset protection zones, strategic grazing and/or mowing is used to reduce fuel loads.

Any fuel hazard reduction burns will be planned in accordance with the *Bush Fire Environmental Assessment Code for New South Wales* (Rural Fire Service, February 2006) and the guidelines contained in the *Threatened Species Hazard Reduction Lists for the Bush Fire Environmental Assessment Code*.

Current recommendations under the Code are:

- in woodland vegetation, fire should not occur within 5 years of a previous fire and consideration should be given to burning within 40 years of any previous fire; and
- in grassland vegetation derived from the woodland vegetation, the recommended fire intervals are the same as woodland vegetation.

Table 22 provides details of an appropriate burning regime as described in the *White Box - Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan* (DECCW, 2011).

Table 22
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan (DECCW, 2011) Best Management Practices

Current Best Practice Site Management Practices for the Continued Existence of Box-Gum Grassy Woodland	
Implement appropriate burning regimes	The minimum fire interval suggested for Box-Gum Grassy Woodlands is five years, with a maximum interval of 40 years. Fire regimes implemented should have regard to the floristic composition and condition of the remnant. For example, remnants dominated by Snow Grass and Kangaroo Grass were found to regenerate well with autumn burning cycles approximately every 5-8 years, where this had historically occurred (Prober et al., 2008). Such high frequency burning cycles may negatively impact other native species, however, and further research is required before burning regimes can be explicitly determined. Any burning should be applied to remnants in mosaics (i.e. burning small areas at staggered intervals) to allow survival of soil and ground fauna (including invertebrates, amphibians and reptiles) and promote diversity in the states of the ecological community. Sites where burning is practiced should retain unburnt areas, to provide refuges for species of fauna and flora that may be intolerant of fire. Timing of burns must be considered in relation to the flowering and seeding of native and exotic species. Where possible burns should be carried out after natives have seeded but before weeds flower and seed. Be aware that some weed species (e.g. Coolatai Grass) increase with burning.

4.8.3 Implementation and Reporting

Annual meetings will be held between Leaseholders, Rural Fire Service and MACH Energy to review the Mount Pleasant Operation Biodiversity Offset Bushfire Management Plan and prepare the annual actions list to prepare for the proceeding fire season.

Any fire incidents will be recorded via the quarterly Agriculture Audit reports and relevant information captured on the Biodiversity Offsets Portal. All relevant fire protection and mapping information will be stored and accessed by the online Biodiversity Offsets Portal.

4.9 CULTURAL HERITAGE

Any cultural heritage sites or values identified will be recorded and managed to ensure their protection. Cultural heritage sites will be managed in accordance with the NSW OEH Due Diligence Code of Practice for the Protection of Aboriginal Objects, to guide the protection of and interaction with the sites across the BMAs. The location and information relating to cultural heritage sites will be stored and accessed from the online Biodiversity Offsets Portal.

5 MONITORING PROGRAMME

This section details programmes to measure short, medium and long term impacts of the OMPRP conservation management strategies. These assessments will provide quantitative data to guide adaptive management, detect trends in the condition of biodiversity values and attainment and maintenance of key performance indicators.

The monitoring programme (Table 23) has been designed to assess changes in the vegetation and habitats of the BMAs against the key performance indicators outlined in Table 8, Table 9, and Table 10.

The monitoring programme comprises three components to capture environmental change at different scales and within different components of the landscape/ecosystems, including:

- Landscape monitoring: to assess vegetation changes and habitat connectivity at the landscape scale in the long term;
- Ecological monitoring: to provide a general indication of changes in biodiversity (indicators of ecosystem condition) and to detect medium and long term changes in Box Gum Grassy Woodland and threatened fauna listed under the EPBC Act (MNES); and
- Strategic grazing monitoring: to inform short term management activities consistent with the adaptive management approach to strategic grazing.

The timing and frequency of monitoring activities will vary depending on the ecosystem/species being targeted. A summary of the monitoring schedule is provided in Table 23.

To enhance the understanding and knowledge of all key stakeholders in the management of the BMAs, Leaseholders and MACH Energy representatives, where feasible, will accompany the Agriculture and/or Biodiversity Auditors during the field based components of this monitoring programme.

5.1 LANDSCAPE MONITORING

Aerial photographic imagery analysis and rapid condition assessments will be used to monitor medium and long-term changes in the distribution and condition of the ecological communities. These techniques will be used to evaluate attainment of the following desired outcomes:

- under the proposed conservation management strategies, there will be an increase in the proportion of the BMAs mapped and categorised as LMU1 and LMU2, indicating an improvement in ecological condition; and
- under the proposed conservation management strategies, there will be an increase in the area of the BMAs mapped as Box Gum Grassy Woodlands, indicating a transition from Low Diversity Derived Native Grassland and Derived Native Grassland to Box Gum Grassy Woodlands.

Aerial photographic imagery analysis and rapid condition assessments will be undertaken in 2020. The analysis of tree canopy cover and condition assessments will be used to map changes in the distribution and condition of Box Gum Grassy Woodlands and other woodland habitats and connectivity of vegetation remnants. Appendix C provides an overview of the rapid condition assessment technique. An increase in the area of tree cover at the expense of grassland, and an improvement in landscape connectivity for remnants of Box Gum Grassy Woodlands and other woodland habitats will also be indicative of successful management of the BMAs to attain and maintain the key performance indicators.

Table 23
Monitoring Schedule

Monitoring Component	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Landscape Monitoring*																
Aerial photo analysis	Nov							Nov							Nov	
Rapid Condition Assessment	Sept – Nov							Sept – Nov							Sept – Nov	
Ecological Monitoring*																
Indicators of Ecosystem Condition	Sept – Nov					Sept – Nov					Sept – Nov					Sept – Nov
MNES – Box Gum Grassy Woodlands		Sept – Nov		Sept – Nov #		Sept – Nov		Sept – Nov		Sept – Nov		Sept – Nov		Sept – Nov		Sept – Nov
MNES – Birds	July – Oct		July – Oct		July – Oct		July – Oct		July – Oct		July – Oct		July – Oct		July – Oct	
MNES – Mammals	July – Oct		July – Oct		July – Oct		July – Oct		July – Oct		July – Oct		July – Oct		July – Oct	
Strategic Grazing Monitoring																
Agricultural Audit	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly	Qtr'ly
Informal Paddock Assessments	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly

Soil analysis (as described in Section 5.2.2) to occur as part of this monitoring round.

* Monitoring timing may be subject to variation based on climatic/seasonal conditions, in consultation with a suitably qualified person.

5.2 ECOLOGICAL MONITORING

Ecological surveys will be conducted to assess changes in the general ecological condition of the BMAs and monitor changes in Box Gum Grassy Woodlands, Derived Native Grasslands and threatened fauna listed under the EPBC Act and their habitats. Preliminary ecological surveys were undertaken in October and November of 2013 and continued through to winter 2014. These surveys provide the baseline condition within LMUs 1-3, against which subsequent years of monitoring data can be compared.

High quality Box Gum Grassy Woodlands and other woodland (LMU2) on the BMAs will represent the target (reference) condition for vegetation and habitat restoration. These areas of high quality vegetation occur across all three BMAs and represent realistic ecological targets for these properties.

Ecological surveys will test predictions about the expected change in vegetation/habitat condition resulting from implementation of the proposed conservation management strategies and investigate the presence and habitat usage of fauna MNES. Surveys have been designed to be repeatable and allow statistical analysis of the data according to testable predictions (hypotheses). Additional data will be collected to assist in interpreting ecological changes including incidental observations and photo reference points.

All plot and survey locations are geographically referenced using a GPS and are available on the Biodiversity Offset Portal.

5.2.1 Indicators of Ecosystem Condition

Birds and reptiles are widespread and typically abundant taxa whose populations are easily surveyed. Although they are relatively mobile taxa, many species can show specialisation in their habitat requirements. Patterns in the distribution and abundance of bird and reptile assemblages can be indicative of biodiversity as a whole and of environmental change. Accordingly, bird and reptile assemblages will be monitored as indicators of general ecosystem condition. In addition, details of general fauna habitat features will also be recorded at each fauna monitoring site. Patterns in bird and reptile populations and habitat will be assessed to test the predication that:

- as grassland (LMU2 and LMU3) and low-quality woodland (LMU3) are restored, bird and reptile assemblages and their habitats will become more similar to assemblages/habitats in the medium-high quality woodland habitats (LMU2).

Thirty-two bird and reptile monitoring plots will be established across the BMAs. Their locations will be strategically and practically chosen to sample across accessible grassland and woodland communities. The plots will take into account spatial variability across the BMAs and different LMU condition categories (LMUs 1-3).

Four monitoring sites will be located in the very-high quality vegetation (LMU1) in the Namoi BMA. The remaining 28 monitoring sites will be spread across all three BMAs to survey grassland (14 sites) and woodland habitats (14 sites) in LMUs 2 and 3.

Baseline surveys were conducted during late spring/early summer 2013 and subsequent surveys will be conducted again in 2020, 2025, 2030 and 3035 (Table 23). Table 24 outlines the survey methods for indicators of ecosystem condition.

Table 24
Survey Methods for Indicators of Ecosystem Condition

Survey Method	Details
Birds	
Habitat area searches	Habitat area searches will be conducted in accordance with Birdlife Australia Atlas search methodology (Birdlife Australia, 2013) and EPBC Act bird survey guidelines (DEWHA, 2010). This method involves searching a set area and recording data only from within the pre-defined search zone. A two ha area will be surveyed for 20 minutes at each of the designated monitoring sites by two observers.
Incidental and opportunistic records	Incidental and opportunistic surveys will include visual observations and calls, and suitable habitat areas will also be recorded when travelling to and between monitoring sites. All opportunistic sightings and their locations will be recorded. General notes and important habitat resources such as tree hollows, flowering trees and nests will be recorded incidentally and photographed, as will any notable bird activities such as specific forage behaviour or signs of breeding activity.
Reptiles	
Active searches	Reptiles will be surveyed at the monitoring sites by undertaking diurnal and nocturnal active searches in suitable habitat (SEWPaC, 2011). Diurnal active searches will involve disturbing shrubs and tussock grasses, lifting bark, fallen logs, bush rock and scraping top soil and nocturnal searches will involve spotlighting for reptiles.
Funnel traps	Four funnel traps will be set at each monitoring location in grassland areas to capture medium to large-sized reptiles. All traps will be checked at least twice a day as they will not be shaded.
Habitat	
50x20m plot	Within a 50 x 20 m plot, the number and species of canopy trees will be recorded. The proportion of trees with hollows (minimum entrance width of 5 cm), mistletoe or flowers/fruit as well as any dead trees and the total length of fallen logs (minimum diameter 10 cm and minimum length 0.5 m) within the plot will also be recorded. Permanent photo reference points are to be established.
20x20m quadrat	Within a 20 x 20 m quadrat, the % cover of litter, rock and bare ground will be estimated.

Photo Reference Points

Photo reference points have been permanently marked within each habitat monitoring plot. Photo reference points are established at the top of the middle 50 m transect at each monitoring site. During each monitoring event, a series of photos will be taken from this point to provide a visual record of any changes in vegetation and habitat condition. Depending of the location of the monitoring site, this might include:

- changes in vegetation structure (e.g. presence/absence of canopy species, shrubs, tussock grasses);
- the presence/condition of special habitat features (e.g. rock outcrops, flowering/fruiting species); and
- changes in identified threatening processes (e.g. weed infestations, erosion).

At each photo reference point, a minimum of five photos will be taken, in the following directions:

- downslope;
- upslope;
- across the slope – left;
- across the slope – right; and
- directly down (when facing downslope).

Photo records will be stored on the Biodiversity Offsets Portal and will be displayed so that monitoring photos can be viewed against the baseline (2013) photo. This will provide an ongoing and gradual visual record of changes in vegetation and habitat as the management strategies are implemented as well as changes in existing threats and early warning of emerging threats at monitoring sites.

5.2.2 Matters of National Environmental Significance

Baseline and subsequent monitoring surveys for Box Gum Grassy Woodlands and fauna species that are MNES will be undertaken. Surveys will also help to assess the progress of management and enhancement activities of Box Gum Grassy Woodlands and habitat for MNES within the BMAs.

MNES at the Mount Pleasant Offset area listed under the EPBC Act include two birds, two mammals and an ecological community which are as follows:

- Box-Gum Grassy Woodlands;
- Regent Honeyeater (*Anthochaera phrygia*);
- Swift Parrot (*Lathamus discolour*);
- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*); and
- Corben's Long-eared Bat (*Nyctophilus corbeni*).

Box Gum Grassy Woodlands

The monitoring programme for the Box Gum Grassy Woodlands aims to assess the success of the conservation management strategies in improving the condition of the Box Gum Grassy Woodland within the BMAs. Accordingly, the monitoring programme has been designed to test the predictions that:

- low-quality Box Gum Grassy Woodlands (LMU3), low quality Derived Native Grassland (LMU3) and medium-high quality Derived Native Grassland (LMU2) will be more ecologically similar to the medium-high quality Box Gum Grassy Woodlands (LMU2).

To assess this prediction, data will be collected on community composition, vegetation structure, canopy regeneration/health and habitat features.

a. Monitoring Sites

The design of the Box Gum Grassy Woodlands monitoring programme is similar to that for indicators of ecological condition except that sites will be focused in Box Gum Grassy Woodlands vegetation (Plate 9) at the exclusion of Other Woodland habitats. Accordingly, thirty-two permanent monitoring sites have been established across the following vegetation/LMU categories:

- Very high quality Box-Gum Grassy Woodlands within LMU1 (4 sites);
- Medium – high quality Box-Gum Grassy Woodlands within LMU2 (7 sites);
- Medium – high quality Derived Native Grassland within LMU2 (7 sites);
- Low quality Box-Gum Grassy Woodlands within LMU3 (7 sites); and
- Low quality Derived Native Grassland within LMU3 (7 sites).

Plate 9: Box Gum Grassy Woodlands, Wahrane, Merriwa West BMA (Cumberland Ecology 2013)

The location of the monitoring sites were determined according to the following criteria:

- Property –where possible, one or more monitoring sites of each condition class was selected from each of the six properties to capture the range of vegetation types across the BMAs and to capture possible variation among properties due to prior management regimes;
- Field assessment – since each LMU has been categorised according to the average vegetation condition and consequently there is some variation in the actual condition across the LMU, field assessment were used to ensure the sites were established within vegetation that is consistent with the designated average condition of the LMU (i.e. a site within LMU3 will be established in low-quality vegetation). This will ensure that the link between changes in vegetation condition and management activities can be established.

b. Field Methods

Monitoring commenced in 2013 to establish baseline data, subsequent monitoring occurred in 2015, 2017 and 2019. Monitoring measurements will be undertaken between September and November, as required by EPBC Approval 2011/5795.

The field methods for data collection have been adapted from the *BioMetric 3.1 methods for assessing Site Value* (Department for Environment and Climate Change, NSW, 2011). Additional measurements have been added these methods to capture details relating to:

- species composition - to enable comparisons with the published species list for Box Gum Grassy Woodlands (DEH, 2006);
- vegetation restoration - to assess community transition relative to the State and Transition Model;
- soil analysis; and
- other requirements in accordance with the Mount Pleasant Project Approval Conditions.

Quadrat and transect surveys will be conducted to collect information on changes in vegetation community composition, structure, canopy regeneration/health and additional habitat features. A 50 m x 20 m plot is established at each monitoring site such that the plot runs downslope. A 20 m x 20 m quadrat is positioned within this larger plot and three 50 m transects will run its length (Figure 12). Where possible, four marker pegs will be used to establish a permanent plot position. GPS coordinates have been taken to ensure monitoring plots can be relocated over time.

The 50 m x 20 m plot is used to record details of the over-storey (canopy) layer including species richness, regeneration and canopy health. Specific habitat features, such as the abundance of tree hollows, flowers/fruit, mistletoe and fallen logs will also be recorded at this scale.

The 20 m x 20 m quadrat is used to record details of the mid-storey and ground stratum species diversity and abundance. This includes details of the composition and % cover of native/exotic species, various plant groups (e.g. grasses, shrubs, other herbaceous plants) and the presence/absence of 'important' species listed for the Box Gum Grassy Woodlands (DEH 2006a). Additional habitat features such as rocks, litter and bare ground will also be recorded at this scale.

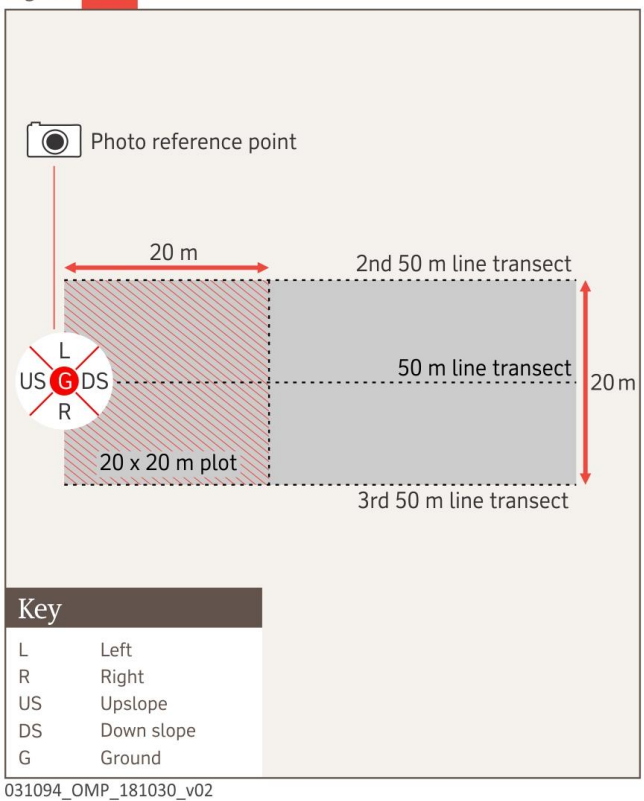
Three 50 m transects are used to assess the % foliage cover of the over-storey. These data will be collected at 10 points (i.e. at every 5m) along the length of the transects.

Further details of the field sampling methods, including a table summarise the variables (measurements) that will be recorded, their unit of measurement, the sampling unit are provided in Appendix H.

Monitoring Plot for Box Gum Grassy Woodland

Offset Management Plan

Figure 12



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c. Photo Reference Points

Photo reference points are established as described previously in Section 5.2.1. The photo records are stored on the Biodiversity Offsets Portal and will be displayed so that monitoring photos can be viewed against the baseline (2013) photo. This will provide an ongoing and gradual visual record of changes in vegetation as the management strategies are implemented as well as changes in existing threats and early warning of emerging threats at monitoring sites.

d. Soil analysis

Soil samples are collected using standard soil sampling techniques with a core sampler within the monitoring quadrat. At least 12 cores are taken at each site and bulked together. Soil analysis consists of assessing the parameters, pH, EC, Available Ca, Mg, K, ammonia, sulphur, organic matter, exchangeable Na, Ca, Mg, K, H, Al, cation exchange capacity, available and extractable phosphorus, micronutrients (Zn, Mn, Fe, Cu and B), total carbon and nitrogen. Exchangeable Sodium Percentages are calculated as a measure of sodicity or dispersion.

Results of key parameters such as pH, electrical conductivity, organic matter, phosphorous, nitrate, Cation Exchange Capacity and Exchangeable Sodium Percentages are used as primary indicators of the suitability of the soil for native vegetation within the monitoring site.

Soil sampling and analysis will be conducted at six yearly intervals. This was last undertaken during the 2017 MNES – Box Gum Grassy Woodlands monitoring. The next sampling will occur in 2023.

Birds (Regent Honeyeater and Swift Parrot)

Monitoring for the Regent Honeyeater and Swift Parrot will determine the presence of these species within the BMAs and collect information regarding their movements and habitat usage. In recognition of the difficulty in monitoring migratory bird species, Leaseholders will be given training to enhance their identification skills and increase their awareness of migratory movements and foraging preferences for these bird species.

Targeted bird searches will be conducted in accordance with Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010). This method involves searches of woodland patches with heavily flowering trees or mistletoes, particularly around water points such as dams and creek lines and especially where flocks of other blossom nomads such as lorikeets and honeyeaters have been detected. In addition to the targeted searches, call playback will be used to elicit a response from various species and GPS readings will be taken when threatened species are observed or heard calling. Where possible, photographs will be taken of threatened bird species.

A desktop study has been undertaken to more accurately predict the timing and distribution of both species in the Merriwa region and to inform monitoring surveys, ensuring surveys are targeted based on known habitat requirements and migratory movements for these species.

Swift Parrots are likely to occur in the BMA region occasionally and in very low numbers between July and October to feed on winter-flowering eucalypts (Swift Parrot Recovery Team 2000; Saunders and Heinsohn, 2008; Saunders and Tzaros, 2011; OEH, 2012).

The Regent Honeyeater is known to breed around the Upper Hunter Valley and Mudgee regions. The species has regular movements with seasonal patterns of abundance and breeding related to regional patterns in flowering of key forage species (Franklin, Menkhorst et al., 1989; Menkhorst, Schedvin et al., 1999; OEH, 2012; SEWPaC, 2012).

MNES Birds (Section 5.2.2) monitoring surveys commenced in winter/spring 2014 to collect baseline data. Subsequent monitoring occurred in 2016, 2018 and 2020 and will continue biennially until 2035 (Table 23). Birdlife Australia will be consulted prior to the commencement of these surveys to coordinate survey effort and increase the likelihood of observations, therefore the timing of survey may be adjusted.

Mammals (Spotted-tailed Quoll and Corben's Long-eared Bat)

MNES mammals (Section 5.2.2) monitoring for the Spotted-tailed Quoll and Corben's Long-eared Bat aims to determine the presence of these species within the BMAs and collect information regarding their movements and habitat usage.

Baseline surveys for these mammals commenced in winter/spring 2014 and subsequent monitoring occurred in 2016, 2018 and 2020 and will continue to occur biennially until 2035 (Table 23). Mammal monitoring sites will be located close to the bird and reptile monitoring plots and exact locations have been chosen based on the presence of suitable habitat and connectivity. Mammal surveys will use a combination of:

- Hair tubes;
- Infra-red (IR) cameras;
- Visual observation; and
- Ultrasonic call recording devices.

Infra-red cameras are a long-term passive detection technique that will maximise the likelihood of detecting the Spotted-tailed Quoll. These cameras will be strategically placed along riparian zones (typical movement corridors for the Spotted-tailed Quoll) across the Merriwa plateau BMAs. It is estimated that the batteries will need to be replaced every 5 months and data uploaded for identification and analysis. The cameras can then be re-deployed in new locations for the next round of passive surveying.

Monitoring for the Corben's Long-eared Bat will be undertaken using a combination of harp trapping and ultrasonic call recording devices set up along suitable flyways. It is noted that current technology does not allow for accurate identification of Nyctophilus genus to a species level, making positive identification of Corben's Long-eared Bat only possible through visual inspection i.e. harp trapping. However, identification of the Nyctophilus genus through ultrasonic call recording will still provide an indication if the Offset areas are possibly used as habitat by Corben's Long-eared Bat.

5.2.3 Indicators of Ecosystem Condition

To assess the success of the management activities in meeting the Key Performance Indicators, data on bird and reptile assemblages, fauna habitats and Box Gum Grassy Woodlands will be analysed against the predicted changes in these groups as a result of implementing the management strategies.

Univariate and multivariate techniques will be used to analyse and visualise patterns in the data and may include:

- Analysis of Variance (ANOVA): to test for changes in univariate data including species richness, abundance of specific habitat features, % cover vegetation structural layers;
- Distance-based permutational Analysis of Variance (Anderson, 2001; 2004) based on Bray-Curtis dissimilarities: to test for changes in multivariate data including fauna and plant community composition;
- Graphs and charts: to summarise patterns in univariate data and visualise changes in variables relative to the reference condition (medium-high quality woodland); and

- Non-metric Multidimensional scaling and SIMPER analyses: to summarise patterns in multivariate data, visualize changes in the data relative to the reference condition and assist in ecological interpretation of the results.

Analysis of the baseline data will assess difference in fauna assemblages, habitats and vegetation condition between grasslands and woodlands across the LMU condition categories. It is expected that in subsequent years, with the progressive improvement in vegetation condition of LMUs, ecological data analysis will eventually show a convergence of ecological variables to that of the medium-high quality woodland. It is expected to be a medium to long-term upward trend that will reflect the regeneration of grassland areas to woodland and the development and availability of critical fauna habitat features such as hollows, ground debris and forage resources. By demonstrating this convergence through time, it will be inferred that the proposed conservation management strategies have been successful in restoring the lower quality vegetation and fauna habitats towards the reference condition.

Any records of fauna MNES on the BMAs will be reported along with any information obtained regarding their habitat usage and movements.

Monitoring data and summary reports of monitoring outcomes will be stored on the Biodiversity Offsets Portal. Authorised users will have access to these data and reports ensuring transparency and enabling independent verification of reported monitoring outcomes.

5.3 STRATEGIC GRAZING MONITORING

To ensure that the strategic grazing regimes do not harm biodiversity values but achieve the desired management outcomes, a monitoring programme of formal quarterly audits will be implemented.

This facilitates regular on-ground monitoring of grassland condition, with a feedback to ensure grazing regimes are targeted to outcomes and responsive to changes in climatic conditions.

Assessment of the paddocks ground cover and grassland condition is required to allocate the appropriate grazing regime. This assessment will be undertaken in consultation with the Agriculture Auditor and the Leaseholder. Typically this will occur during a quarterly audit. To ensure paddocks are not over grazed between quarterly audits, simple informal paddock assessments will be undertaken by the Leaseholder and reported to MACH Energy and the Agriculture Auditor monthly. These paddock assessment reports will be provided on the Biodiversity Offsets Portal, for access by authorised stakeholders at any time.

5.3.1 Agricultural Audit

The Agriculture Auditor will prepare a quarterly audit that includes a summary of the informal monthly paddock assessments as well as additional monitoring if required.

The Agriculture Auditor will review and report on achievement of the management objectives:

- weed control - new or significant changes to priority weed infestations and control activities;
- pest animal control - damage or presence of feral pest animal and control activities;
- strategic grazing – analysis of effects of grazing regimes on natural regeneration of ecological communities, changes in seasonal growing conditions and grassland growth; and requirement for paddock resting;
- revegetation – update on planned activities;
- infrastructure improvements – requirements for new infrastructure as well as maintenance or repair of existing infrastructure (roads/fences);

- buffer zones- management operations (spraying/cropping);
- fire management - fire fuel hazard assessments and control activities; and
- tree flowering events.

Soil and water analysis will be conducted where circumstances require investigation.

The Agricultural Audit reports will be provided on the Biodiversity Offsets Portal, for access by authorised stakeholders at any time.

6 RISKS AND CONTINGENCY MEASURES

Table 25 identifies the key risks to the OMPRP, contingency measures and relevant sections in the OMPRP that addresses the risk. Table 25 identifies the key responsible person and the components of the monitoring programme aimed to observe the presence or impacts of the risk. This adaptive management approach to risk and corrective action is made effective by the monitoring programmes, communication of information via the online to relevant stakeholders and implementation of conservation management strategies.

Table 25
Risk Management Matrix

Risk	Description of Risk	Corrective Action	Reference in OMPRP	Key Responsible Person	Monitoring Program
Weed Incursion	Introduction of new weeds through stock movements.	Ensure weed hygiene methods described in Table 10 are being implemented by Leaseholder (including ensuring new livestock being introduced to a property will be quarantined for several days, so any potential weed seeds can pass through their system in a known area and be treated later). Review adequacy of weed control methods across grazed paddocks. Implement additional weed control if new weed species abundance exceeds strategic grazing regime thresholds.	Section 4.2.2, Table 12 (Weed Control Methods).	Leaseholder.	Ecological monitoring – MNES – Box Gum Grassy Woodlands (Section 5.2.2). Strategic Grazing Monitoring – Agricultural audit (Section 5.3).
	Vehicles spreading weeds.	Ensure weed hygiene methods described in Table 10 are being implemented by Leaseholder (including washing down machinery and vehicles and controlling vehicles to drive on formed tracks). Review adequacy of weed control methods that have been undertaken. Implement additional weed control measures if review indicates effort has been inadequate/not consistent with measures described in Section 4.2.2.	Section 4.2.2, Table 12 (Weed Control Methods).	Leaseholder. All visitors to the BMAs.	Strategic Grazing Monitoring – Agricultural audit (Section 5.3).
	Absence of groundcover and poor pasture condition.	Seek Agricultural Auditor's advice regarding measures to be implemented to return the area to ground cover and pasture condition required under Targeted Strategic Grazing Regime in Table 13.	Strategic Grazing (Section 4.4).	Leaseholder. Agriculture Auditor.	Strategic Grazing Monitoring – Agricultural audit (Section 5.3).
Over Grazing	Stock grazing preventing natural regeneration or over grazing.	Seek Agricultural Auditor's advice regarding measures to be implemented to promote natural regeneration objectives under Targeted Strategic Grazing Regime in Table 13. Apply the Agricultural Auditor's recommendations and conduct consecutive monthly paddock assessments (Section 5.3) on the relevant paddock(s) and review monitoring data in consultation with Agricultural Auditor.	Strategic Grazing (Section 4.3). Targeted Strategic Grazing Regimes (Table 13, Section 4.4.3).	Leaseholder. Agriculture Auditor. Biodiversity Auditor.	Ecological monitoring – MNES –Box Gum Grassy Woodlands (Section 5.2.2). Strategic Grazing Monitoring – Agricultural audit (Section 5.3).

Table 25
Risk Management Matrix

Risk	Description of Risk	Corrective Action	Reference in OMPRP	Key Responsible Person	Monitoring Program
Pest Animals	High populations of pest animals restricting native plant regeneration or growth.	Implement additional control measures to bring the populations under control. Conduct follow-up inspections after control campaigns to review effectiveness of campaign. Seek Agricultural Auditor's advice regarding measures to be implemented to re-establish native plant regeneration. Review adequacy of annual pest animal control programme and if an increase in frequency of the programme is required in the short-term.	Pest animal control (Section 4.3).	Leaseholder. Agriculture Auditor. Biodiversity Auditor.	Ecological monitoring (Section 5.2). Strategic Grazing Monitoring – Agricultural audit (Section 5.3).
	Negative outcomes for control programmes – i.e. baiting.	Review the methods used during the pest control programme in consultation with Agricultural Auditor, including the reason why baiting was used instead of other methods. Review to consider increasing the frequency of other control methods and a combination of alternate control methods, instead of using baiting.	Controlled activities (Section 4.1) and Pest animal control (Section 4.3.2).	Leaseholder. Agriculture Auditor.	
Fire	Wildfire entering the BMA.	Implementation of Mount Pleasant Operation Biodiversity Offset Bushfire Management Plan.	Fire management (Section 4.8)	Manager – Offsets MACH Energy.	
	Increased fire intensity due to higher fuel loads.	Implement Strategic grazing regime in consultation with Agricultural Auditor to control hazardous fuel loads.	Strategic Grazing (Section 4.4). Fire management (Section 4.8).	Leaseholder. Agriculture Auditor.	Ecological monitoring (Section 5.2). Strategic Grazing Monitoring – Agricultural audit (Section 5.3).
	Fire ignition on BMA.	Implementation of Mount Pleasant Operation Biodiversity Offset Bushfire Management Plan.	Fire management (Section 4.8).	Manager - Offsets MACH Energy.	
Drought	Reduction of ground cover, damage to native flora.	Destock. Seek Agricultural Auditor's advice regarding when strategic grazing can recommence and appropriate stocking numbers.	Strategic Grazing (Section 4.4).	Leaseholder. Agriculture Auditor.	Strategic Grazing Monitoring – Agricultural audit (Section 5.3).
Herbicide Drift	Chemical spray drift.	Establish buffer zones, follow government regulations and only spray in variable weather conditions. Use alternative weed control measures where practical (e.g. Biological control).	Buffer zones (Section 4.7). Weed Control (Section 4.2). Controlled activities (Section 4.1).	Leaseholder. Agriculture Auditor.	Ecological monitoring (Section 5.2). Strategic Grazing Monitoring – Agricultural audit (Section 5.3).

Table 25 (Continued)
Risk Management Matrix

Risk	Description of Risk	Corrective Action	Reference in OMPRP	Key Responsible Person	Monitoring Program
Vegetation Management	Removal or clearing of native vegetation, including dead timber and live plants observed to be occurring on BMAs.	Review property security controls and determine adequacy or if additional control measures (i.e. fencing or signage) required. Clearing of vegetation for essential farm infrastructure will adhere to relevant legislation.	Controlled activities (Section 4.1). Infrastructure improvement (Section 4.6).	Leaseholder. Agriculture Auditor. Biodiversity Auditor.	Ecological monitoring (Section 5.2). Strategic Grazing Monitoring – Agricultural audit (Section 5.3).
	High density regrowth restricting native species diversity.	Conduct thinning of regrowth according to techniques specified in "A Guide to Managing Box Gum Grassy Woodlands" (Rawlings et al., 2010) and in consultation with Biodiversity Auditor.	Re-establishment Plan (Section 4.5.2).	Biodiversity Auditor.	Ecological monitoring (Section 5.2).
Erosion	Significant loss of native vegetation cover due to erosion.	Review Strategic grazing regime in consultation with Agricultural Auditor and determine requirement for destocking, of stock reduction and appropriate remediation measures required. Implement Review outcomes.	Strategic Grazing (Section 4.4).	Leaseholder. Agriculture Auditor. Biodiversity Auditor.	Ecological monitoring (Section 5.2). Strategic Grazing Monitoring – Agricultural audit (Section 5.3).
	Stock grazing causing stream bank erosion.	Limit or exclude livestock access to eroded stream bank area. Review adequacy of off-stream livestock watering systems and property infrastructure (e.g. fencing) surrounding eroded stream bank area. If Review indicates in adequate systems and infrastructure available for livestock watering, additional off stream stock water infrastructure to be installed. Consider requirement for stream bank remediation measures.	Figures 7 (a) to (e) identify the Re-establishment Areas that are along streams which will involve revegetation to improve stream bank stabilisation.	Leaseholder. Agriculture Auditor. Biodiversity Auditor.	Ecological monitoring (Section 5.2). Strategic Grazing Monitoring – Agricultural audit (Section 5.3).

7 CONCLUSION

The OMPRP is the framework document for an effective conservation management system. The written document, that identifies the objectives, key performance indicators, conservation management strategies and monitoring programme, is supported by an online Biodiversity Offsets Portal (Section 1.2.2).

The Biodiversity Offsets Portal is a tool to effectively disseminate information, such as objectives, monitoring results and safety and project management advices. The Portal includes an interactive map that enables users to access the latest spatial and management data to create accurate maps to direct on ground management activities and ensure the protection of MNES.

Development and implementation of annual control programmes and rigorous assessment of monitoring results will inform management actions to ensure it adapts to climatic changes and informs ongoing management.

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APPENDIX A

EPBC APPROVAL 2011/5795 CONDITIONS RELATING TO OFFSETS AND THE RE-ESTABLISHMENT PLAN

Table A-1
Mount Pleasant Operations EPBC Approval Conditions Relevant to this Offset Management Plan and Re-establishment Plan

Approval Condition	Reference
2. The person taking the action must register a legally binding conservation covenant over the Biodiversity Management Areas in the map at Appendix B no later than 25 November 2021. The mechanism/s must provide enduring protection of no less than: a) 12,875 ha of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community b) 8,475 ha of suitable habitat for *Anthochaera phrygi*a (Regent Honeyeater) and *Lathamus discolour* (Swift Parrot) c) 8,475 ha of suitable habitat for *Dasyurus maculatus maculatus* (Spotted-tail Quoll) d) 8,475 ha of suitable habitat for *Nyctophilus corbeni* (Greater long-eared Bat). Note: Offsetting requirements for some species' habitat may be accommodated within the White Box – Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community components if this habitat is verified as present and includes specific habitat requirements for each relevant species.	Offset Security (Section 1.1.2)
3. The person taking the action must submit to the **Minister** for approval an Offset Management Plan for the Biodiversity Management Areas by no later than 31 May 2013, or as otherwise agreed to in writing by the **Minister.** The Offset Management Plan must contain details of measures to offset the impacts to the White Box—Yellow Box—Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community, and fauna species identified in condition 2. The approved Offset Management Plan must be implemented.	This Plan.
4. The Offset Management Plan must include, but not be limited to, the following information:	
a) a text description and map to clearly define the location and boundaries of the Biodiversity Management Areas. This must be accompanied with the offset attributes and a shapefile.	a) Biodiversity Management Areas (Section 2).
b) a detailed survey and description (prior to any management activities, hence a baseline) of the current condition of the extant vegetation of each Biodiversity Management Area. This must be consistent with the State and Transition Model and include, but not be limited to: i) location of survey points (gps reference) ii) vegetation condition mapping iii) photo reference points iv) tree age class representation v) percentage tree canopy cover vi) number of native plant species in ground layer vii) percentage of nativeness of total plant groundcover (herbaceous plants and small shrubs, 1m tall), measured using basal area viii) description of fauna habitat including condition, type and connectivity ix) bird and reptile surveys The detailed description will provide the baseline condition for the purpose of monitoring;	b) Biodiversity Management Areas (Section 2) and Appendices B and E
c) details of the management actions that will improve the baseline condition (referred to in condition 2 (b)), of a minimum of 12,875 Ha within the Biodiversity Management Areas consistent with the State and Transition Model, listing advice and recovery plan for the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community	c) Conservation Management Strategies (Section 4).

Approval Condition	Reference
d) management implementation schedules for all Biodiversity Management Areas identifying targeted activities for specific areas to protect and enhance the extent and condition of habitat values of the Biodiversity Management Areas, including but not limited to: i) a map showing areas to be managed ii) type of actions for each areas and details of the methods to be used iii) timing of management activity for each area iv) performance criteria for each area v) a monitoring plan to assess the success of the management activities measured against the baseline condition. The monitoring must be statistically robust and able to quantify change in the condition of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community. This should include, but not be limited to, control sites, periodic ecological surveys to be undertaken by a qualified ecologist as agreed to in writing by the Minister vi) contingency measures to be implemented if performance criteria are not met vii) a process to report, to the department, the progress of management activities undertaken in the Biodiversity Management Areas and the outcome of those activities, including identifying any need for improved management and activities to undertake such improvement viii) details of the various parties responsible for management, monitoring and implementing the management activities, including their position or status as a separate contractor ix) details of the independent committee review of the Offset Management Plan as set out in the condition 24 Note: Unless otherwise agreed to in writing by the department the baseline surveys must be undertaken between September and November, and monitoring must include September and November	d) Land Management Units (Section 2.4); Conservation Management Strategies (Section 4); Conservation Objectives and Key Performance Indicators (Section 3); Monitoring Programme (Section 5); Risks and Contingency Measures (Section 6); Reporting, Review and Responsibilities (Section 1.2.4).
5. Where the person undertaking the action has proposed cropping activities on non-offset areas within the offset properties, a minimum 150m buffer zone surrounding the cropping area must be established in order to protect the proposed offset areas	Sustainable Agriculture (Section 4.7)
6. No cropping activities are to be undertaken within 10m of a tree	Sustainable Agriculture (Section 4.7)
7. The person undertaking the action must submit to the department, as part of the Offset Management Plan identified in condition 3, a map identifying cropping areas and buffer zones	Sustainable Agriculture (Section 4.7) Figure 11
8. Where strategic grazing has been proposed as a management activity, the person undertaking the action must provide, as part of the Offset Management Plan identified in condition 3, details of the proposed grazing activities for each Biodiversity Management Area. This must include: a) objectives b) a map showing areas to be grazed c) details of the grazing methods to be used d) timing including seasons in which grazing will occur, period of grazing and rest period e) proposed stocking rate per season f) monitoring of impacts of grazing including any changes in the condition of vegetation, habitat and weed density.	Strategic Grazing (Section 4.4)
9. Grazing activities must be undertaken in accordance with the guidelines for Strategic Grazing (Rawlings et al., 2010). A minimum sward height of 10cm and 70% groundcover must be maintained at all times on at least 50% of the area to be grazed, as identified in condition 8(b). Note: Condition 5, 6, 7, 8 and 9 must be implemented unless otherwise agreed to in writing by the department	Strategic Grazing (Section 4.4).

Approval Condition	Reference
11. Within 3 years of the commencement of construction the person undertaking the action must provide, for the approval of the Minister, a Re-establishment Plan for the Biodiversity Management Areas secured under condition 2. The approved Re-establishment Plan must be Implemented.	Section 4.5
12. The Re-establishment Plan must provide for commitments and activities to deliver the increase in the spatial extent and improvement in the condition of existing remnants by at least 677 ha within 5 years of the commencement of construction, and for the establishment of self sustaining functional remnant vegetation community, with the capacity to provide habitat for the species identified in condition 2.	Section 4.5
13. The Re-establishment Plan must include:	
a) details of the areas to be re-established (re-establishment areas) including location and maps	Section 4.5.3 and Figures 7a to 7e
b) documentation including mapping of current environmental values relevant to **MNES** of the re-establishment areas	Section 4.5.3
c) where revegetation through planting seedlings and/or seeds is intended details of appropriate species and ratios of species relevant to historically occurring listed migratory and listed threatened species habitat and the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland *and* Derived Native Grassland Ecological Community	Section 4.5.4.1
d) the source and provenance of the seed and/or seedlings which will be used	Section 4.5.4.2
e) measures to address threats to **MNES** including but not limited to grazing pressure and damage by livestock and adverse impacts from feral animals and weeds	Section 4.5.5
f) measures to provide fire management regimes appropriate for the **MNES**	Section 4.8
g) measures to manage the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community in accordance with the recommendations of the approved recovery plan for the ecological community	Section 4.5.5
h) monitoring measures including ecological surveys to measure the establishment and ongoing success of the revegetation based on a comparison with high quality habitat for listed migratory and listed threatened species, and ecological community reference sites	Section 4.5.6
i) performance measures and reporting requirements against identified objectives, including trigger levels for contingency measures to be taken to ensure performance measures and objectives are met	Sections 4.5.7, 4.5.8 and 4.5.9
j) identify persons responsible and arrangements for implementing the Re-establishment Plan and for reporting on performance.	Section 4.5.9
14. To ensure the long term protection of the Re-establishment Areas as described in condition 13a, the proponent must:	
a) manage and maintain the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community components of the Re-establishment Area define contingency measures which will be undertaken if performance measures and reporting indicate that successful re-establishment has not been achieved within 10 years of commencement of construction	Sections 4 and 4.5.8
b) define contingency measures which will be undertaken if performance measures and reporting indicate that successful re-establishment has not been achieved within 10 years of commencement of construction	

APPENDIX B

BMA BIOPHYSICAL DESCRIPTION

1 MERRIWA EAST AND WEST BMAs

1.1 CLIMATE

The region's climate is greatly affected by topography, elevation and aspect. While the climate is temperate, the proximity of the Liverpool Range to the north causes considerable variation in rainfall, particularly due to summer thunderstorms. Temperatures are highest in December and January, with a 30°C mean monthly maximum and 14°C mean monthly minimum at Cassilis.

A mean annual rainfall up to 660 mm is recorded for the Merriwa area, with considerable variation occurring from the lower elevations, which have lower, less reliable rainfall, and the more elevated sites, which receive as much as 850 mm annually. To the western boundary, Cassilis has an annual rainfall of 624 mm.

The distribution of rainfall is strongly influenced by elevation and proximity to the Liverpool Ranges to the north. Summer thunderstorms have an important bearing on rainfall intensity, with the higher elevations having a higher frequency of intense rainfalls than the lower areas of the Merriwa plateau. Typically monthly rainfall shows summer dominance, with monthly rainfall in the range of 50-60 mm in summer and 30-40 mm in winter. The late summer-autumn rainfall is the most variable due to reliance on thunderstorms, and consequently, the risk of erosion and minor flooding is heightened because of the high intensity events.

1.2 TOPOGRAPHY/LANDFORM

These BMAs are located on the Merriwa plateau and lie parallel to the Liverpool Range. The landform consists mostly of rolling hills, with scattered basaltic knolls and hillocks rising to moderately steep hills. Slopes range from gently to moderately inclined (5-10%), with slopes from 500-1,500 m long. Drainage lines are mostly between 500 m -1,000 m apart and dissect the landscape with southward flowing streams. Alluvial flats and terraces occur on larger streams.

Elevation ranges from 450 to 620 m above sea level. The long slopes give the area a potentially high erosion hazard, with some severe gully erosion occurring in drainage lines, especially in association with Black earth (basaltic) soils.

The sharp dissected streams, often with rocky outcrops, make access difficult, particularly in the steeper slopes. Access is also often impeded by the high soil clay content, which can be impassable when wet.

1.3 SOILS

The Black Earths soils across the Merriwa BMAs are predominantly formed from basalt parent material. The soils have high natural fertility levels, moderate to high water holding capacity and are well drained.

Topsoil's are seasonally cracking or friable, with some surface layers self–mulching and loose. They have silty clay to light medium clay textures that have a hard consistency when dry but are very sticky when wet.

Other characteristics of these soils include: neutral to alkaline pH of the topsoil's, which are often relatively deep (25 cm), and the black medium- heavy clay alkaline subsoil's.

Other common soil types include Red Clays (usually on the upper slopes and steep mid-slopes) and Euchrozems (shallow sandy clay loam topsoils overlaying clay loams of moderate fertility) which occur mostly on crests and upper slopes.

Alluvial soils occur along drainage lines which have formed from the accumulation of sediment and tend to be a high flood risk areas.

1.4 LAND USE

The Merriwa plateau was dominated by woodlands, which have largely been cleared for agricultural production. The area supports a range of agricultural enterprises. Grazing enterprises are significant, particularly on the land that has limitations for cropping (e.g. slope, stoniness and extent). Beef production (both breeding and fattening) has slowly replaced sheep production as the dominant livestock enterprise.

Cropping of winter cereal crops, canola and some summer crops is limited to the floor of valleys and the Merriwa plateau where the flatter land is more suitable for cultivation. Areas used for cropping are decreasing, with the smaller areas (such as minor alluvial valleys) being used for the growth of forage crops or improved pastures for livestock enterprises.

Across the BMAs, recent land use has been mostly beef cattle grazing, with some sheep and a relatively small amount of cropping with forage crops for livestock fattening. Improved pastures such as Lucerne usually form a rotation on the cropping land, which is mostly on alluvial land or along drainage lines.

Merriwa is a main service town with rail transport facilities. Cassilis (43 km to the west) is a small village situated on the Munmurra River.

Coolah Tops National Park is situated to the north/west of Cassilis and the BMAs.

1.5 VEGETATION

McRae and Cooper (1985) have mapped four vegetation communities within the Merriwa plateau and all have been characterised by widely spaced trees 8 -15 m high, very little to no shrub cover and a ground cover consisting mainly of perennial grass species. The main tree, White Box (*Eucalyptus albens*) / Coastal Grey Box (*E. moluccana*) is an intergrade between two related box species with White Box being found more commonly in the west and Coastal Grey Box to the east in the Hunter Valley (McRae and Cooper 1985). On the Merriwa plains, open woodland of White Box – Yellow Box (*E. melliodora*) and Kurrajong (*Brachychiton populneus)* usually dominated the broad valleys and rounded hills with an altitudinal range from 400–500 ASL and slopes less than 15 degrees.

Native grasses occur over most of the region, becoming the dominant community where clearing has occurred. Plains grass (*Austrostipa aristiglumis*) is common on the areas of Black Earth soils, *Poa sp*. on lighter soils, in protected aspects and along drainage lines in the higher altitudes. Red grass (*Bothriochloa macra*) and blue grass (*Dicanthium sericium*) are also common with kangaroo grass (*Themeda australis)* being limited to areas less intensively grazed.

2 NAMOI BMA

2.1 CLIMATE

The region has a dry sub-humid climate. This is a function of its latitudinal location and is influenced by substantial mountain ranges to the east and south. Temperatures are warm to hot in summer, mild in autumn and spring and cold in winter. The average monthly maximum temperatures are highest in January with 31.6°C and lowest in July with 15.7°C.

Frosts may occur between April and September but peak in July.
Rainfall is fairly equally distributed across the year, with slight summer dominance. Summer rain is dominated by storms. Average annual rainfall is 642 mm (at Gunnedah Research Centre) with an average of 75 rain days per year.

Soil moisture storage is greatest during the winter and spring periods and least during summer and autumn.

2.2 TOPOGRAPHY/LANDFORM

The terrain consists of broad undulating to rolling hills of sandstones and conglomerates. Slopes range from 3-10% but average around 5-6%. Rock outcrops are relatively common.

Crests are broad with moderately long mid-slopes with well incised drainage lines.

Some saline outbreaks occur in deep gully beds and along lower foot-slopes, especially where sub-surface drainage is impeded.

Much of the land has water erosion hazards, with evidence of sheet and gully erosion, particularly in previously cropped areas.

2.3 SOILS

The soils vary considerably due to major differences in parent material. The dominant soils are shallow, Red-brown Earths on crests and sideslopes, with moderately deep Red-brown Earths, Yellow Pozolic and Yellow Solodic soils on the lower side-slopes and along drainage lines. Some Black Earths occur on benches and fans along lower side-slopes. Localised areas of rock outcrop and stony soils occur sporadically across the landscape.

Soil limitations include high water erosion hazards and high structural decline hazards, which include hard setting surfaces. Dry land salinity potential is developing on the lower foot-slopes. Soils have localised high erodibilty and stoniness.

The soils are generally of low natural fertility.

2.4 LAND USE

The area was inhabited originally by a number of different tribal groups of the Kamilaroi language group. European settlement began in the 1830’s and the land was predominantly used for sheep and cattle grazing. In the 1880’s cropping became an important land use on the red soils of the area on the foot-slopes and low sandstone hills. As technology became available to cultivate the heavy clays of the basalt slopes and plains in the Gunnedah region, cropping of the more marginal lighter soils on the slopes declined.

Original land clearing and cultivation of slopes have resulted in several soil and landscape related problems including soil erosion, structural decline and dry land salinity in some areas.

The Warrawoona property has been used for grazing and cropping in the past. Recently crops have been restricted to forage crops for livestock and improved pastures.

2.5 VEGETATION

Much of the landscape has been largely cleared with the exception of the steep ridges, which retain native woodland.

Common native grass species include Wiregrasses (*Aristida spp*), Spear grasses (*Austrostipa spp.),* red grass (*Bothriocloa decipiens*), love grasses (*Eragrostis spp.*) and others.

Agricultural weeds and introduced pasture plants are also common.

APPENDIX C

RAPID CONDITION ASSESSMENT

The ‘Save the Bush Toolkit’ provides a rapid assessment technique which identifies the presence or absence of key habitat components and threatening processes. It is not applicable to all types of native vegetation (e.g. native grasslands, wetlands or pastures) but is a quick and reliable way to determine the condition of bushland and woodland communities.

It requires answering true or false to a series of questions and a tally of the “True” scores will tell you how healthy it is. Where answers are false, improved management in these areas may be required. Sites scoring 16 - 20 “trues” are generally considered to be areas of healthy vegetation that are sustainable under current management. Sites scoring 10 – 15 “trues” are generally considered to be areas of moderately disturbed bushland that have key elements missing and needs improved management. Scores lower than 10 are highly disturbed and have many key elements missing. They are generally unsustainable under the current management and require improved management.

Table C-1
Rapid Condition Assessment Attributes

Remnant Attribute	Site
Low grazing intensity - never farmed	True
Tree and shrub regeneration present (<2 m)	True
Infrequent fire regime (<5 year intervals)	True
Healthy mature trees (no dieback)	False
Little to no evidence of rabbits	True
Little to no evidence of foxes/cats	True
Low abundance of weeds (most remnants contain some weeds)	True
No evidence of firewood collection	False
No obvious signs of erosion or salinity	True
Not susceptible to fertiliser application, herbicide or pesticide drift	True
Less than 20% trees with Mistletoe (NB some mistletoe is healthy)	True
Few tracks, trails or fence lines	True
Presence of native shrubs	True
Presence of large, old growth trees with hollows	True
Dead timber is left standing	True
Fallen timber and logs are left on the ground	True
Abundance of native ground flora	True
Presence of litter, cryptogams, cracks and rocks	True
Remnant is large (> 5 ha is optimum)	True
Connected to or in close proximity to other remnant vegetation	True
Total No. True answers (x/20)	**18/20**

APPENDIX D

AREA OF EACH ECOLOGICAL COMMUNITY WITHIN LMU COMPARTMENTS

Table D-1
Merriwa East: Area of Each Ecological Community and Agriculture within LMU Compartments

LMU Type	Compartment ID	Box Gum Grassy Woodland (ha)	Derived Native Grassland (ha)	Low Diversity Derived Native Grassland (ha)	Other Woodland (ha)	Agriculture (ha)	Total (ha)
Black Rock Property							
2	BR1 (2)	485	331		15	4	834
2	BR11 (2)	114	10			1	125
2	BR12 (2)	194	15				208
2	BR5 (2)	374	85	48	20	8	535
Subtotal LMU2		*1,166*	*440*	*48*	*35*	*13*	*1,702*
3	BR10 (3)	34	12			1	47
3	BR13 (3)	12			5	32	49
3	BR2 (3)	330	191		11	14	545
3	BR8 (3)	22			1	85	109
3	BR9 (3)	338	222	8	18	100	685
Subtotal LMU3		*735*	*425*	*8*	*35*	*232*	*1,435*
4	BR14 (4)	1			0	12	13
4	BR15 (4)	28	114	37		122	301
4	BR16 (4)	19	6			136	161
4	BR3 (4)	6	4			83	94
4	BR4 (4)	49	0	0	0	62	111
4	BR6 (4)	9	48		4	42	104
4	BR7 (4)	23	8		0	275	307
Subtotal LMU4		*134*	*181*	*37*	*5*	*733*	*1,090*
Black Rock Total		***2,035***	***1,047***	***93***	***74***	***978***	***4,228***
Clare Park Property							
2	CP2 (2)	301	67				368
3	CP1 (3)	21	27			0	48
Clare Park Total		***322***	***94***	***0***	***0***	***0***	***416***
Gum Ridge Property							
2	GR3 (2)	1,332	356	5		3	1,695
3	GR1 (3)	126	71			2	198
3	GR5 (3)	10				8	18
3	GR6 (3)	28	7	0		2	37
3	GR7 (3)	89	115	0		97	302
Subtotal LMU3		*253*	*193*	*0*	*0*	*109*	*555*
4	GR2 (4)	17	2			179	199
4	GR4 (4)		0			41	41
4	GR8 (4)	3	1	39		0	43
4	GR9 (4)	36	8	17		46	107
Sub Total LMU4		*56*	*11*	*56*	*0*	*266*	*389*
Gum Ridge Total		***1,641***	***560***	***61***	***0***	***378***	***2,639***
Merriwa East BMA		**3,998**	**1,701**	**154**	**74**	**1,356**	**7,284**

Note:

The areas presented in this table may slightly differ from those shown on Figures 7a to 7e and/or the tables presented in the text of the OMPRP. These minor differences are due to small discrepancies between the mapping layers, the cadastral data and the actual location of internal and external property fences.

Table D-2
Merriwa West: Area of Each Ecological Community and Agriculture within LMU Compartments

LMU Type	Compartment ID	Box Gum Grassy Woodland (ha)	Derived Native Grassland (ha)	Low Diversity Derived Native Grassland (ha)	Other Woodland (ha)	Agriculture (ha)	Total (ha)
St Antoine Property							
2	SA11 (2)	326	158	54	15		553
Subtotal LMU2		*326*	*158*	*54*	*15*		*553*
3	SA10 (3)	719	357	13	2	3	1,094
3	SA12 (3)	313	277		21		611
3	SA13 (3)	1		2		8	11
3	SA2 (3)					12	12
3	SA3 (3)	0			0	12	12
3	SA4 (3)	517	547	68	0	158	1,291
3	SA5 (3)	358	80	126	3	412	978
3	SA6 (3)	53	50	20	40	176	339
3	SA8 (3)	31	14		3	37	87
3	SA9 (3)	186	59	14			259
Subtotal LMU3		*2,179*	*1,384*	*243*	*70*	*818*	*4,694*
4	SA1 (4)	9		45	2	183	239
4	SA7 (4)	12		17		29	58
Subtotal LMU4		*21*	*0*	*62*	*2*	*212*	*297*
St Antoine Total		***2,526***	***1,541***	***359***	***87***	***1,030***	***5,544***
Wahrane Property							
2	WA7 (2)	829	152			0	981
Subtotal LMU2		*829*	*152*	*0*	*0*	*0*	*981*
3	WA3 (3)	124	177		26	55	383
3	WA4 (3)		1		2	0	4
3	WA5 (3)	1	16		6	31	53
3	WA8 (3)	7	4				11
Subtotal LMU3		*131*	*198*	*0*	*35*	*87*	*451*
4	WA1 (4)	7	2		0	65	74
4	WA2 (4)	2	0			56	58
4	WA6 (4)	16	2			18	36
Subtotal LMU4		*26*	*3*	*0*	*0*	*139*	*169*
Wahrane Total		*987*	*353*	*0*	*35*	*226*	*1,601*
Merriwa West BMA		3,512	1,894	359	123	1,286	7,145

Note:

The areas presented in this table may slightly differ from those shown on Figures 7a to 7e and/or the tables presented in the text of the OMPRP. These minor differences are due to small discrepancies between the mapping layers, the cadastral data and the actual location of internal and external property fences.

Table D-3
Namoi BMA: Area of Each Ecological Community and Agriculture within LMU Compartments

LMU Type	Compartment ID	Box Gum Grassy Woodland (ha)	Derived Native Grassland (ha)	Low Diversity Derived Native Grassland (ha)	Other Woodland (ha)	Agriculture (ha)	Total (ha)
Warrawoona Property							
(1)	W4 (1)	113	48		0	3	164
(1)	W6 (1)	149	1		45	1	195
Subtotal LMU1		*261*	*49*	*0*	*45*	*4*	*359*
(2)	W1 (2)	44	78			3	125
(2)	W5 (2)	174	46			0	221
Subtotal LMU2		*219*	*124*	*0*	*0*	*3*	*345*
(3)	W2 (3)	5	12			65	82
(3)	W3 (3)	33	5		0	156	193
(3)	W9 (3)	2	4			21	27
Subtotal LMU3		*39*	*22*	*0*	*0*	*241*	*303*
(4)	W7 (4)	2	14			35	52
(4)	W10 (4)	0	1			23	24
(4)	W8 (4)	2	2			62	66
Subtotal LMU4		*5*	*17*	*0*	*0*	*120*	*142*
Warrawoona Total		***524***	***211***	***0***	***45***	***369***	***1,149***
NAMOI BMA		**524**	**211**	**0**	**45**	**369**	**1,149**

Note:

The areas presented in this table may slightly differ from those shown on Figures 7a to 7e and/or the tables presented in the text of the OMPRP. These minor differences are due to small discrepancies between the mapping layers, the cadastral data and the actual location of internal and external property fences.

APPENDIX E

BASELINE FLORA, FAUNA AND SOIL ASSESSMENT (CUMBERLAND ECOLOGY, 2013)

MOUNT PLEASANT OFFSET MANAGEMENT PLAN

Baseline Flora, Fauna, and Soil Assessment of Offset Properties

For:

Rio Tinto Coal Australia

January 2014

Final

PO Box 2474

Carlingford Court 2118

Report No. 12101RP5

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Revision	Date Issued	Reviewed by	Approved by	Date Approved	Revision Type
1	1/12/2013	DR	DR	1/12/2013	First draft
2	23/1/14	DR	DR	23/1/14	Final Draft

Approved by: Dr David Robertson

Position: Director

Signed: David Robertson

Date: *24 January, 2014*

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Executive Summary

Cumberland Ecology has been engaged by Coal & Allied Industries Limited to establish monitoring plots, and baseline fauna and flora studies for the Mount Pleasant Project Offsets at three biodiversity management areas: Merriwa East, Merriwa West, and Namoi.

In compliance with Condition 4b of the Conditions of Approval, initial baseline surveys were conducted to:

- Establish fauna and flora monitoring sites;
- Evaluate habitat at monitoring sites;
- Evaluate baseline flora within plots; and
- Evaluate baseline soil characteristics.

S1 Background

The Mount Pleasant Project (MtPP) has been approved as an open cut coal mine in the lower Hunter Valley in NSW. The MtPP has been granted to clear 2,591 hectares of native vegetation of which 571.8 comprises of Coastal Grey Box/White Box Intergrade Woodland, and 2,019.1 ha of Derived Native Grassland, which form part of the White Box - Yellow Box – Blakely's Red Gum Grassy Woodland, and Derived Native Grassland ecological communities.

The approved project will have an impact upon flora and fauna that are listed as matters of national environmental significance (MNES) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), including one critically endangered ecological community (CEEC). To offset the impacts of clearing on MNES, Approval Conditions require the protection of 15,643 ha of similar ecological communities and habitats in the region. The offsets for the Mount Pleasant project have been acquired and are divided into three Biodiversity Management Areas (BMAs): Merriwa East, Merriwa West, and Namoi.

A key condition of approval of the Mount Pleasant Project Offset Management Plan was to monitor indicators of ecosystem condition and MNES using techniques that are scientifically robust and repeatable. The indicators include floristics and structure of Box Gum Woodland and Derived Native Grassland, soil fertility, and reptile and bird assemblages.

S2 Key Findings

Analysis of this baseline data shows differences between Namoi and the Merriwa BMAs as expected, but the differences between LMU classes was much more subtle. Important differences in the LMU classes were the richness of birds, the prevalence of exotic plants,

and soil properties (Calcium concentrations). Reptile diversity and abundance was low across all properties, and this may be attributed to preceding conditions and management strategies. Despite the dry conditions preceding surveys, the prevalence of a greater diversity of exotic plants at lower LMU classes is consistent with the State and Transition Model, and supports the initial classification of LMU classes.

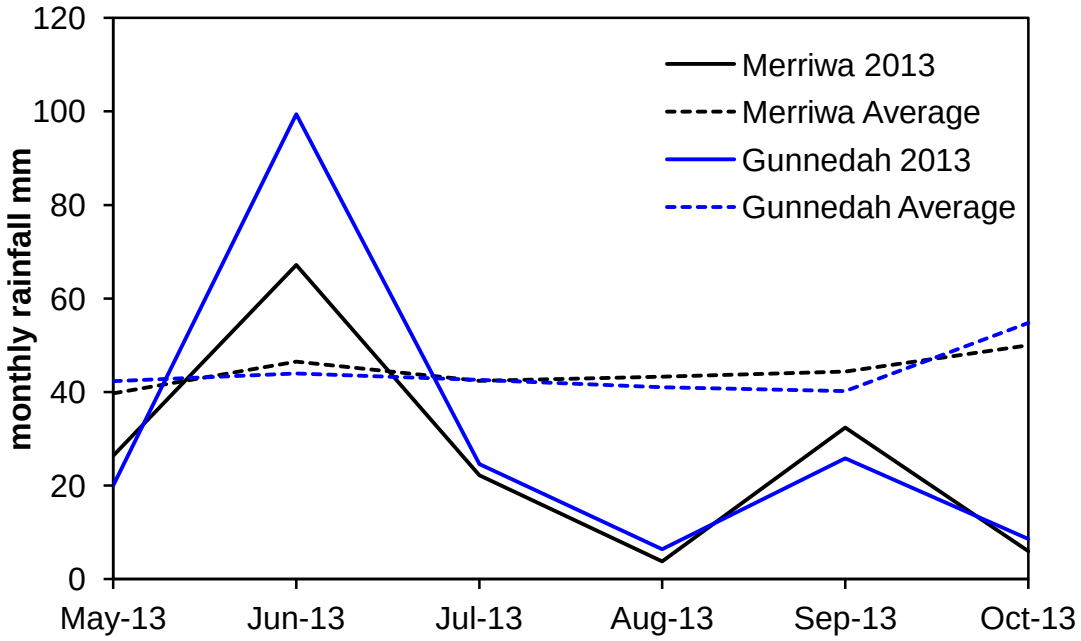


Figure S.1.1 2013 monthly, and historic average monthly rainfall records for Merriwa (Merriwa East and West BMAs) and Gunnedah (Namoi BMA) for the 6 months preceding surveys

S3 Conclusion

Data was collected across all plots, and this can be used as baseline data for future monitoring studies. Baseline data was collected for bird and reptile abundance, fauna habitat features, and photographs at all 32 Indicators of Ecological Condition (IEC) sites. Baseline data was collected for flora abundance and richness, habitat features, photographs, and soil properties at all 32 BGGW sites. All work was carries out to satisfy condition 4b of the Mount Pleasant Project approval.

The Beesons Road Fire affected all but one monitoring site at Namoi BMA, and burnt a considerable percentage of Warrawoona. As such there is not an opportunity to compare burnt with unburnt sites, however the collection of baseline data a day before the fire allows for a benchmark for potential recovery of the property. It is important to consider however, that fire is a natural process and future assemblages may not necessarily resemble the baseline data from before the fire.

The ongoing monitoring of established sites at Merriwa BMAs will now be able to track any shift from lower LMU classes to higher LMU classes under active management. The changes in ecosystem condition at Namoi BMA sites will undertake a different trajectory due to the interactive effects of fire, rainfall, and destocking over the next two years.

Chapter 1

Introduction

1.1 Background

The Mount Pleasant Project (MtPP) has been approved as an open cut coal mine in the lower Hunter Valley in NSW. The MtPP has been granted to clear 2,591 hectares (ha) of native vegetation of which 571.8 ha comprises of Coastal Grey Box/White Box Intergrade Woodland, and 2,019.1 ha of Derived Native Grassland, which form part of the White Box - Yellow Box – Blakely's Red Gum Grassy Woodland, and Derived Native Grassland ecological communities.

The approved project will have an impact upon flora and fauna that are listed as matters of national environmental significance (MNES) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), including one critically endangered ecological community (CEEC) and several threatened fauna species:

- the CEEC is White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (referred to hereafter as "Box Gum Woodland and Derived Native Grassland"); and
- the threatened fauna Regent Honeyeater *Anthochaera phrygia*; Swift Parrot *Lathamus discolor*; Spotted-tailed Quoll *Dasyurus maculates maculates*; and Greater (South-eastern) Long-eared Bat *Nyctophilus corbeni*.

To offset the impacts of clearing on MNES, Approval Conditions require the protection of 15,643 ha of similar ecological communities and habitats in the region. The offsets for the Mount Pleasant project have been acquired and are divided into three Biodiversity Management Areas (BMAs): Merriwa East, Merriwa West, and Namoi Figure 1.1. All BMAs are comprised of properties which were predominately used for agriculture including cropping and mixed agriculture prior to acquisition by the Mount Pleasant Project.

An Offset Management Plan (OMP) has been prepared by Rio Tinto Coal Australia on behalf of Coal & Allied Industries Limited (Coal & Allied) for the management of offsets for the Mt Pleasant Project. The OMP was submitted to the Department of the Environment (DoE) in May 2013 for approval by the Minister.

A key condition of approval of the Mount Pleasant Project (OMP) was to monitor indicators of ecosystem condition and MNES using techniques that are scientifically robust and repeatable. The indicators include floristics and structure of Box Gum Woodland and

Derived Native Grassland, soil fertility, and reptile and bird assemblages (see Chapter 2). Specifically with relation to Approval Condition 4b. The OMP must include, but not be limited to, the following information:

- Location of the survey points (gps reference)
- Vegetation condition mapping
- Photo reference points
- Tree age class representation (diameter at breast height)
- Percentage tree canopy cover
- Number of native plant species in the ground layer
- Percentage of nativeness of total plant groundcover (herbaceous plants and small shrubs, 1m tall) measured using basal area
- Description of fauna habitat including condition, type and connectivity
- Bird and reptile surveys

1.2 Purpose

The purpose of this report is to describe the establishment of monitoring sites for the continued monitoring of the selected biodiversity within Mount Pleasant Project Biodiversity Management Areas, and to provide an analysis of the baseline data collected from these sites in spring 2013.

In compliance with Condition 4b of the Conditions of Approval, initial baseline surveys were conducted to:

- Establish fauna and flora monitoring sites;
- Evaluate habitat at monitoring sites;
- Evaluate baseline flora within plots; and
- Evaluate baseline soil characteristics.

Coordinate System: MGA Zone 56 (GDA 94)

Pilliga Nature Reserve
GUNNEDAH
OXLEY HIGHWAY
Wondoba State Conservation Area
CURLEWIS
MOOKI RIVER
TAMWORTH
Goran State Forest
COXS (TURRABEILE) CREEK
WERRIS CREEK ROAD
Breeza State Forest
COONABARABRAN
WERRIS CREEK
Trinkey State Conservation Area
QUIRINDI PREMER ROAD
QUIRINDI CREEK
CASTLEREAGH RIVER
Spring Ridge State Forest
PREMER
Binnaway Nature Reserve
QUIRINDI
NEW ENGLAND HIGHWAY
BINNAWAY
BINNIA CREEK
COOLABURRAGUNDY RIVER
Coolah Tops National Park
MURRURUNDI
COOLAH
KRUI RIVER
Towarri National Park
PAGES RIVER
MERRIWA RIVER
TALBRAGAR RIVER
GOLDEN HIGHWAY
DUNEDOO
SATUR
SCONE

Legend

- Merriwa East BMA
- Merriwa West BMA
- Naomi BMA
- National Parks and Reserves
- State Forests
- River
- Road
- Town

Grid North

Data Source:
© Copyright Commonwealth of Australia (Geoscience Australia) 2006
NPWS Estate 2012
Forests NSW, 2011

CUMBERLAND ECOLOGY

I:\...\12101\Figures\12101RP4\Figure 1 Regional Layout_20131129

Figure 1.1 Regional Layout of Mount Pleasant Biodiversity Management Areas

10 0 10 20 30 40 km

1.3 Merriwa East and Merriwa West BMAs

The Merriwa East and Merriwa West BMAs are about 50km northwest of the township of Merriwa and approximately 60km east of the township of Coolah. These BMAs are located on the Merriwa plateau and lie parallel to the Liverpool Plain. Topography is typically rolling hills with occasional moderately steep hills, and elevations between 450 and 620m above sea level. Climate at both BMAs are classified as temperate, however rainfall is dependent on summer thunderstorms and as such is highly variable temporally and spatially. Soils within the Merriwa BMAs are basaltic, are naturally highly fertile with a high clay content and are generally pH neutral to alkaline. The region is primarily used for beef production, and cropping is common on alluvial soils in the valleys where soil fertility is highest.

The Merriwa East BMA (MEBMA) is comprised of three properties (Black Rock, Clare Park, and Gum Ridge), intersected by several roads and ephemeral watercourses and covers an area of 7284ha Figure 1.2 . The vegetation of the MEBMA comprises of a matrix of Box Gum Grassy Woodland (3998 ha) and Derived Native Grasslands (1701 ha) of varying habitat quality. The vegetation quality within the BMA varies from medium - high quality habitat (LMU2; 3,765 ha) to low quality habitat (LMU3; 2038 ha), with the remaining area being used for cropping or occupied by infrastructure. Merriwa West BMA (MWBMA) comprises of two farming properties, St Antoine and Wahrane, covering an area of 7176 ha and is also intersected by several minor roads and ephemeral watercourses Figure 1.3 . The MWBMA also forms a matrix of Box Gum Grassy Woodland (3512 ha) and Derived Native Grassland (1894 ha); and landscape condition is more degraded with a low proportion of LMU2 (1534 ha) relative to LMU3 (5176 ha).

Photograph 1.1 Box Gum Grassy Woodlands on Wahrane, Merriwa West BMA (14th November 2013)

Coordinate System: MGA Zone 56 (GDA 94)

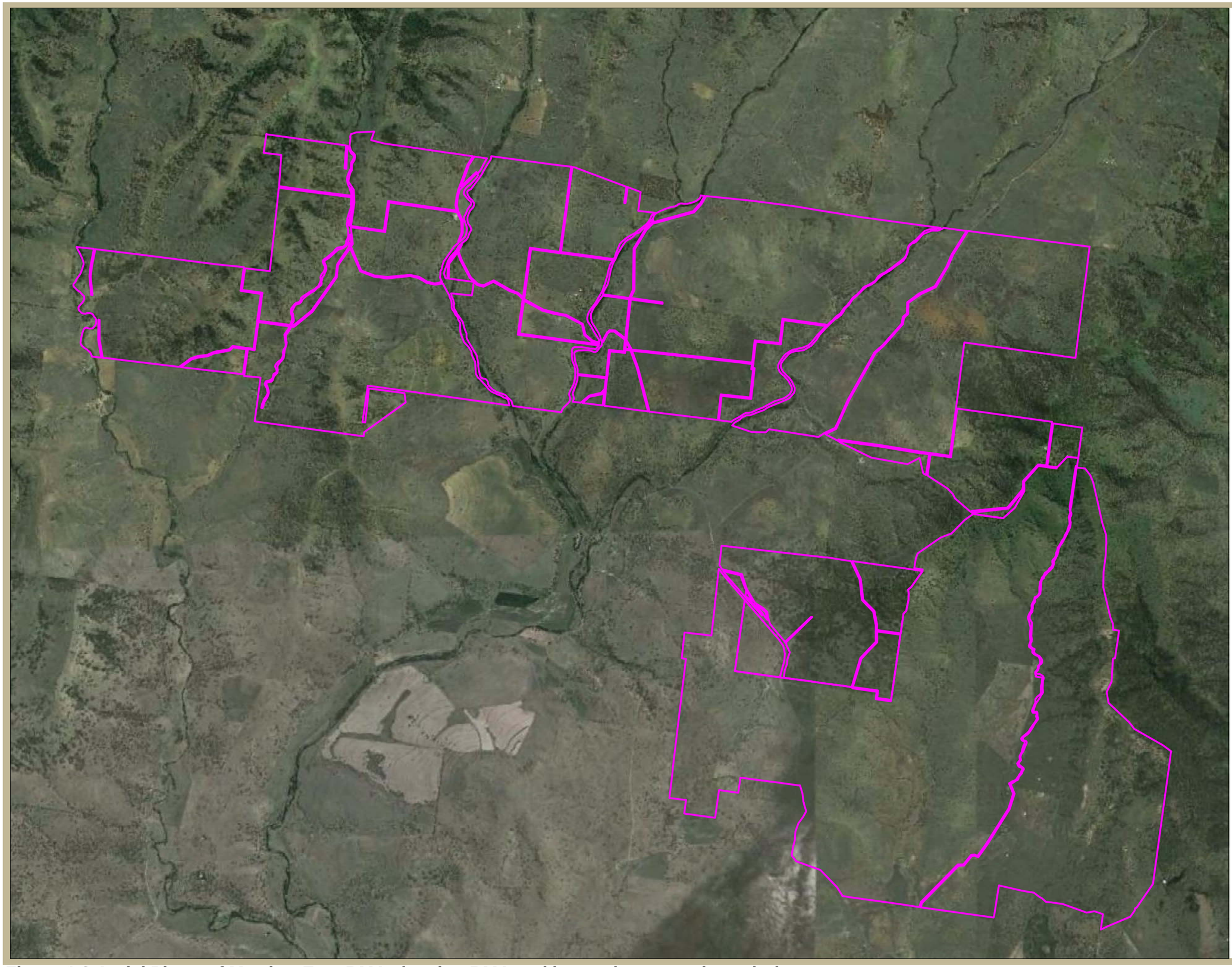


Figure 1.2 Aerial Photo of Merriwa East BMA showing BMA and internal property boundaries

Coordinate System: MGA Zone 56 (GDA 94)

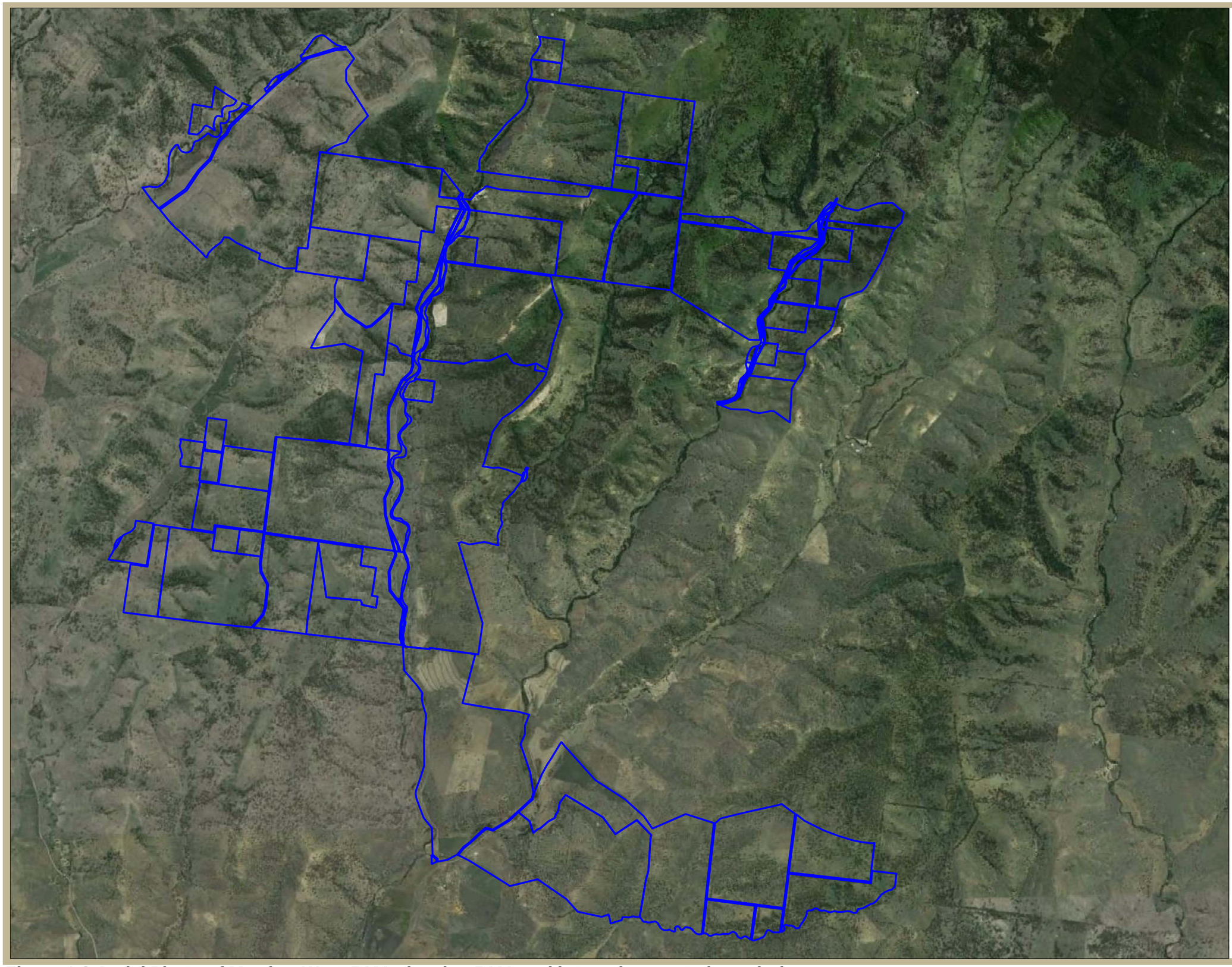


Figure 1.3 Aerial Photo of Merriwa West BMA showing BMA and internal property boundaries

1.4 Namoi BMA

The Namoi BMA (NBMA) consists of Warrawoona, an 1143 ha property to be managed for conservation values as an offset for the Mt Pleasant Project. The study area is 35km southeast of the township of Gunnedah and is immediately east of the Township of Breeza. Landscape features in proximity of the NBMA include the Mooki River to the east and Breeza State Forest to the west. Regionally the climate is dry and sub-humid due to its location with significant mountain ranges to the south and east. Rainfall is equally distributed throughout the year and an average rainfall of approximately 642mm annually. Within Warrawoona there is 355 ha of very-high quality habitat, predominately Box Gum Grassy Woodlands.

Photograph 1.2 Derived Native Grasslands on Warrawoona, Namoi BMA (7th November 2013)

Coordinate System: MGA Zone 56 (GDA 94)

Legend

Namoi BMA

Grid North

CUMBERLAND ECOLOGY

I:\...\12101\Figures\12101RP4\Figure 1.4 Namoi_20131129

Figure 1.4 Aerial photo of Namoi BMA showing Warrawoona boundary

250 0 250 500 750 1000 m

1.5 Terminology

The following terminology is used throughout the report:

- BMA: Refers to a Biodiversity Management Areas, which encompasses one or more adjacent properties in a region;
- LMU: Refers to land management unit, a measure of land condition as shown in the Mount Pleasant Project Offset Management Plan;
- TSC act: refers to the *Threatened Species and Conservation ACT 1995*;
- EPBC Act: refers to the *Environmental Protection and Biodiversity Conservation Act 1999*;
- Study Site: refers to a parcel of land within the boundary of the BMA at which flora and fauna assessments are conducted;
- Threatened species: refers to those flora and fauna species listed as vulnerable, endangered or critically endangered under the TSC Act or EPBC Act;
- MtPP: refers to the Mount Pleasant Project;
- MNES: refers to Matter of National Environmental Significance;
- IEC: refers to the Indicators of Ecological Condition
- Site: refers to the location where data was collected. Each site includes bird census, reptile census, photograph points, and a monitoring plot.
- Plot: refers to the 50m x 20m area at each monitoring site whereby environmental and flora data was collected.

Chapter 2

Methods and Analyses

2.1 Ecological Monitoring Methods

2.1.1 Land Management Units

Land Management Units (LMUs) are a method of classifying the condition of ecological communities for the purpose of land management. LMUs are generally bounded by fences, roads or other infrastructure, and facilitate the design and implementation of management strategies at this scale.

Each LMU has been assigned one of four condition categories considering the level of disturbance to ecological communities, extent of connectivity of ecological communities, management infrastructure, and the "state" as classified by the "State and Transition model (A guide to Managing Box Gum Grassy Woodlands; Rawlings 2010).

In this study, land management units were used to assess baseline condition of ecosystems, and can be used in further studies to assess improvements of land quality under new management practices.

The score for each LMU was assigned using aerial photo interpretation, and an ecosystem health and habitat score, prior to the current study. The LMU State and Transition model allows for shifts between LMU states with various management techniques.

In short, ceasing grazing and fertilisation allows for transition shift from lower LMU classes (ie LMU3) to higher LMU classes (LMU2). Conversely increased grazing and fertilisation results in a shift to lower LMU classes. LMU classes are broadly defined as:

- LMU1
    - Eucalyptus spaced as woodland, large and medium tussock grasses, high diversity of grasses and herbs, all native species, mostly perennial, few annuals, and regeneration present.
- LMU2
    - Eucalyptus generally present, medium and small tussock grasses, high diversity of grasses and herbs, mostly native species with some exotics, mainly native annuals, and regeneration usually present.

- LMU3
  - Eucalyptus scattered or absent, few small perennial tussock grasses, low diversity of grasses and herbs, mostly exotic species, annuals tend to dominate, few native species regenerating.
- LMU4
  - Eucalyptus scattered or absent, dominated by sewn species, mostly exotic annual species, few or no native species present, native generally not regenerating.

2.1.2 Indicators of Ecosystem Condition

Birds and reptiles are widespread, abundant, and populations are easily surveyed. Although they are highly mobile, their association with habitat types due to their own requirements can be used as indicators of overall biodiversity.

As assemblages of birds and reptiles can be linked to habitat condition, changes in bird and reptile assemblages can therefore be used to evaluate performance of the OMP. Specifically, it is predicted that as grassland (LMU2 and LMU3) and low quality woodland (LMU3) areas are restored, the assemblages of birds, reptiles within these areas will become increasingly similar to assemblages in the medium-high quality woodland habitats (LMU2).

A total of thirty-two bird and reptile monitoring sites were established across the three BMAs. The locations were strategically and practically chosen to sample accessible grassland and woodland communities. The monitoring sites were located to account for spatial variability across the BMAs and included the different LMU categories. The locations of the sites are provided in Figure 2.2 . At each site a monitoring plot was established measuring 20 x 50m as shown in Figure 2.1. A summary of the established sites is provided in Table A.1 and below.

- Four sites within very-high quality woodlands LMU1 (Namoi BMA only)
  - 2 sites in Box Gum Grassy Woodlands, 2 sites in Callitris / Ironbark Woodland
- Seven sites within medium-high quality woodlands LMU2
  - 6 Sites within Box Gum Grassy Woodland, one site within Riparian Zone
- Seven sites within medium-high quality grasslands LMU2
  - 6 Sites within Derived Native Grassland, one site within Low Diversity Grassland
- Seven sites within low quality woodlands LMU3
  - 3 Sites in Box Gum Grassy Woodlands, and 4 Sites in Riparian Zone

- Seven sites within low quality grasslands LMU3
    - Four sites in Derived Native Grassland, and three sites in Low Diversity Grassland

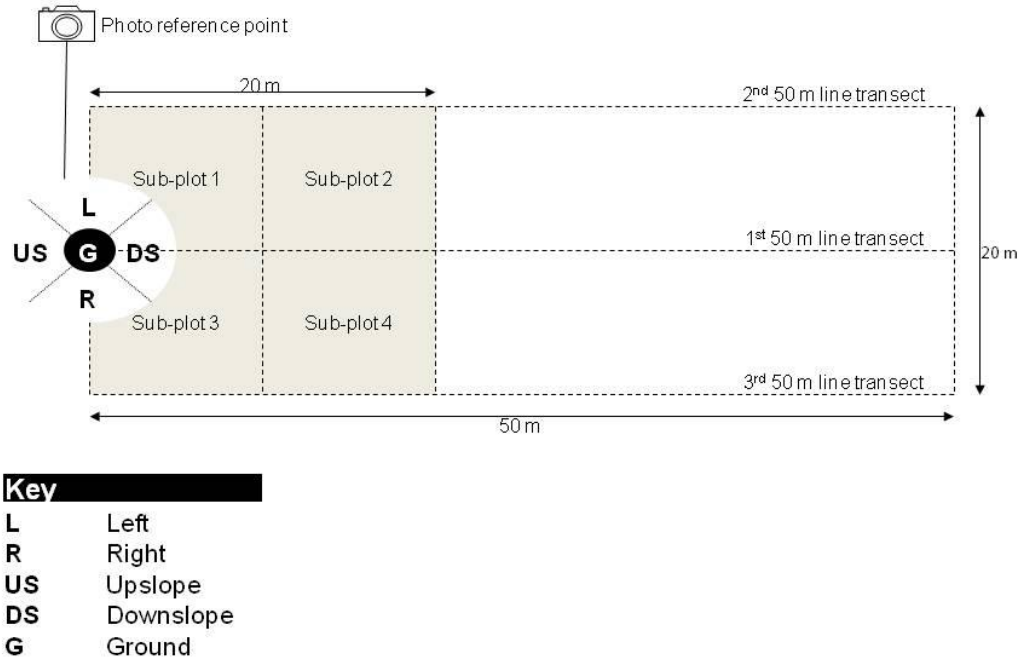


Figure 2.1 Monitoring plot schematic for Indicators of Ecosystem Condition and Box Gum grassy Woodlands

i. Fauna Habitat Features

Each monitoring plot was assessed for fauna habitat quality. Within a 50 x 20m plot, the following was recorded at each site:

- number and species of canopy trees;
- proportion of trees with hollows (minimum entrance width of 5cm);
- presence of mistletoe, flowers, fruit, and dead trees; and
- size and quantity of fallen logs (minimum diameter 10cm and minimum length 50cm).

Within a smaller 20 x 20m plot the percent cover of litter, rock, and bare ground was estimated, by dividing the plot into four 10 x 10m sub-plots, and averaging together to obtain a mean for the site.

Coordinate System: MGA Zone 56 (GDA 94)

Grid North

0 5
kilometres
Scale: 1:91,370

0 5
kilometres
Scale: 1:101,600

0 2
kilometres
Scale: 1:32,440

Legend

BMA Boundaries

- Merriwa West BMA
- Merriwa East BMA
- Namoi BMA

Habitat / LMU Class of IES Monitoring Sites

- Riparian
- CI Woodland
- Woodland
- Grassland
- LMU 1
- LMU 2
- LMU 3

Image Sources:
Google Pro (2013)
DigitalGlobe (2013)
Cnes/Spot Image (2013)
Sinclair Knight Merz (2013)
(Captured 29/11/2013)

CUMBERLAND ECOLOGY

I:\...\12101\Figures\12101RP4\Figure 2.1 IEC Monitoring Sites_20131129

Figure 2.2 Monitoring sites for Indicators of Ecosystem Condition (Merriwa East BMA)

ii. Birds

a. Habitat area searches

Habitat area searches were conducted in accordance with Birds Australia Atlas search methodology (Birds Australia 2013) and the EPBC Act bird survey guidelines (DEWHA 2010). Each site was surveyed for birds by two observers for 20 minutes within a 2 ha area (about the monitoring plot). All birds sighted or heard calling during this period were recorded and their behaviours noted.

b. Incidental and opportunistic records

Incidental and opportunistic surveys were conducted including visual observations and detected calls, as well as suitable habitat areas were recorded across all three BMAs. General notes on important habitat resources (such as tree hollows, flowering trees, and nests) were recorded incidentally and photographed, as well as any notable bird activity such as specific forage behaviour or signs of breeding activity.

iii. Reptiles

a. Active Searches

Reptiles were surveyed by undertaking diurnal and nocturnal searches of the 20 x 50m monitoring plots. Diurnal searches involved disturbing shrubs and tussock grasses, lifting bark, fallen logs, bush rock, and scraping top soil; whereas nocturnal searches involved spotlighting for reptiles in suitable habitat at call playback locations.

b. Funnel Traps

Four funnel traps were set out at each monitoring site along a single drift fence. The drift fence was erected beginning at the centre of the down-slope 20 m boundary of the plot, and extending in a straight line 7m directly perpendicularly down-slope. Two funnels were placed alongside, and another two were placed at either end of the drift fence. The drift fence was not dug within the boundaries of the monitoring plot, so as not to introduce disturbance associated weeds into the plot. At site 38, traps were only set out for one night due to weather and time restrictions; however 8 traps were set out to equal 8 x trap nights as per other sites.

c. Photo Reference Points

A photo reference point was established and permanently marked within each monitoring plot, to provide a visual record of any changes in vegetation and habitat condition. The photo location was established at the middle of the upslope boundary of the plot, and marked by a steel picket. GPS waypoints were taken at the location of the picket.

Depending on the location, the photo references provided information on:

- Changes in vegetation structure (such as canopy trees, shrubs, tussock grasses)

- The presence/condition of species habitat features (such as rocky outcrops, flowering/fruiting species)
- Changes in identified threatening processes (such as weed infestations, erosion)

At each monitoring site 5 digital photographs were taken in the following directions:

- Downslope (photo a);
- Upslope (photo b);
- Across the slope – Left (photo c);
- Across the slope – Right (photo d); and
- Directly down (photo e).

Photographs and data from the Indicators of Ecosystem Condition are to be stored on the Mount Pleasant Project – Biodiversity Management Areas Portal.

2.1.3 Matters of National Environmental Significance (MNES) - Box Gum Grassy Woodlands

Surveys to establish conditions of Box Gum Grassy Woodland and threatened fauna species listed as MNES were undertaken. These surveys establish the baseline conditions that will help to assess the progress of management and restoration activities for Box Gum Grassy Woodlands and habitat for threatened fauna within the BMAs. The relevant MNES listed under the EPBC Act are:

- White box - yellow box - Blakely's red gum grassy woodlands and derived native grasslands
- Regent Honeyeater *Anthochaera phrygia*;
- Swift Parrot *Lathamus discolor*;
- Spotted-tailed Quoll *Dasyurus maculates maculates*; and
- Greater (South-eastern) Long-eared Bat *Nyctophilus corbeni*.

The current survey was not required to target any MNES fauna. These species will be assessed during additional surveys commencing in winter 2014. The current project focussed on a vegetative and habitat assessment of the BMAs.

i. Monitoring Plots

The design of the Box Gum Grassy Woodlands monitoring programme is similar to the Indicators of Ecosystem Condition except sites were focussed in Box Gum Grassy

Woodland vegetation to the exclusion of other woodland vegetation. The sites were allocated to each BMA as follows:

- Four sites within Very high quality Box-Gum Grassy Woodlands LMU1
  - Namoi BMA only
- Seven sites within medium-high quality Box-Gum Grassy Woodlands LMU2
  - Namoi, Merriwa East, and Merriwa West BMA
- Seven sites within medium-high quality Derived Native Grasslands LMU2
  - Namoi, Merriwa East, and Merriwa West BMA
- Seven sites within low quality Box-Gum Grassy Woodlands LMU3
  - Namoi, Merriwa East, and Merriwa West BMA
- Seven sites within low quality Derived Native Grasslands LMU3
  - Namoi, Merriwa East, and Merriwa West BMA

The sites were selected according to the following criteria:

- Property: where possible one or more monitoring sites of each condition class were selected from each of the 6 properties to capture the range of vegetation types across the BMAs and to capture variation among properties due to prior management regimes.
- Field Assessment: since each LMU has been categorised according to average vegetation condition, and consequently there was some variation in the actual condition across the LMU, field assessment was used to ensure sites are established within vegetation consistent with the designated average condition of the LMU.
- Photographs and data are to be stored on the Mount Pleasant Project – Biodiversity Management Areas Portal.

Coordinate System: MGA Zone 56 (GDA 94)

Grid North

0 5
kilometres
Scale: 1:91,370

0 5
kilometres
Scale: 1:101,600

0 2
kilometres
Scale: 1:32,440

Legend

BMA Boundaries
- Merriwa West BMA
- Merriwa East BMA
- Namoi BMA

Habitat / LMU Class of MNES Monitoring Sites
- Woodland
- Grassland
- LMU 1
- LMU 2
- LMU 3

Image Sources:
Google Pro (2013)
DigitalGlobe (2013)
Cnes/Spot Image (2013)
Sinclair Knight Merz (2013)
(Captured 29/11/2013)

CUMBERLAND ECOLOGY

I:\...\12101\Figures\12101RP4\Figure 2.3 MNES Monitoring Sites_20131129

Figure 2.3 Monitoring sites for MNES

ii. Floristic Methods

Monitoring was commenced to establish baseline data for subsequent bi-annual monitoring. Field methods have been adapted from the BioMetric 3.1 methods for assessing site value (Department for Environment and Climate Change, NSW, 2011). A combination of quadrat and transect surveys were conducted to collect information on changes in vegetation community composition, structure, and canopy regeneration. A 50m x 20m plot was established at each monitoring site such that the plot runs down slope. A 20m x 20m quadrat was established within the larger plot, and three transects ran its length, as shown in Figure 2.1.

The 50m x 20m plots were used to record details on the over-storey layer including species richness, abundance of tree hollows, flowers/fruit, mistletoe, and fallen logs. The 20m x 20m quadrat was used to record details of the mid storey and ground stratum species diversity and abundance, including composition and % cover of exotic/native species, various plant groups, and the presence/absence of 'important' species listed in the EPBC act for Box gum Grassy Woodland Communities (DEH 2006a). Additional features such as rocks, litter and bare ground were recorded at this scale. A summary of all sampling methods is presented below in Table 2.1.

Table 2.1 Summary of sampling methods for MNES Box Gum Grassy Woodlands monitoring

Variable	Measurable Units	Sampling Area
Community Composition and Species Richness		
Native over-storey	Specied ID and Species/m2 No.	50 x 20m plot
Native mid-storey	Specied ID and Species/m2 No.	20 x 20m quadrat
Native ground stratum (grasses)	Specied ID and Species/m2 No.	20 x 20m quadrat
Native ground stratum (shrubs)	Specied ID and Species/m2 No.	20 x 20m quadrat
Native ground stratum (other)	Specied ID and Species/m2 No.	20 x 20m quadrat
Exotic ground stratum	Specied ID and Species/m2 No.	20 x 20m quadrat
Total	Specied ID and Species/m2 No.	20 x 20m quadrat for mid-storey and ground stratum,

Table 2.1 Summary of sampling methods for MNES Box Gum Grassy Woodlands monitoring

Variable	Measurable Units	Sampling Area
		50 x 20m plot for overstorey
Total native species	Specied ID and No. Species/m2	20 x 20m quadrat for mid-storey and ground stratum, 50 x 20m plot for overstorey
Total important species	Specied ID and No. Species/m2	20 x 20m quadrat for mid-storey and ground stratum, 50 x 20m plot for overstorey
Total exotic species	Specied ID and No. Species/m2	20 x 20m quadrat for mid-storey and ground stratum, 50 x 20m plot for overstorey
Community structure		
Native over-storey	% cover	3 x 50m transects
Native mid-storey	% cover	20 x 20m quadrat
Native ground stratum (grasses)	% cover	20 x 20m quadrat
Native ground stratum (shrubs)	% cover	20 x 20m quadrat
Native ground stratum (other)	% cover	20 x 20m quadrat
Exotic	% cover	20 x 20m quadrat
Over-storey regeneration/health		
Over-storey regeneration	No. Species	50 x 20m plot
Over-storey species stem diameter class (0 - 10cm)	No./m2	50 x 20m plot
Over-storey species stem diameter class (10 - 20cm)	No./m2	50 x 20m plot
Over-storey species stem diameter class >20cm)	No./m2	50 x 20m plot

Table 2.1 Summary of sampling methods for MNES Box Gum Grassy Woodlands monitoring

Variable	Measurable Units	Sampling Area
Additional habitat features		
Litter	% cover	20 x 20m quadrat
Rock	% cover	20 x 20m quadrat
Bare ground	% cover	20 x 20m quadrat
Log	length	50 x 20m plot
Tree hollows	number	50 x 20m plot
Dead trees	(% tree population)	50 x 20m plot
Mistletoe	(% tree population)	50 x 20m plot

iii. Photo reference points

Photo reference points were established as described previously in the Indicators of Ecosystem Condition. The photographs were stored on the Mount Pleasant Project – Biodiversity Management Areas Portal and are displayed so that photos can be viewed against a baseline photo (2013) in the future. The photo records will provide a visual record of changes in vegetation as management strategies are implemented.

iv. Soil analysis

Soil samples were undertaken using standard soil sampling techniques with a core sampler within the 20m x 20m monitoring quadrat. 12 cores were taken at each site and bulked together. Soil sampling assessed the parameters: pH; electrical conductivity; Available calcium, magnesium, Potassium, ammonia, Sulphur, and organic matter; exchangeable sodium, calcium, magnesium, potassium, hydrogen; cation exchange capacity; available and extractable phosphorous, micronutrients (Zinc, Manganese, Iron, Copper, boron); total carbon and nitrogen. Soil samples were sent to the Environmental Analysis Laboratory at Southern Cross University for analyses.

2.1.4 Analysis of Data

Data was analysed using common scientific methods to evaluate differences between treatments. Analysis of Variance (ANOVA) was used to detect differences between treatments for single factors such as species richness, abundance of specific habitat features (% cover vegetation structural layers etc). ANOVA compares the means between treatments and determines the likelihood of means differing by chance alone.

For multivariate data, non-metric multi-dimensional scaling (MDS) and SIMPER analysis were used to visualise and detect differences between factors. MDS incorporates multiple factors (such as ground cover, log count, overstorey species) and presents the findings in a two dimensional graph to show how each site (or treatment) relates to each other. The MDS plots are dimensionless, and there are no values for the x- or y-axis, but are highly effective for visualising relatedness between treatments.

SIMPER analysis is used in conjunction to the MDS plots and these provide a value on how similar responses are within sites (ie how similar grassland plots are to each other), or how dissimilar responses are between treatments (ie how different all grassland sites are to all woodland sites) and this is presented as a percent similarity (or dissimilarity). The SIMPER values are important for future monitoring as they will be able to detect changes in sites.

Graphs and charts have also been used to visualise the results, and summarise patterns in data. It is important to note that baseline monitoring collects a large volume of data, and this report only presents key findings from the initial assessment, and so other data relevant to the project that did not produce significant results has not been presented. This data remains important for future monitoring and may be accessed at a later date.

Chapter 3

Results

3.1 Field Survey Conditions

Field studies were undertaken at each of the Mt Pleasant Offset BMAs over the following time periods:

- 28th October – 1st November Merriwa East
- 4th November – 8th November Namoi BMA
- 11th November – 15th November Merriwa West BMA

During this time the weather was mostly clear and warm, with daily highs in the low 30s and overnight temperatures about 10 degrees. There was an exception to the stable weather pattern, on the 11-13th November, where large thunderstorms brought significant rainfalls to the Merriwa Plateau.

The Merriwa BMAs are currently very dry and although there were widespread rain showers during the third week of surveys, the region has suffered below average rainfall for the preceding 4 months. Similarly dry conditions to the Merriwa BMAs were observed at the Namoi BMA, Warrawoona. Both Merriwa and Namoi regions have had below average rainfalls for 5 months. As such the ground condition is quite poor; and most herbaceous flora and grasses were very dry, at times difficult to identify, or not visibly present. As a result of a prolonged dry period, the density and height of grasses in some areas was very low. The dry conditions also have an effect on the abundance of feed resources available (such as seeds and insects) for birds and small reptiles, and this was reflected particularly in lower than expected abundances of small reptiles such as skinks.

3.2 Indicators of Ecosystem Condition

i. Fauna Habitat Features

Woodland habitats consisted of Box-gum grassy woodlands, Callitris-Ironbark woodlands, and Riparian woodlands along creek lines. Overstorey species for each woodland type varied considerably. Box-gum grassy woodlands were dominated by White Box Eucalyptus albens, Callitris-Ironbark Woodlands were dominated by White cypress Pine *Callitris glaucophylla*, and Riparian woodlands were dominated by River Oak *Casuarina cunninghamiana*.

Photograph 3.1 Box gum Grassy Woodland on Clare Park at Merriwa East BMA (31st October 2013)

Photograph 3.2 Callitris – Ironbark Woodland on Warrawoona at Namoi BMA (7th November 2013)

Photograph 3.3 Riparian Woodland on St Antoine at Merriwa West BMA (14th November 2013)

Habitat features were assessed and analysed using ANOVA, and non-parametric multidimensional scaling to assess for dissimilarity between habitats and land management types. A summary table of habitat features for Indicators of Ecosystem Condition can be found at Table B.1. There was a significant difference in leaf litter % cover between LMU classes with LMU1 being significantly different to LMU2 and LMU3 (no difference between LMU2 and LMU3. Derived Native Grassland and Box Gum Woodland sites were significantly different, and Callitris – Ironbark sites were different to all other habitat types Figure 3.1 .

There was a significant difference in the number of logs at each 50 x 20m monitoring plot, with all habitat types and LMU classes being different to each other Figure 3.2. There was no significant difference between habitat features such as rocks and bare ground between sites and LMU classes.

MDS analysis showed a good spread of data between sites at each BMA. The MDS data incorporates all habitat features (Table B.1), and shows the how each site relates to each other in a two dimensional graph. Although the MDS plot is dimensionless, it provides a useful visual presentation of how similar sites are to each other. A separate MDS was conducted for each BMA. At Merriwa East BMA, there was slight grouping between grassland sites. Riparian sites and Box Gum Woodlands also grouped, and the two groups were separated. The likely driver of this separation is features related to the occurrence of overstorey flora (such as trees). As regeneration occurs at grassland sites this grouping is expected to break down and sites will become more related to each other.

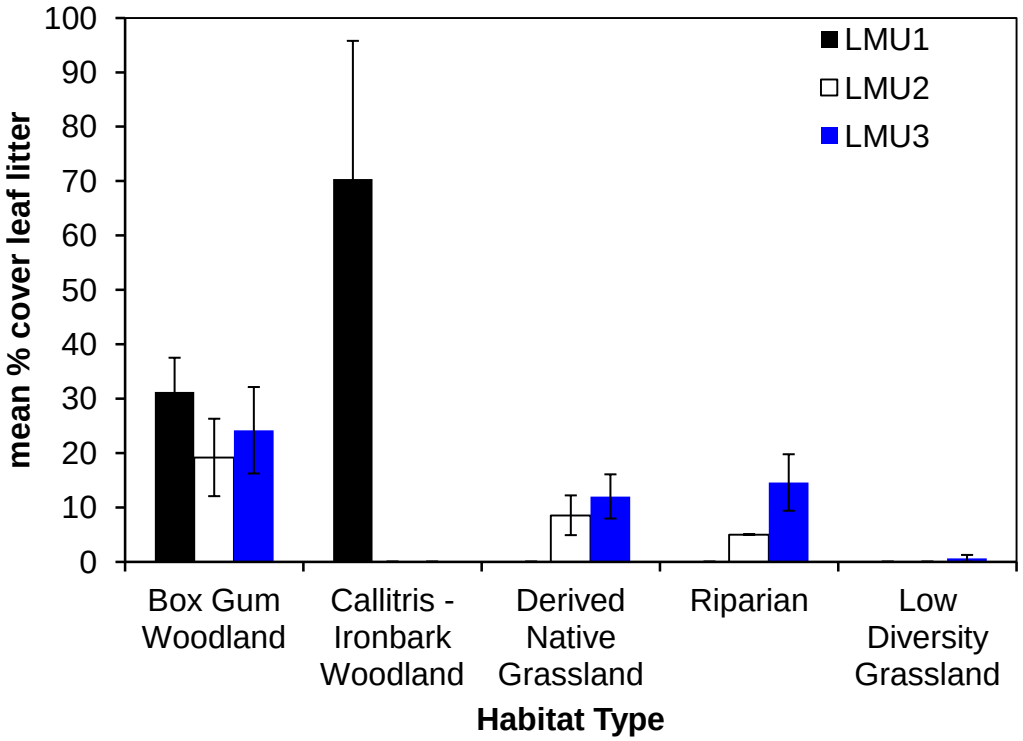


Figure 3.1 **Mean percent cover of leaf litter at IEC monitoring sites**

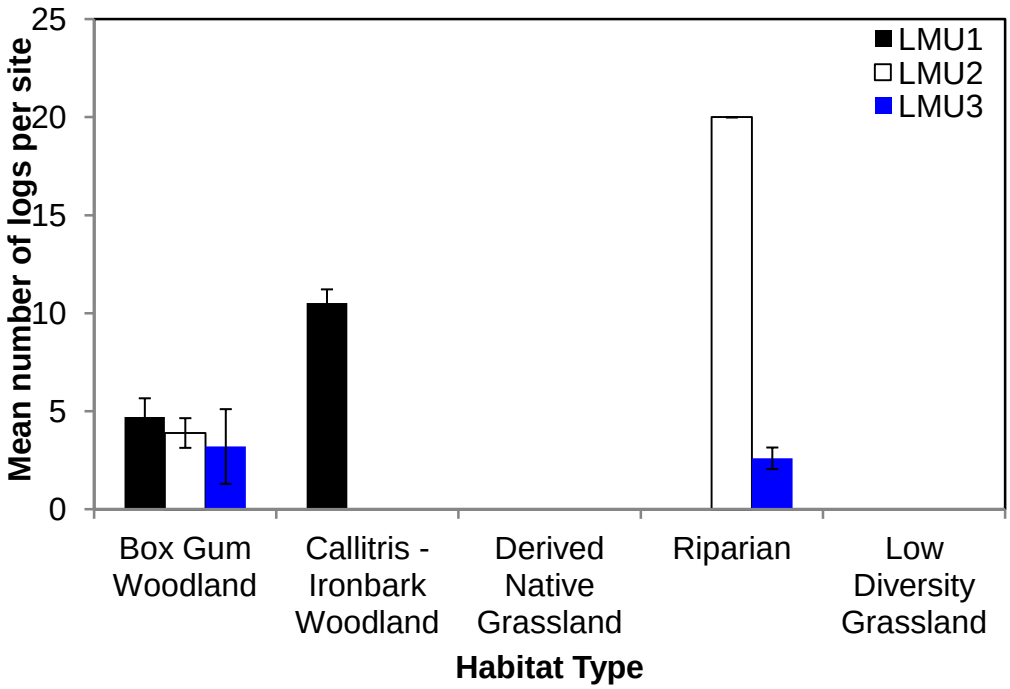


Figure 3.2 **Mean number of logs per IEC monitoring site**

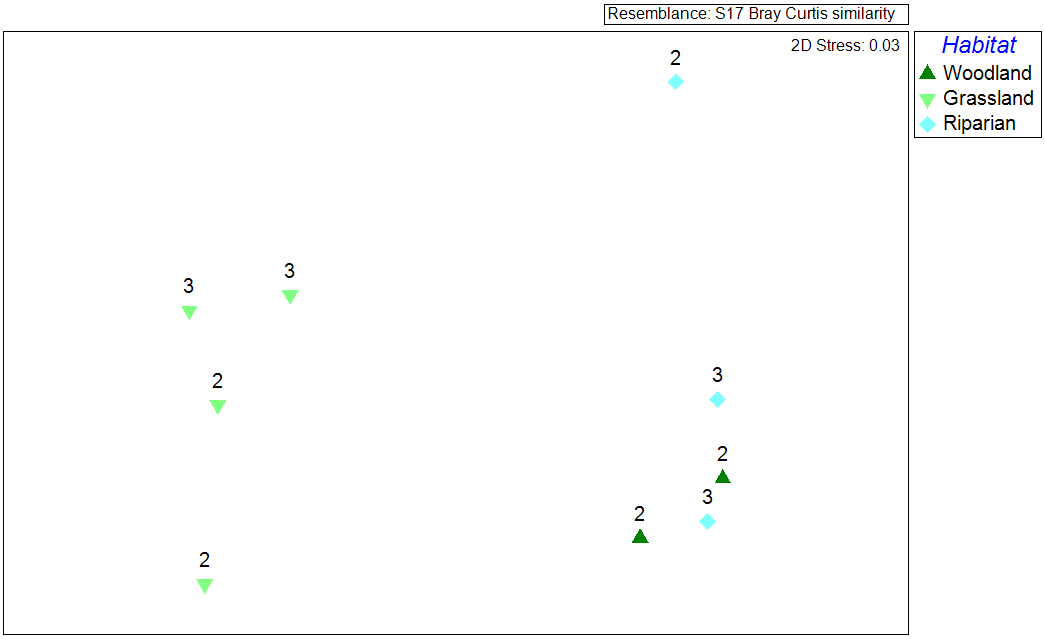


Figure 3.3 **MDS plot of habitat features at Merriwa East BMA showing spread of LMU classes (numbers) and habitats (symbols)**

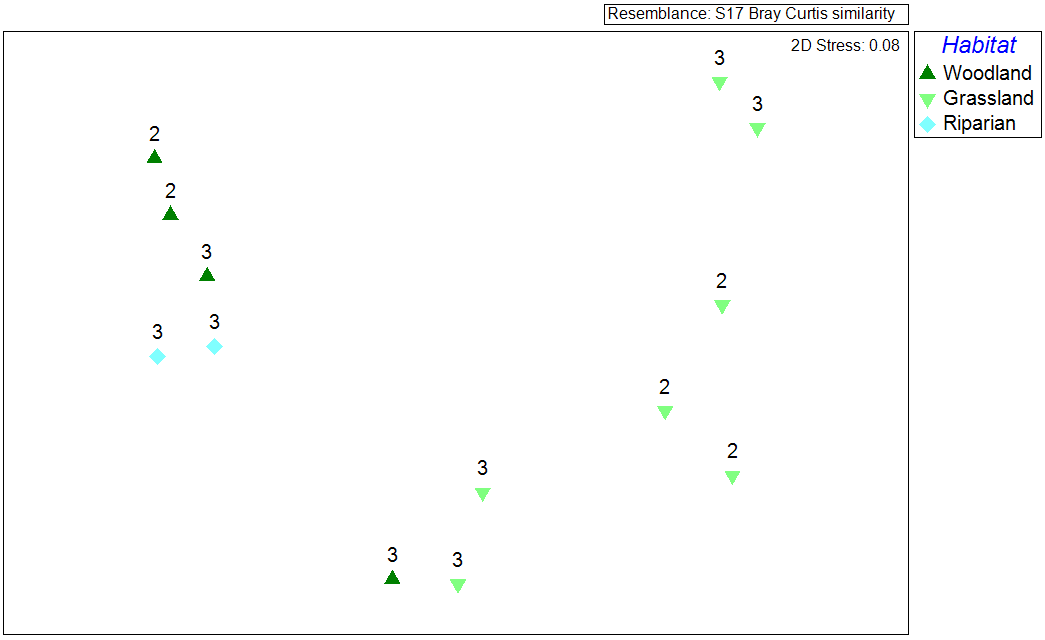


Figure 3.4 **MDS plot of habitat features at Merriwa West BMA showing spread of LMU classes (numbers) and habitats (symbols)**

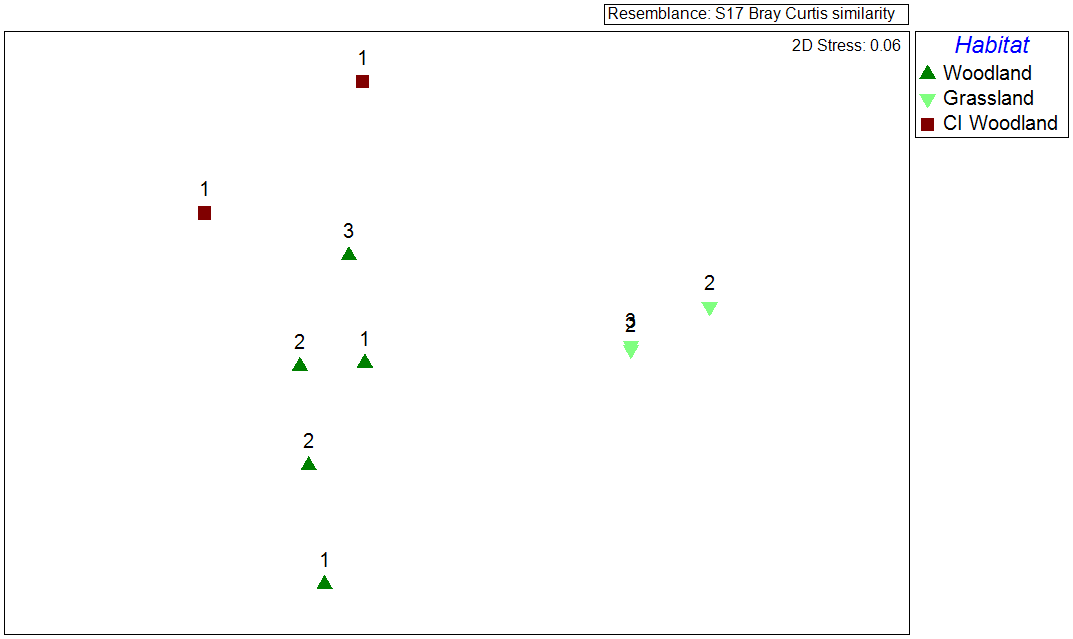


Figure 3.5 MDS plot of habitat features at Namoi BMA showing spread of LMU classes (numbers) and habitats (symbols)

ii. Birds

There were a total of 94 bird species observed across the three BMAs, 74 which were observed during morning bird census at IEC monitoring locations, and 20 which were observed as incidentals whilst traversing the sites.

Four species observed during the survey period are currently listed as vulnerable under the TSC act 1995:

- Speckled Warbler *Chthonicola sagittata;*
- Painted Honeyeater *Grantiella picta;*
- Grey-crowned Babbler *Pomatostomus temporalis; and*
- Diamond Firetail *Stagonopleura guttata.*

Avifauna species richness was calculated for each site using presence absence data from the daily census. Richness varied from 3 species (Site 28, LMU2, Grassland) to 22 species (Site 24, LMU1, Woodland), with generally higher diversity at woodland sites than grassland sites. There was no difference in bird species richness between habitat types and land management units, and this is attributed to high species richness at the riparian sites in LMU3. Removal of these sites from the data shifts the trend to fit with the hypothesis that LMU2&3 grasslands resemble LMU3 woodlands in terms of species richness, presented at section 2.2.1. This trend was not significant though Figure 3.6 . A full list of observed bird species observed at IEC monitoring sites is listed in Table B.2 and a list of incidental bird sightings is available at Table B.3.

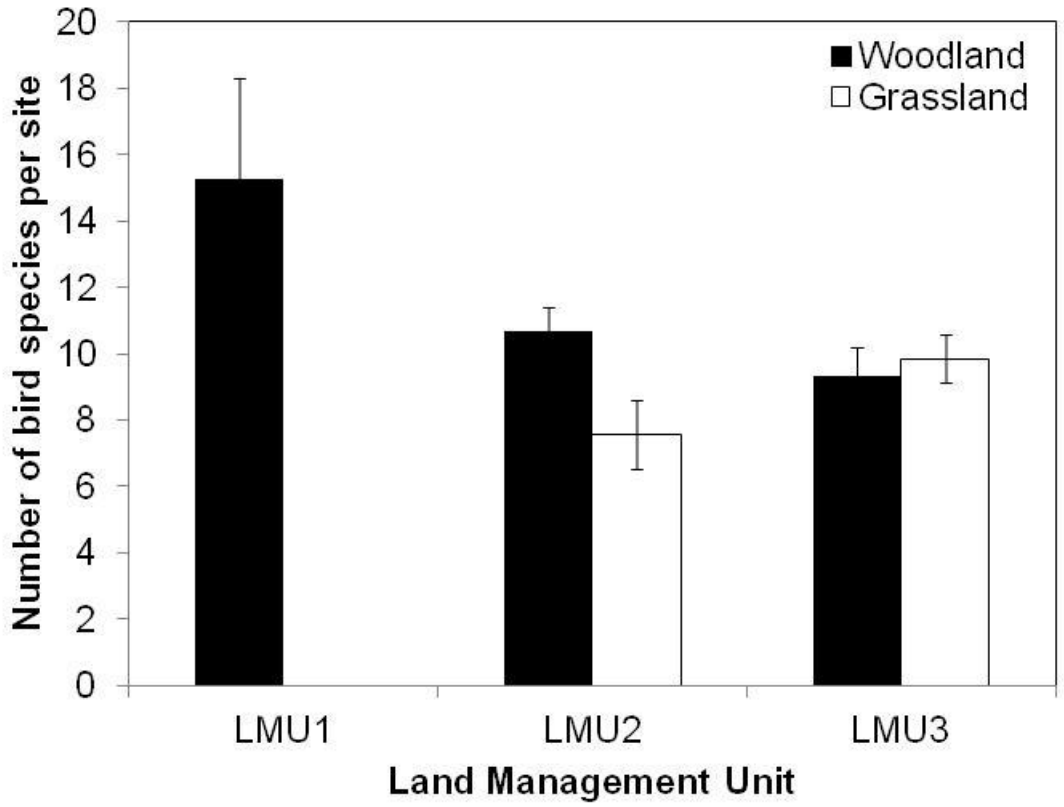


Figure 3.6 Species richness of birds at Indicators of Ecosystem Condition monitoring sites. The above data excludes bird data from riparian sites

For this analysis, a separate MDS was conducted for each BMA. The MDS incorporated all data from Table B.2. When analysed at a regional scale, the MDS plots did not show any differences in bird assemblage between BMAs or LMU classes Figure 3.7 , with the exception of site 38, seen on the far right of the MDS plot. Site 38 is a Riparian habitat site on Merriwa East, and there were several bird species observed only at this site (including the Diamond Firetail *Stagonopleura guttata*), and this is the reason for the separation.

SIMPER analysis was conducted to establish similarities and dissimilarities between bird assemblages at each site. For MEBMA there was a dissimilarity between LMU2 and LMU3 of 79 %, indicating a difference exists in the assemblages of birds between sites. Woodland and grassland were 42 % dissimilar, which supports the findings above with low diversity in woodland sites. Riparian and woodland sites were 95.83% dissimilar which is also supporting of the high diversity at the riparian monitoring sites. The high diversity at riparian sites may be indicative of the recent dry conditions, with little flowering species and feed species available outside areas with constant water supply.

At MWBMA, the SIMPER analysis found most similarities to be about 50 % within LMU classes. There was a 72 % dissimilarity between Riparian and Woodland sites at Merriwa West, which is consistent with findings at Merriwa East. At the Namoi BMA, there was low similarity between LMU2 sites (23 %) which may be resultant of the high diversity of birds at

Warrawoona. There was a 15 % similarity between grassland sites, and this is resultant from very low richness at site 28 (3 species).

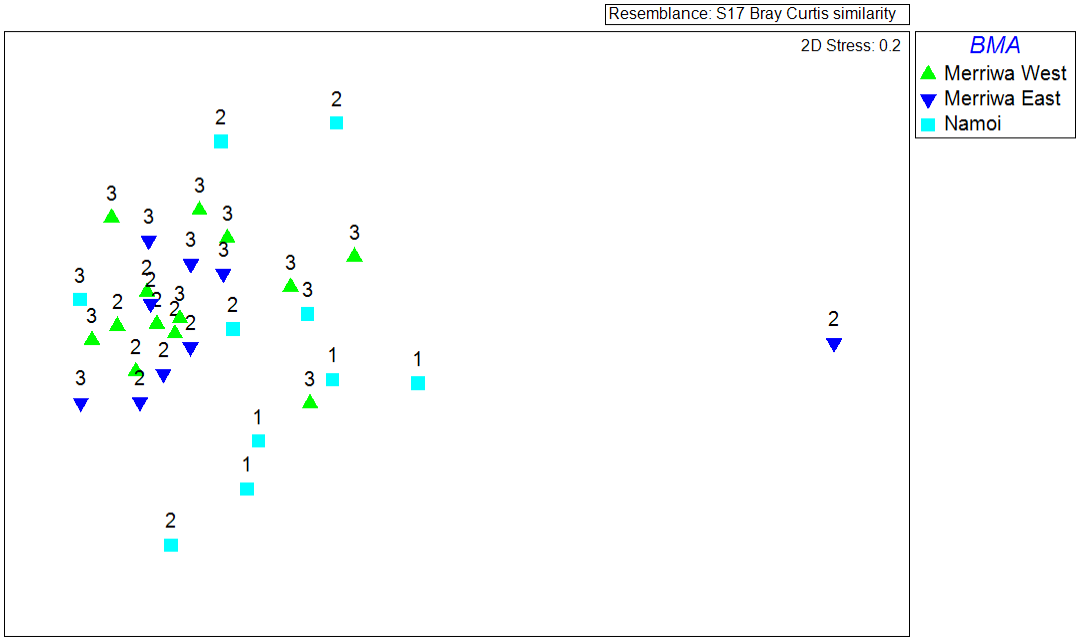


Figure 3.7 **MDS plot of bird observations across all BMAs. The colour denotes the BMA and the numbers indicate LMU.**

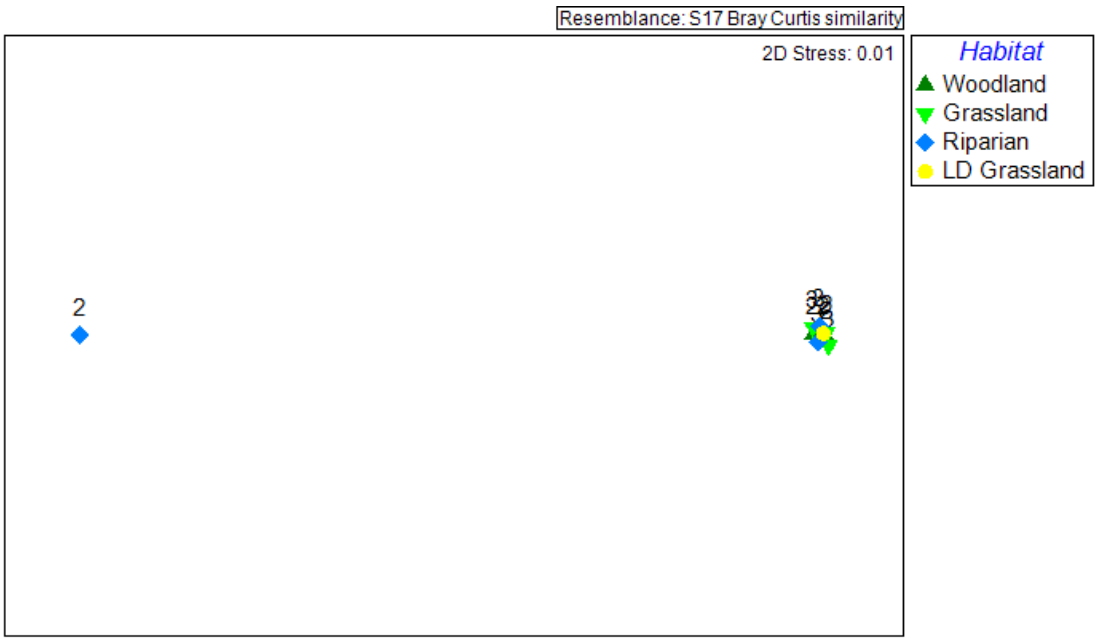


Figure 3.8 **MDS Plot of bird observations across LMU classes (numbers) and habitat types (symbols) at Merriwa East BMA**

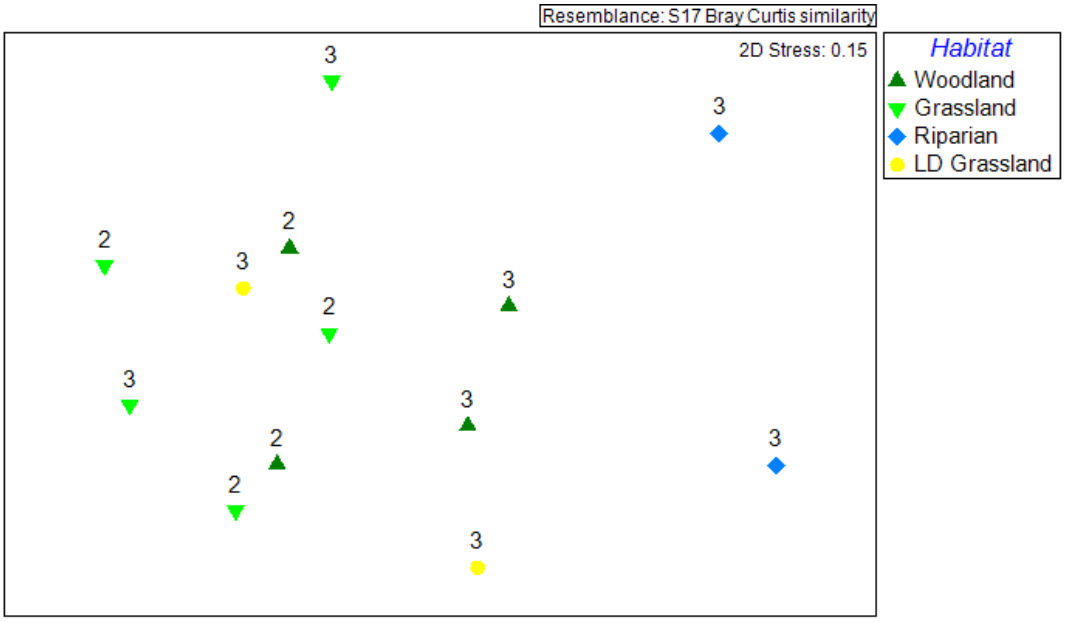


Figure 3.9 MDS Plot of bird observations across LMU classes (numbers) and habitat types (symbols) at Merriwa West BMA

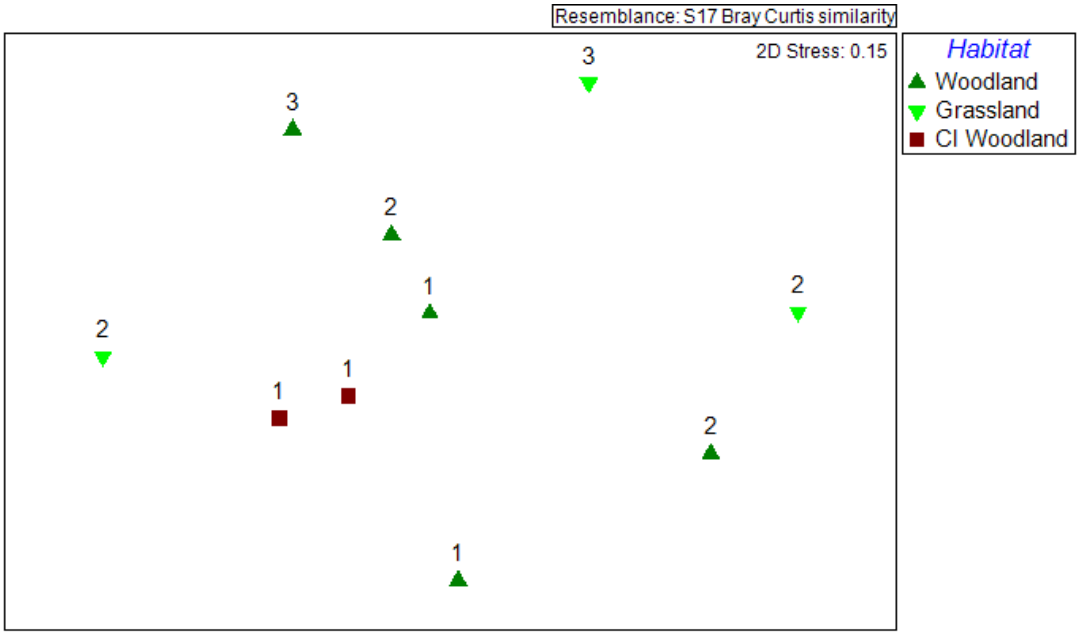


Figure 3.10 MDS Plot of bird observations across LMU classes (numbers) and habitat types (symbols) at Namoi BMA

BioEnv Analysis (BEST Analysis) was carried to determine which environmental variable was driving the separation in bird abundance MDS plots (Figure 3.8, Figure 3.9, and Figure 3.10). BioEnv uses Spearman Rank Correlations to interface environmental variables (habitat characteristics) with response variables (bird species). For Merriwa East BMA, the MDS was primarily driven (0.620) by % cover of rock, Overstorey Species (DBH 0-10cm, and 10-20cm). The prevalence of % rock cover is likely an indicator of habitat type supporting birds rather than a biological indicator of bird abundance. At Merriwa West the data was driven (0.245) by Overstorey Regeneration (number of species), % cover of rock,

% cover of bare ground, and number of stags per site. At Namoi BMA, the flora MDS was driven by Overstorey Regeneration (number of species), number of logs per site, and the number of hollows per site.

iii. Reptiles

Herpetofauna diversity was very low across all BMAs and all habitat types, and is likely indicative of the current dry conditions. A total of 9 species of reptiles were detected across the three BMAs with no threatened species observed. All species observed are common for the region and are expected to occur in Box-gum Grassy Woodlands or derived native grasslands. Due to the low abundance of reptiles at each site, reptile data was assessed as a presence-absence data at each site. LMU1 woodland sites had higher occurrences of reptiles than both LMU 2&3 woodland and grassland sites; however ANOVA found this difference to be not significant (Figure 3.11). A full list of reptiles observed is presented in Table B.5 .

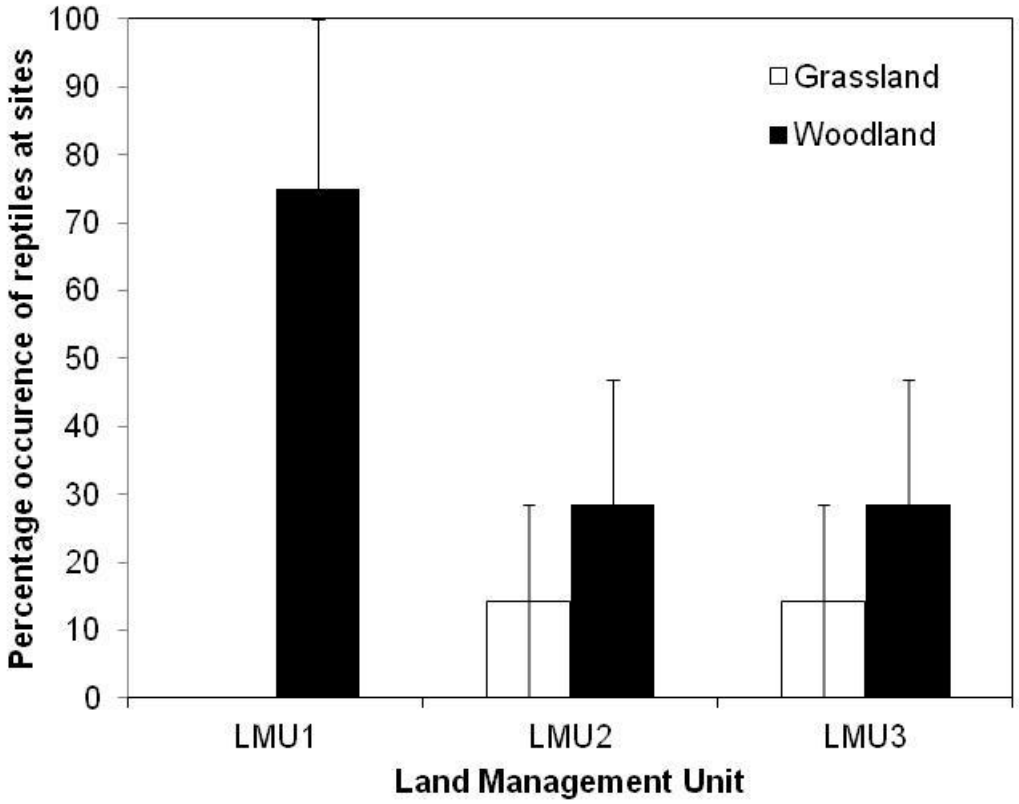


Figure 3.11 Occurrence of reptiles across habitat types at different land management units

Photograph 3.4 Southern Rainbow-Skink *Carlia tetradactyla* at St Antoine (13th November 2013)

Photograph 3.5 Eastern Bearded Dragon *Pogona barbata* at Warrawoona (7th November 2013)

iv. Other threatened fauna observed.

During daytime bird census and spotlighting, koalas Phascolarctos cinereus in Callitris – Ironbark woodlands and in Box Gum grassy woodlands. Koalas are currently listed in NSW as vulnerable under the TSC Act 1995.

Photograph 3.6 Koala *Phascolarctos cinereus* in a Yellow box E. melliodora on Warrawoona (5th November 2013)

3.2.2 Matters of National Environmental Significance (MNES) - Box Gum Grassy Woodlands

Flora monitoring plots were carried out at 32 sites. Box Gum Grassy Woodland sites were typified by *Eucalyptus albens* and *Eucalyptus melliodora*. Derived Native grasslands were typified by Speargrass *Austrostipa scabra* and Perennial Ryegrass *Lolium perenne*. The total number of important species per site was analysed and not found to be significant between LMU classes or habitat types. Total exotic species per site was analysed and a significant difference was found between land management units, but not between habitats. LMU1 had significantly lower abundance of exotic species per plot than LMU2 or LMU3. LMU2 and LMU3 did not differ significantly in number of exotic species Figure 3.12. This is supportive of the classification of LMU1 sites in having little to no exotic species.

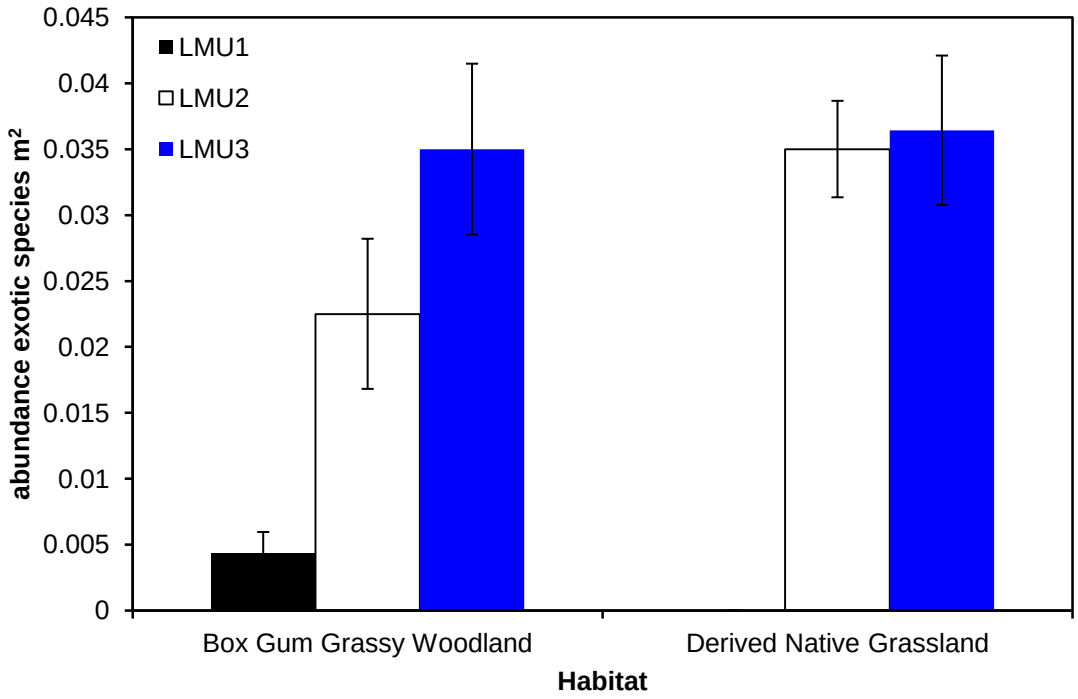


Figure 3.12 Mean number of exotic species m^2 in MNES monitoring plots between habitat types and LMU classes.

MDS analysis was carried out at each BMA using all habitat data variables as shown in Table C.1. Sites showed a reasonable spread and 2D stress on graphs was <0.2. For Merriwa East BMA there was a significant grouping of Derived Native Grassland sites. This grouping is indicative of previous farming practices whereby all grassland sites were likely subjected to similar influences Figure 3.13 .

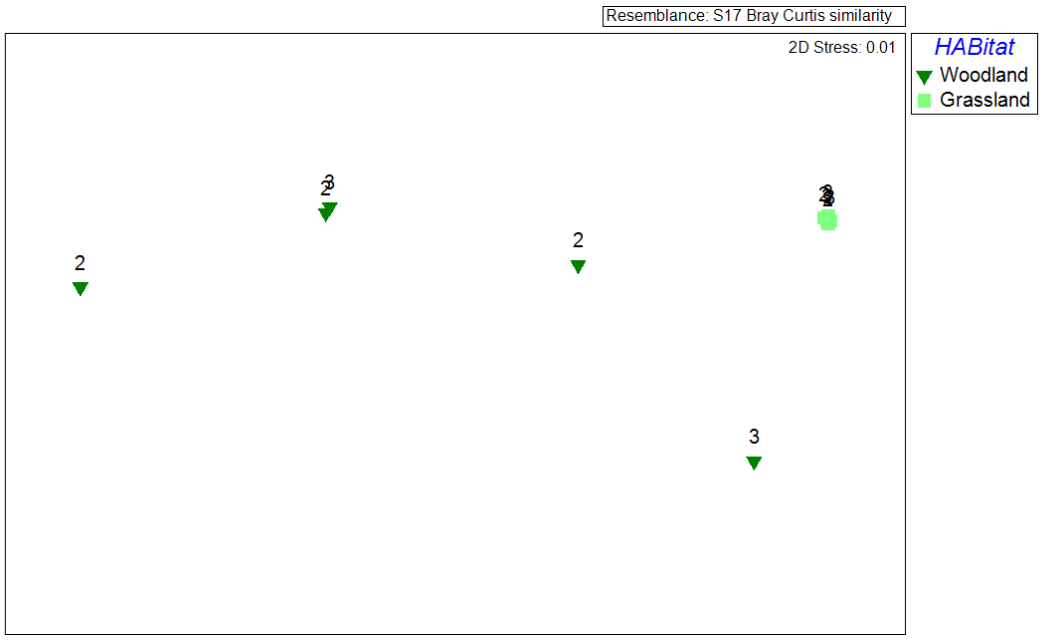


Figure 3.13 MDS plot of MNES monitoring sites at Merriwa East. Colour indicates habitat type and number indicates LMU.

At Merriwa West BMA, there was a similar separation of Derived Native Grassland and Box Gum Grassy Woodland sites, however this was separated by LMU Figure 3.14 . This separation may be indicative of previous management practices as the sites were also grouping by property (LMU2 – Wahrane, LMU3 – St Antoine). There was a reasonable spread of woodland sites but these were not grouped by property within MWBMA.

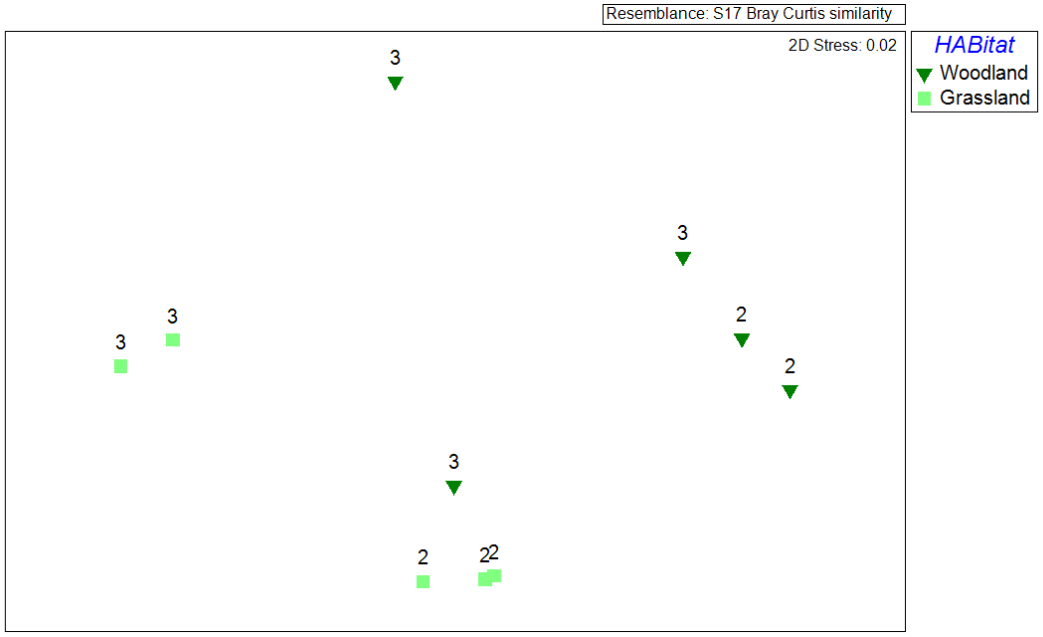


Figure 3.14 MDS plot of MNES monitoring sites at Merriwa West. Colour indicates habitat type and number indicates LMU.

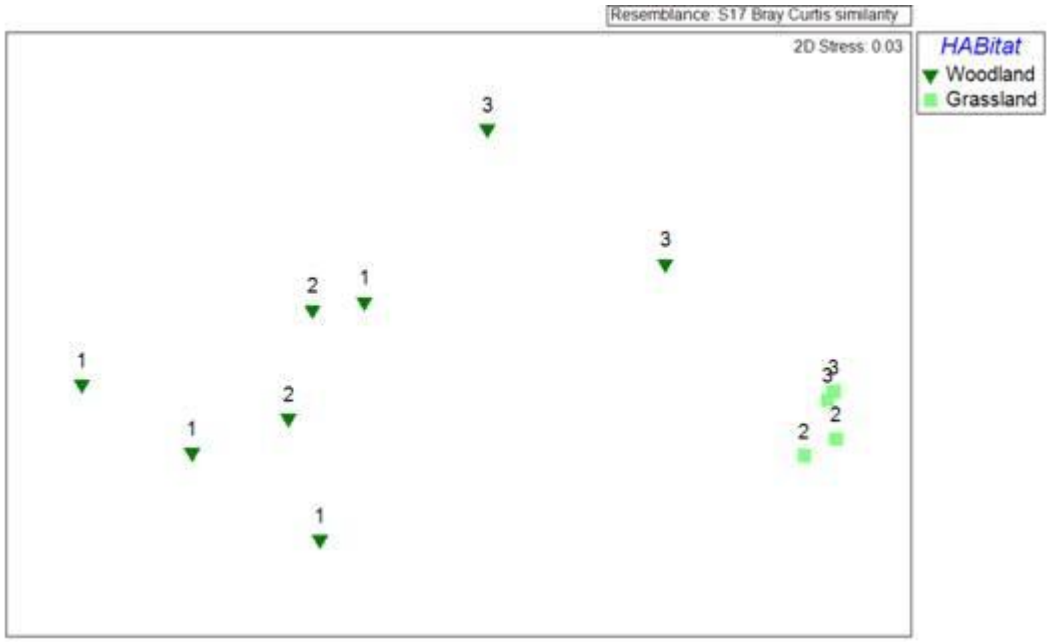


Figure 3.15 MDS plot of MNES monitoring sites at Namoi BMA. Colour indicates habitat type and number indicates LMU.

At Namoi BMA, the Derived Native Grassland sites grouped compactly and separately to Box Gum Grassy Woodland Sites Figure 3.15 . There was a gradient in Woodland sites with LMU1 sites grouping distant to LMU3 woodland sites. Interestingly, the LMU2 and LMU3 sites did not show any separation, which indicates that features determining these LMU classes may not have been present. The grouping here may highlight the poor environmental conditions that have occurred at Namoi BMA over the past few months.

SIMPER analysis was carried out for all Biodiversity Management Areas, and is shown in Table C.2. At Merriwa East within LMU similarity was lower than both Merriwa West and Namoi BMA. The LMU classes were similarly dissimilar across all BMAs (Merriwa East 59 %, Merriwa West 50 %, Namoi 65 %). The dissimilarity between grassland and woodland sites at Merriwa East and West (55 % & 54 % respectively) was lower than at Namoi BMA (79 %), and this is resultant of the occurrence of LMU1 woodlands on Warrawoona.

The MDS plot from Merriwa East Figure 3.16 showed grouping within all sites and a large separation to Site 14 (grassland LMU3; below). This site is an outlier and resultant from the very low diversity of flora at the site (9 species total).

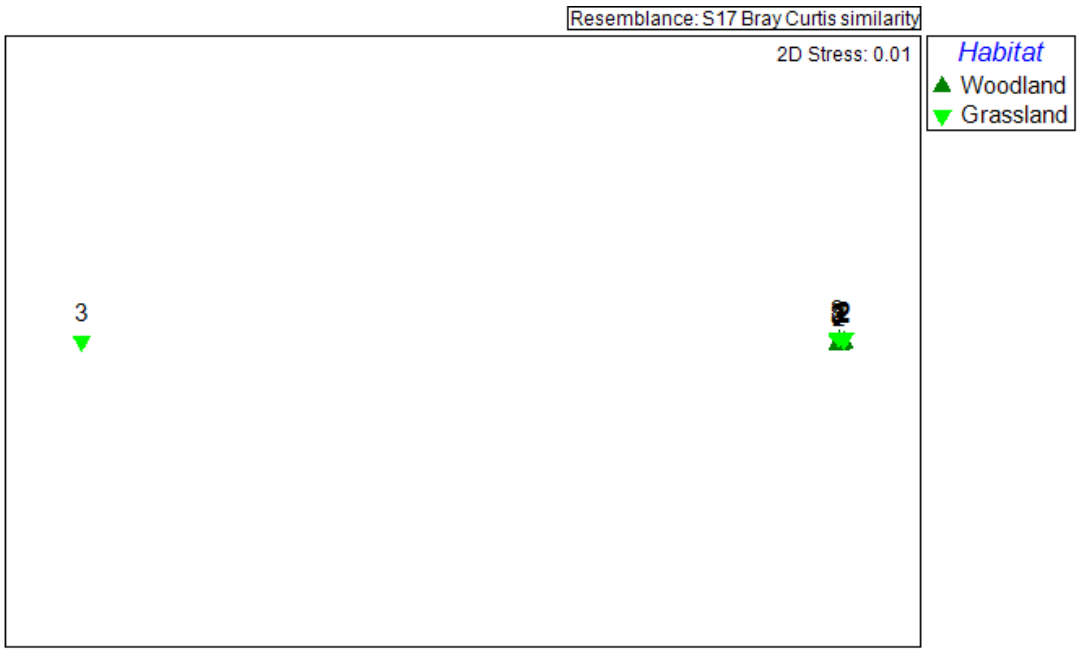


Figure 3.16 MDS plot using flora assemblage at Merriwa East BMA showing LMU class (number) and habitat type (symbols)

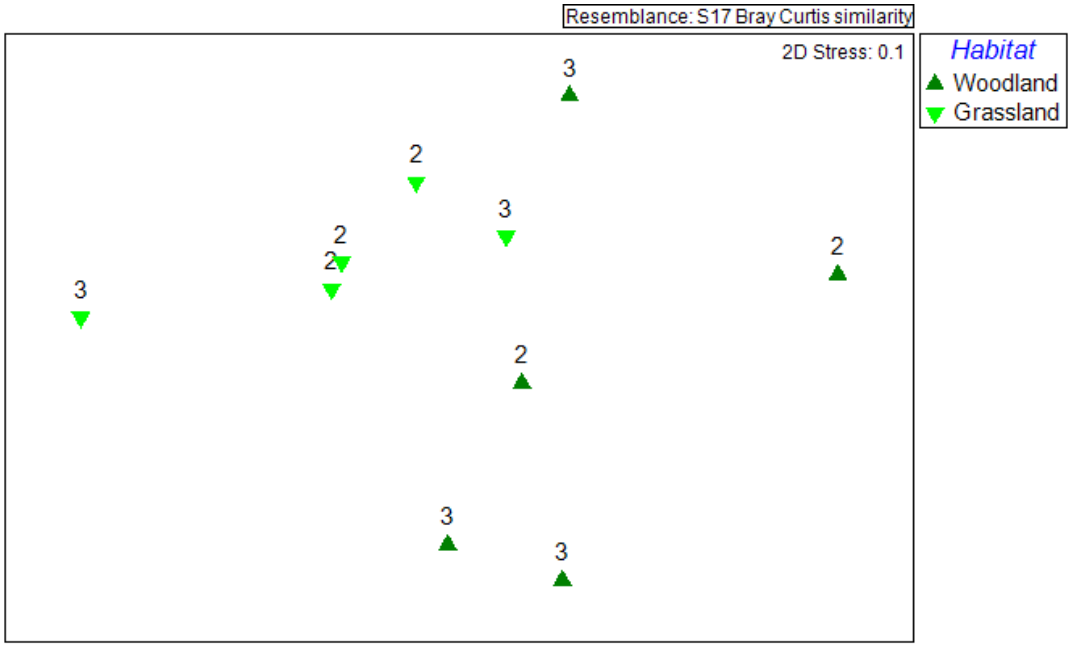


Figure 3.17 MDS plot using flora assemblage at Merriwa West BMA showing LMU class (number) and habitat type (symbols)

The MDS plot at Merriwa West (Figure 3.17) showed a relatively even spread of LMU classes, and low grouping within habitat types. There was little separation of LMU classes and this may change in better seasons.

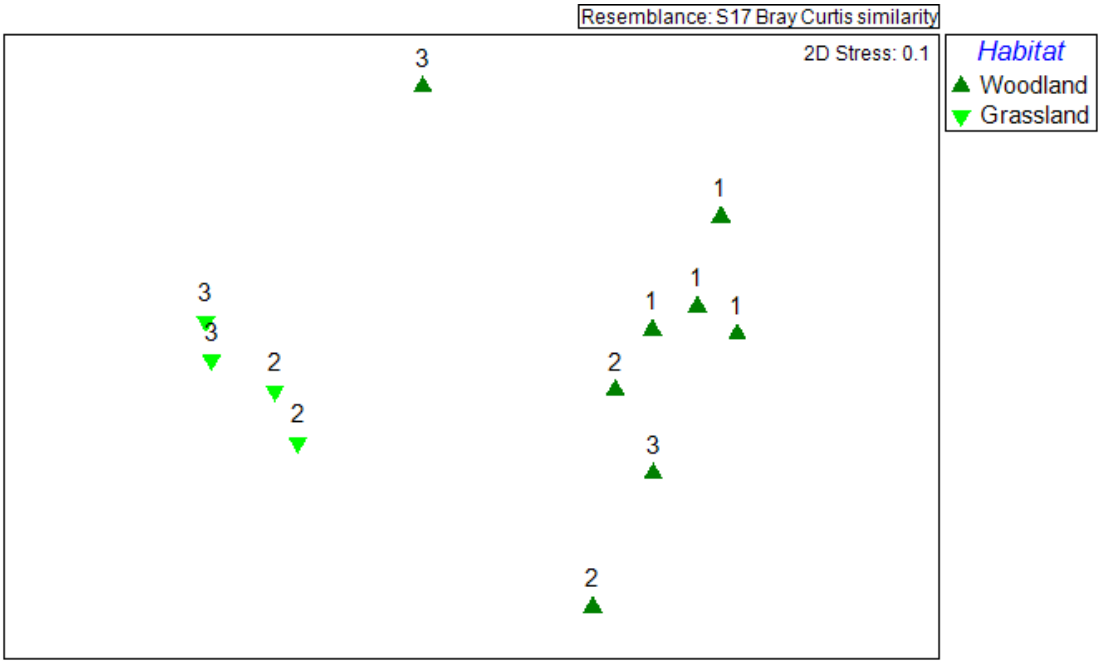


Figure 3.18 MDS plot using flora assemblage at Namoi BMA showing LMU class (number) and habitat type (symbols)

The flora assemblage at Namoi BMA separated between Box Gum Grassy Woodland and Derived Native Grasslands clearly Figure 3.18 . This separation was also seen in the MDS of

habitat features for Namoi BMA. The grouping of Box Gum Woodland Sites indicates that there may be some sites at Warrawoona that are approaching LMU1 based on flora alone.

BioEnv Analysis (BEST Analysis) was carried to determine which environmental variable was driving the separation in bird abundance MDS plots (Figure 3.16, Figure 3.17, and Figure 3.18 .). BioEnv uses Spearman Rank Correlations to interface environmental variables (habitat characteristics) with response variables (flora species). For Merriwa East BMA, the MDS was primarily driven (0.826) by native overstorey, ground stratum (grasses), ground stratum (other), and Overstorey Species (DBH 10-20cm and >20cm). At Merriwa West the data was driven (0.756) by Overstorey Species (DBH 10-20cm and >20cm), ground stratum (other), ground stratum (exotic) and total exotic species. At Namoi BMA, the flora MDS was driven by native overstorey (number of species), native mid storey (number of species), % cover of shrubs, % cover of exotic, and % trees with mistletoe.

i. Soil analysis

Soil samples were analysed using non-parametric MDS. These MDS plots incorporate only the soil features. The plot shows a distinct separation between the Namoi BMA, and Merriwa East and Merriwa West. This separation is irrespective of habitat type. This separation is due to a combination of alternate previous farming practices, and spatial separation between the sites.

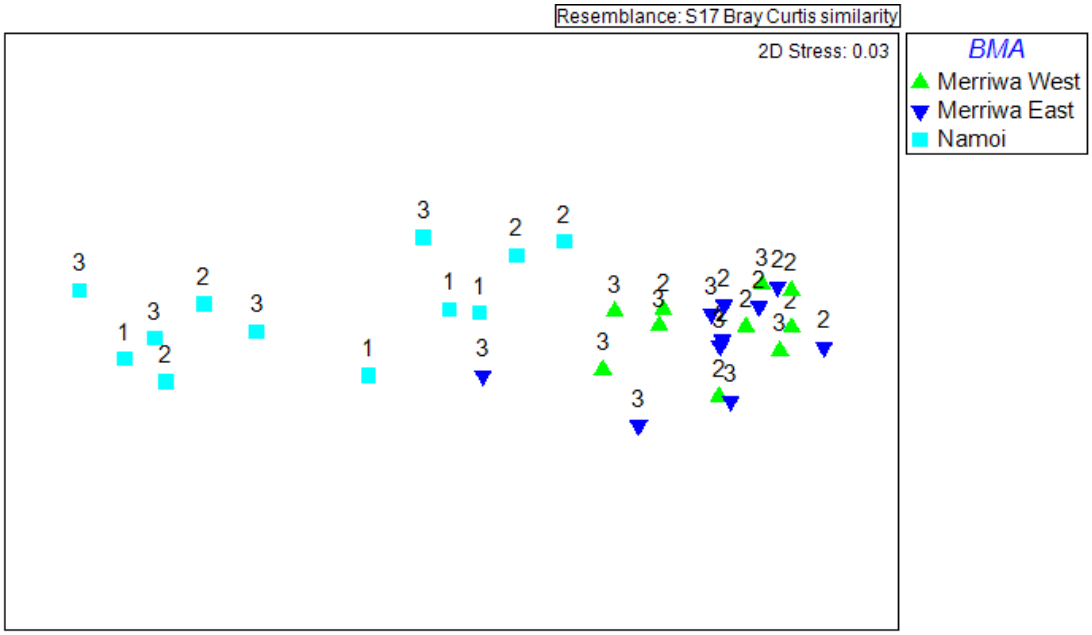


Figure 3.19 MDS plot using soil characteristics between biodiversity management areas (symbols) and land management units (numbers)

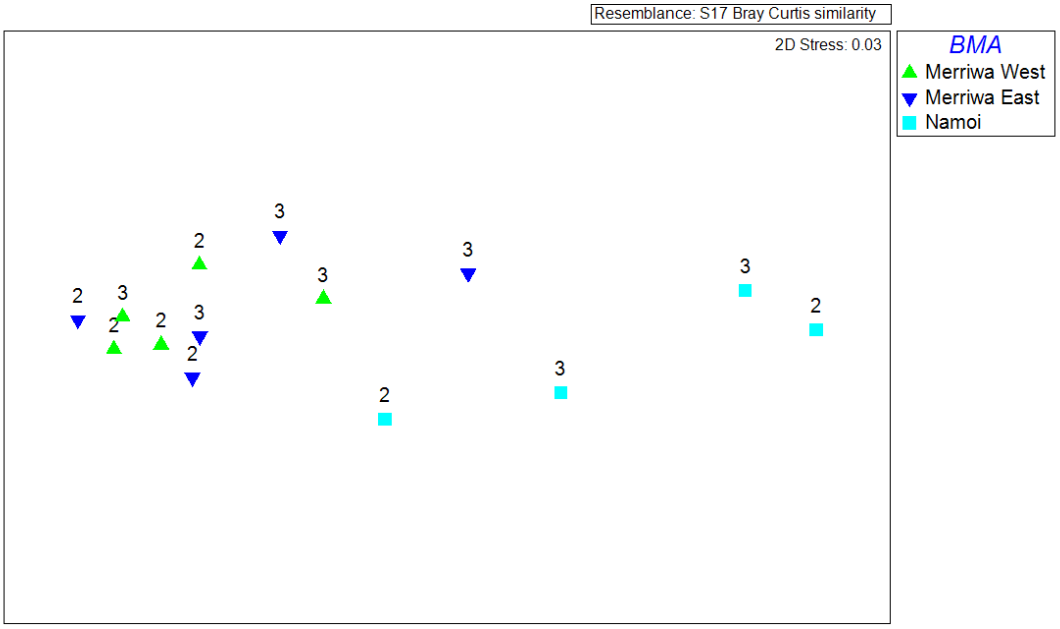


Figure 3.20 MDS plot of soil analysis for Derived Native Grassland Sites only between BMA (symbol) and LMU (number)

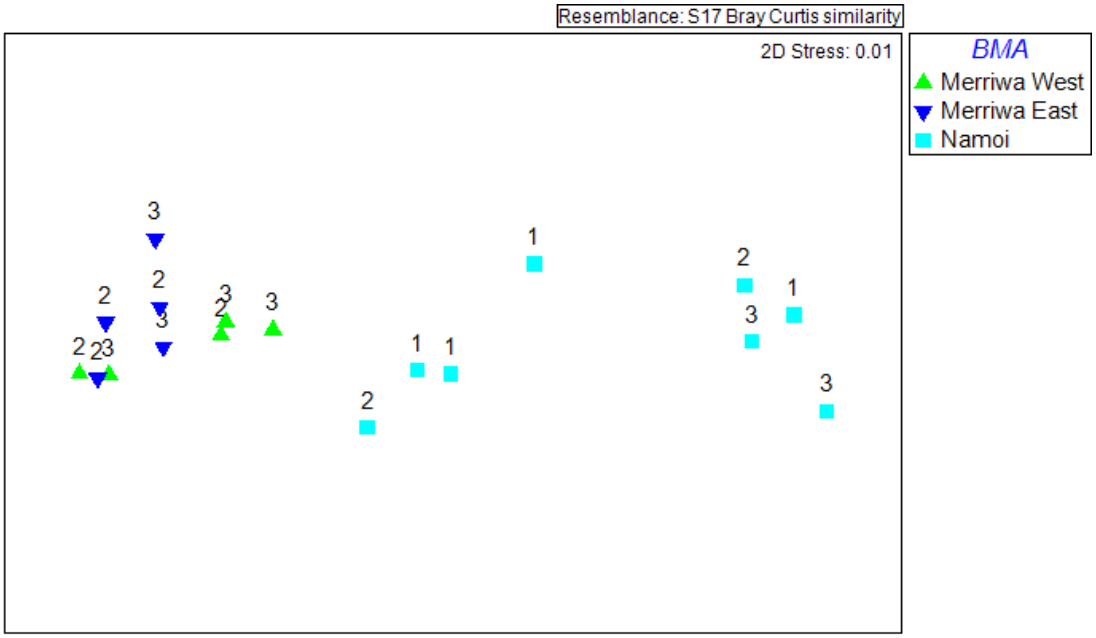


Figure 3.21 MDS plot of soil analysis for Box Gum Grassy Woodland Sites only between BMA (symbol) and LMU (number)

SIMPER analysis showed that Merriwa East and Merriwa West BMAs showed high similarity within treatments for both grassland and woodland Table C.3 . There was a higher dissimilarity for both Merriwa East and Merriwa West BMAs to Namoi BMA, and this is evident in the MDS plots. There was a high similarity within sites for LMU2 and LMU3, indicating within treatment variance is low for soil characteristics. LMU1 was more dissimilar to LMU2 and LMU3. These similarities are expected to change with time; and dissimilarity to LMU1 between LMU2 and LMU3 is expected to decrease with ongoing management.

Reviewing the data more closely by habitat type showed a similar trend for Derived Native Grassland (Figure 3.20), and Box Gum Grassy Woodland (Figure 3.21). This trend was assessed using Principal Component Analysis (PCA), and this showed that the factor driving the difference was Calcium for both box gum woodland and derived native grassland MDS plots. Calcium levels can be used as an indicator of excessive use of highly acidifying fertilisers, or of soils with very low pH (<4), however all sites were considered to be above the threshold of 0.5 meq/100g and therefore not deficient in calcium Figure 3.22.

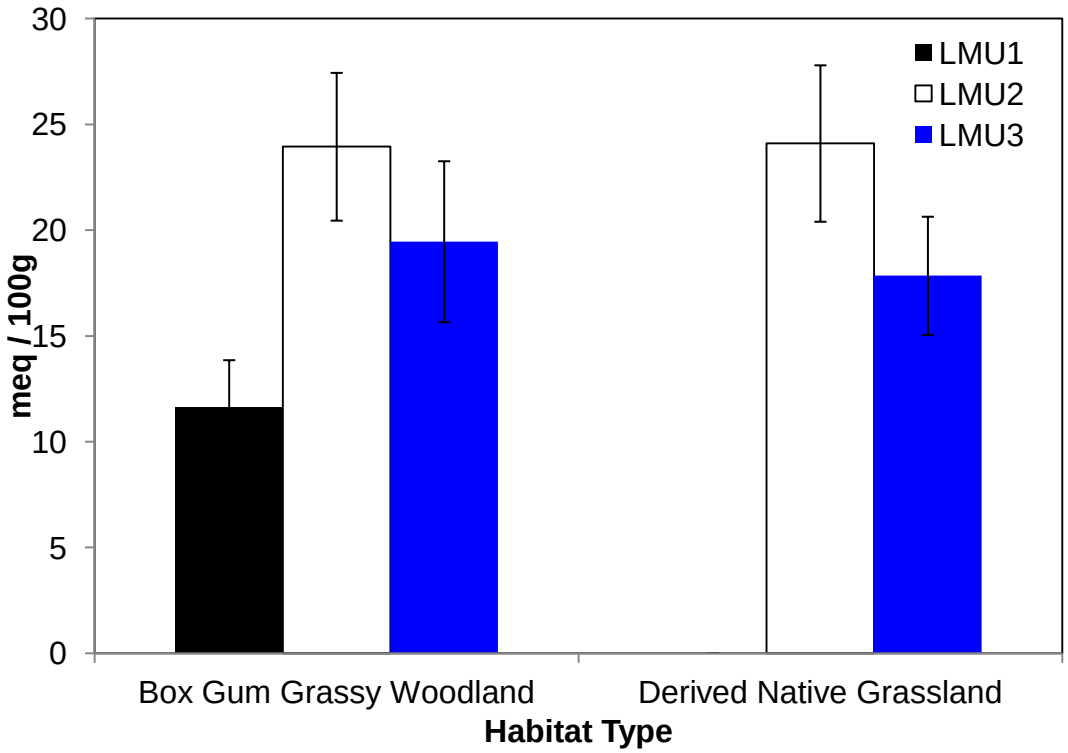


Figure 3.22 Exchangeable calcium at monitoring sites (molar equivalent 100g-1) across habitat type and LMU class

3.2.3 Beesons Rd Fire - Photographic Update

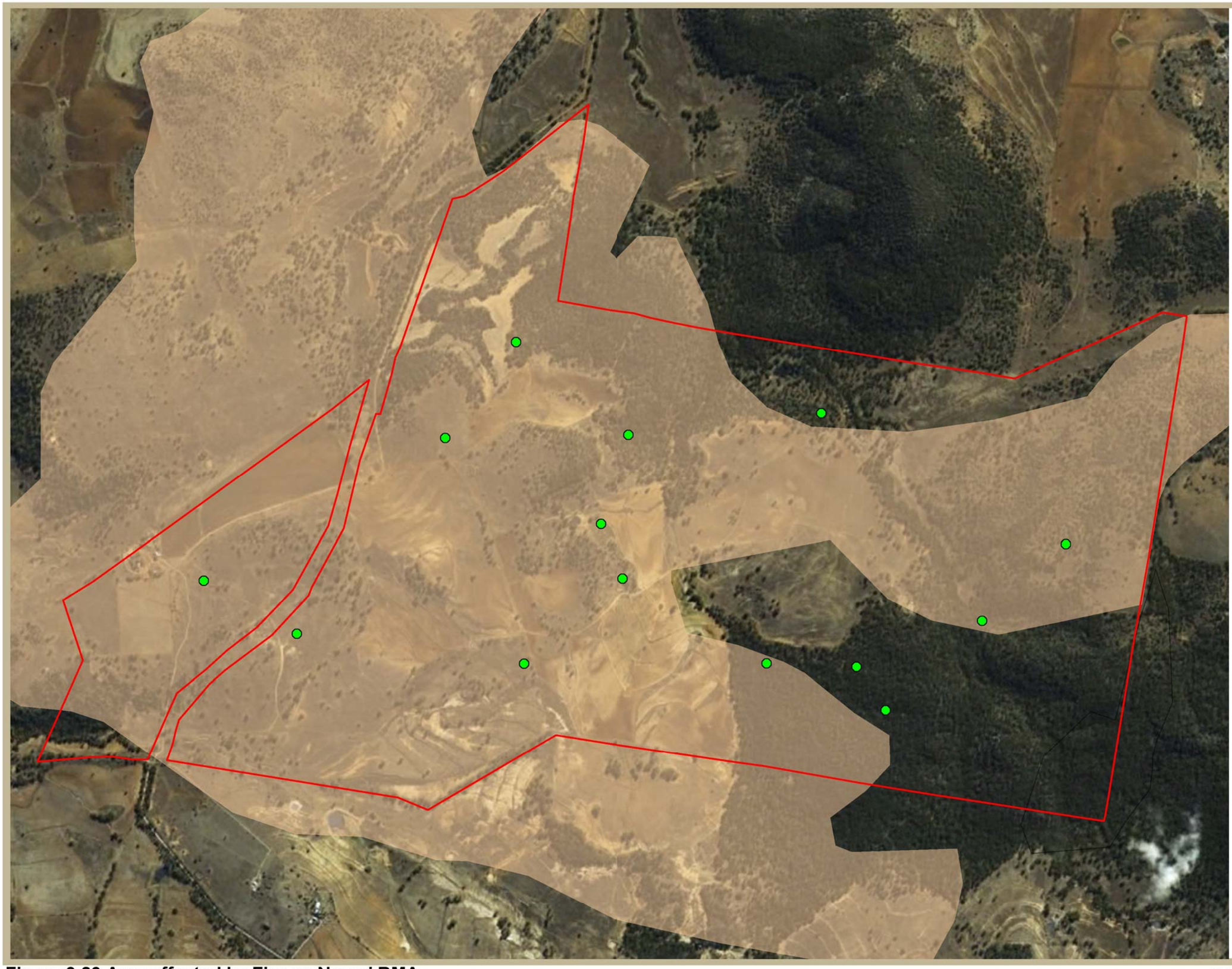
On Saturday 9 November 2013, a large proportion of Warrawoona was impacted by a 2,000 ha bush fire that spread from a neighbouring property. As such the photo records taken were no longer indicative of the conditions at the Namoi BMA. Photographs were retaken on 27th of November at each site affected by the fire to provide accurate comparisons with future photographs.

In addition to retaking photographs, the presence of Koalas on the site was also re-evaluated. A vehicular traverse of the property was undertaken at night, and call playback was used to determine if any koalas remained on site after the fire.

Photograph 3.7 Burnt woodland in the south eastern corner of Warrawoona (27/11/13)

Review of the area found that a significant proportion of the property (78.7%; 899.5 ha) was burnt in the Beesons Rd Fire. Of the 14 monitoring sites established at Warrawoona, 8 were affected significantly with almost complete removal of ground cover (and canopy where applicable). 3 sites were partially burnt and showed areas of spot fires but the understorey remained relatively intact. One woodland site was not burnt at all (Site 26). The burn condition of two sites (Site 27 & Site 32) in the south eastern corner of the property remain unknown due to access issues with fallen timber across tracks and continued burning of large stumps.

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Namoi BMA
- Monitoring Locations
- Fire affected area

Grid North

Image Source:
GooglePro 01Apr2010

CUMBERLAND ECOLOGY

I:\...\12101\Figures\12101RP5_Figure 2.4_Fire affected area

250 0 250 500 750 1000 m

Figure 3.23 Area affected by Fire on Namoi BMA

In the 17 days between the Beesons Road Fire and the re-taking of monitoring protographs, the Gunnedah area received 57mm of rainfall which has triggered the growth of new grasses and herbs. This is evident in the photo record as a relatively green ground cover, however the cover is quite sparse. Updated photographs were taken at all photograph monitoring points across Warrawoona.

Table 3.1 Status of environmental monitoring sites after the Beesons Rd Fire

Site Name	Habitat	Burn Condition
Site 21	Grassland	Burnt – ground cover removed
Site 22	Woodland	Burnt – canopy intact but ground cover removed
Site 23	Grassland	Burnt – ground cover removed
Site 24	Woodland	Burnt – canopy and understorey removed. Many fallen trees
Site 25	Woodland	Burnt – canopy intact
Site 26	Woodland	Unburnt
Site 27	Woodland	Unknown – Access restricted due to fallen timber
Site 28	Grassland	Burnt – ground cover removed
Site 29	Grassland	Burnt – ground cover removed
Site 30	Woodland	Burnt – canopy and understorey removed
Site 31	Woodland	Partly Burnt – fire within 10m, but plot mostly unburnt
Site 32	Woodland	Unknown – Access restricted due to fallen timber
Site 33	CI Woodland	Partly burnt – canopy intact in places
Site 34	CI Woodland	Partly burnt – limited areas of understorey remaining

i. Implications of the Beesons Road Fire on Monitoring

The Bessons Road fire had a significant effect on flora at all but one of the monitoring sites. The effects of the fire have the potential to conceal in the short term any effects of management regime changes by the management plan. In general there are three categorisations of species on site and how they respond to fire: Resprouters, obligate seeders, and those plants in which fire kills both the seeds and the plant need to recolonise from nearby unburnt patches.

a. Resprouters

These are plants that regrow following fires from tubers underground, they often have lignotubers, which are a woody mass (or swelling) underground which is protected from fire. In these plants the above ground biomass of the plant is generally wiped out but they resprout stems from the lignotubers dormant buds. They use stored starches to give the plant energy to resprout. An example on site of a herb that does this is Brunoniella australis which may be seen in the short term. The species Acacia implexa, Indigofera australis,

Eremophila debilis, Dianella longifolia and Lomandra longifolia also use lignotubers and occur on the Namoi BMA.

Many Eucalypts develop lignotubers so in cases of extreme fires knocking out most of the tree can resprout from the base. Many Eucalypts also contain epicormic buds, which are dormant buds protected along the trunk and branches of the tree from which resprouting occurs following fires that destroy all the foliage on them. Eucalypts on site with lignotubers include Eucalyptus albens. Eucalyptus melliodora is an example of a Eucalypt on site which regrows from epicormic buds. Although information is sparse on the subject it is likely all eucalypt species on site have epicormic buds, or lignotubers, or both.

b. Obligate Seeders

These plants hold seeds in woody pods such as cones, and when exposed to fire the plant dies but the seeds are held in the woody pods, or cones. Due to exposure to heat in the fire these cones crack open not long after the fire and release seeds which drop into the soil so new plants can grow. Examples on site include both Callitris species and Allocasuarina leuhmannii.

Obligate seeders also include plants that drop seeds that are stored in the soil for long periods of time. When a fire wipes out all the living plants the combination of nutrients in the post fire environment and exposure to light (due to the canopy and undergrowth being wiped out) trigger germination. Lomandra longifolia is a resprouter but also recovers by mass seed germination following fire. In the case of certain Acacia species part of the chemical components of smoke (and ash) trigger germination of seedlings post-fire.

Photograph 3.8 Site 23 Grassland before (above 7/11/13) and after (below 27/11/13) the Beesons Rd Fire with significant ground cover removed

Photograph 3.9 Site 24 Woodland before (above 8/11/13) and after (below 27/11/13) the Beesons Rd Fire with significant ground cover and canopy removed

Chapter 4

Conclusion

Monitoring sites at The Mount Pleasant Project Offset properties have now been established. This includes 32 sites for the Indicators of Ecosystem Condition study, and 32 sites for the Box Gum Grassy Woodland study. The monitoring sites were set up to capture information on all habitat types of the BMAs, and sites were strategically set out at each of the 6 properties that make up the Mount Pleasant Offsets. Sites were set out in locations that best represent the condition class, and habitat type, as provided in the Offset Management Plan.

Data was collected across all plots, and this can be used as baseline data for future monitoring studies. Baseline data was collected for bird and reptile abundance, fauna habitat features, and photographs at all 32 IEC sites. Baseline data was collected for flora abundance and richness, habitat features, photographs, and soil properties at all 32 BGGW sites.

Analysis of this baseline data shows differences between Namoi and the Merriwa BMAs as expected, but the differences between LMU classes was much more subtle. Important differences in the LMU classes were the richness of birds, the prevalence of exotic plants, and soil properties (Calcium concentrations). Despite the dry conditions preceding surveys, the prevalence of a greater diversity of exotic plants at lower LMU classes is consistent with the State and Transition Model, and supports the initial classification of LMU classes. The ongoing monitoring of established sites at Merriwa BMAs will now be able to track any shift from lower LMU classes to higher LMU classes under active management. The changes in ecosystem condition at Namoi BMA sites will undertake a different trajectory due to the interactive effects of fire, rainfall, and destocking over the next two years.

The Beesons Road Fire affected all but one monitoring site at Namoi BMA, and burnt a considerable percentage of Warrawoona. As such there is not an opportunity to compare burnt with unburnt sites, however the collection of baseline data a day before the fire allows for a benchmark for potential recovery of the property. It is important to consider however, that fire is a natural process and future assemblages may not necessarily resemble the baseline data from before the fire.

It is also important to consider that whilst all data was incorporated into analyses, this report only presents data that showed differences between habitats and LMU classes. In future studies, monitoring should consider all data collected and not replicate specific data presented in this report.

Appendix A

General Summary Tables

Table A.1 Site Locations for MNES and IEC studies

Site	BMA	Property	LMU	Habitat	Easting	Northing	MNES	IEC
1	Merriwa West	St Antoine	3	Woodland	218268	6464859	X	X
2	Merriwa West	Wahrane	2	Grassland	222582	6460389	X	X
3	Merriwa West	Wahrane	2	Woodland	222945	6459129	X	X
4	Merriwa West	Wahrane	2	Grassland	222725	6459904	X	X
5	Merriwa West	St Antoine	3	Woodland	225092	6470491	X	
6	Merriwa West	St Antoine	3	Grassland	224061	6468666	X	X
7	Merriwa West	St Antoine	3	Grassland	219780	6462432	X	X
8	Merriwa West	St Antoine	3	Woodland	219022	6460804	X	X
9	Merriwa West	Wahrane	2	Grassland	222530	6459411	X	X
10	Merriwa West	Wahrane	2	Woodland	221296	6460912	X	X
11	Merriwa East	Black Rock	3	Woodland	234400	6464028	X	
12	Merriwa East	Black Rock	3	Grassland	234703	6464597	X	
13	Merriwa East	Black Rock	2	Woodland	237234	6462025	X	X
14	Merriwa East	Black Rock	3	Grassland	241890	6463919	X	X
15	Merriwa East	Black Rock	3	Woodland	242019	6463752	X	
16	Merriwa East	Clare Park	2	Woodland	238915	6459386	X	X
17	Merriwa East	Clare Park	2	Grassland	238987	6459063	X	X
18	Merriwa East	Gum Ridge	2	Woodland	239702	6455238	X	
19	Merriwa East	Gum Ridge	2	Grassland	239987	6455005	X	
20	Merriwa East	Gum Ridge	3	Grassland	243155	6455096	X	X
21	Namoi	Warrawoona	2	Grassland	223096	6562014	X	X
22	Namoi	Warrawoona	3	Woodland	225116	6562351	X	
23	Namoi	Warrawoona	3	Grassland	224311	6562767	X	
24	Namoi	Warrawoona	1	Woodland	225250	6562807	X	X
25	Namoi	Warrawoona	1	Woodland	224661	6563263	X	X
26	Namoi	Warrawoona	2	Woodland	226232	6562941	X	X
27	Namoi	Warrawoona	2	Woodland	227495	6562312	X	X
28	Namoi	Warrawoona	2	Grassland	223576	6561757	X	X
29	Namoi	Warrawoona	3	Grassland	224740	6561636	X	X
30	Namoi	Warrawoona	3	Woodland	225237	6562079	X	X
31	Namoi	Warrawoona	1	Woodland	226442	6561664	X	
32	Namoi	Warrawoona	1	Woodland	227076	6561913	X	
33	Namoi	Warrawoona	1	Callitris/ Ironbark	225983	6561669		X
34	Namoi	Warrawoona	1	Callitris/	226595	6561448		X

				Ironbark				
35	Merriwa East	Black Rock	3	Riparian	241261	6463880		**X**
36	Merriwa East	Black Rock	3	Riparian	235080	6464941		**X**
37	Merriwa West	St Antoine	3	Riparian	224735	6470224		**X**
38	Merriwa East	Black Rock	2	Riparian	234742	6463754		**X**
39	Merriwa West	St Antoine	3	Riparian	219323	6460701		**X**
40	Merriwa East	Black Rock	2	Low Diversity Grassland	235977	6463006		**X**
41	Merriwa West	St Antoine	3	Low Diversity Grassland	218454	6471074		**X**
42	Merriwa West	St Antoine	3	Low Diversity Grassland	217969	6471115		**X**
						Total	**32**	**32**

Appendix B

Summary Tables for Indicators of Ecosystem Condition

Table B.1 Habitat features for all monitoring sites for Indicators of Environmental Condition

			Over-storey regeneration/health				Additional habitat features							
LMU	Habitat	Site	Over-storey regeneration No. Species	Over-storey species stem diameter class (0 - 10cm) No./m2	Over-storey species stem diameter class (10 - 20cm) No./m2	Over-storey species stem diameter class >20cm) No./m2	Litter % cover	Rock % cover	Bare ground % cover	Log length	Tree hollows number	Dead trees (% tree population)	Mistletoe (% tree population)	Flower/fruit (% tree population)
1	CI Woodland	33	1	0	0	0	95.75	0	4.25	11.2	5	0	0	0
		34	2	0.002	0.003	0.003	45	22.5	2.5	9.8	37	25	0	0
	Woodland	24	1	0	0	0.015	37.5	6.25	5.25	5.7	19	0	20	0
		25	2	0	0.001	0.007	25	8.75	8.75	3.75	4	0	87.5	0
2	Grassland	2	0	0	0	0	2	2	1	0	0	0	0	0
		4	0	0	0	0	5	0.25	1.75	0	0	0	0	0
		9	0	0	0	0	2.5	0	2.5	0	0	0	0	0
		17	0	0	0	0	1.75	3.25	0.75	0	0	0	0	0
		21	1	0	0	0	20	5	3.5	0	0	0	0	0
		28	0	0	0	0	20	0.75	0	0	0	0	0	0
	LD Grassland	40	0	0	0	0	0	2.5	4.75	0	0	0	0	0
	Riparian	38	1	0	0	0.003	5	0	0	20	8	50	0	0
	Woodland	3	2	0	0	0.004	9.5	2.25	0.25	5.5	0	0	0	100
		10	1	0	0	0.003	3.5	3.75	0	2.7	2	0	0	100
		13	1	0	0.001	0.002	6.25	1.5	5.5	2.2	0	0	0	33.3
		16	1	0	0	0.003	13.25	3	5	2	4	0	0	100
		26	2	0	0	0.01	40	5	12.5	4.6	4	0	60	0
		27	1	0	0	0.009	42.5	1.25	2.5	6.3	16	0	33.3	0
3	Grassland	6	0	0	0	0	15	1.75	0	0	0	0	0	0
		7	0	0	0	0	20	0	4.25	0	0	0	0	0
		14	0	0	0	0	0	6.25	0.75	0	0	0	0	0
		20	0	0	0	0	5	4.5	0	0	0	0	0	0
		29	0	0	0	0	20	5	5	0	0	0	0	0
	LD Grassland	41	0	0	0	0	1.25	3.75	2.5	0	0	0	0	0
		42	0	0	0	0	0	6.25	0	0	0	0	0	0
	Riparian	35	2	0	0	0.004	10	0.25	4	4.125	13	0	0	50
		36	3	0.001	0.002	0.004	4.5	19.25	0.5	2.5	7	14.3	0	71.4
		37	1	0	0.005	0.012	15	8.25	2.75	2.3	0	17.6	0	35.3
		38	1	0	0	0.005	28.75	21.25	0	1.5	0	0	0	40
	Woodland	1	1	0	0	0.003	10	5.75	0	1.625	0	0	0	0
		8	3	0	0	0.005	25	2.75	2.5	1	0	0	0	60
		30	2	0	0	0.005	37.5	0	7.5	7	11	20	0	0

Table B.2 Species List of birds observed at Indicators or Ecosystem Condition sites

Common Name	Species Name	Merriwa East	Merriwa West	Namoi
Australian Wood Duck	*Chenonetta jubata*	1	1	0
Grey Teal	*Anas gracilis*	0	1	0
Pacific Black Duck	*Anas superciliosa*	2	0	0
Common Bronzewing	*Phaps chalcoptera*	0	1	1
Crested Pigeon	*Ocyphaps lophotes*	1	4	2
Peaceful Dove	*Geopelia striata*	1	0	2
White-faced Heron	*Egretta novaehollandiae*	2	0	0
Wedge-tailed Eagle	*Aquila audax*	0	1	0
Nankeen Kestrel	*Falco cenchroides*	1	0	1
Brown Falcon	*Falco berigora*	0	0	0
Peregrine Falcon	*Falco peregrinus*	0	1	0
Dusky Moorhen	*Gallinula tenebrosa*	0	1	0
Galah	*Eolophus roseicapillus*	7	9	7
Little Corella	*Cacatua sanguinea*	0	0	1
Sulphur-crested Cockatoo	*Cacatua galerita*	6	9	7
Musk Lorikeet	*Trichoglossus haematodus*	7	6	0
Australian King-Parrot	*Alisterus scapularis*	1	3	0
Crimson Rosella	*Platycercus elegans*	2	3	0
Eastern Rosella	*Platycercus eximius*	7	11	2
Australian Ringneck	*Barnardius zonarius*	0	0	1
Red-rumped Parrot	*Psephotus haematonotus*	2	4	5
Eastern Koel	*Eudynamys orientalis*	0	1	0
Channel-billed Cuckoo	*Scythrops novaehollandiae*	1	0	1
Laughing Kookaburra	*Dacelo novaeguineae*	1	3	2
Sacred Kingfisher	*Todiramphus sanctus*	1	0	0
Dollarbird	*Eurystomus orientalis*	1	0	0
White-throated Treecreeper	*Cormobates leucophaea*	2	1	3
Red-browed Treecreeper	*Climacteris erythrops*	0	0	1
Superb Fairy-wren	*Malurus cyaneus*	0	1	3
White-browed Scrubwren	*Sericornis frontalis*	0	1	0
Weebil	*Smicrornis brevirostris*	0	0	2
White-throated Gerygone	*Gerygone albogularis*	1	0	0
Yellow Thornbill	*Acanthiza nana*	0	0	1

Table B.2 Species List of birds observed at Indicators or Ecosystem Condition sites

Common Name	Species Name	Merriwa East	Merriwa West	Namoi
Buff-rumped Thornbill	*Acanthiza reguloides*	0	0	2
Brown Thornbill	*Acanthiza pusilla*	0	0	1
Spotted Pardalote	*Pardalotus punctatus*	1	0	0
Striated Pardalote	*Pardalotus striatus*	4	5	4
Yellow-faced Honeyeater	*Lichenostomus chrysops*	1	2	0
White-plumed Honeyeater	*Lichenostomus penicillatus*	2	0	1
Noisy Miner	*Manorina melanocephala*	6	12	8
Red Wattlebird	*Anthochaera carunculata*	0	0	1
Magpie-lark	*Gralina cyanoleuca*	3	6	1
Brown-headed Honeyeater	*Melithreptus brevirostris*	1	2	0
White-naped Honeyeater	*Melithreptus lunatus*	1	0	0
Blue-faced Honeyeater	*Entomyzon cyanotis*	0	1	0
Noisy Friarbird	*Philemon corniculatus*	5	3	0
Striped Honeyeater	*Plectorhyncha lanceolata*	0	0	3
Painted Honeyeater	*Grantiella picta*	0	0	0
Grey-crowned Babbler	*Pomatostomus temporalis*	0	0	3
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	5	2	3
Cicadabird	*Coracina tenuirostris*	0	0	1
White-winged Triller	*Lalage sueurii*	0	0	1
Rufous Whistler	*Pachycephala rufiventris*	2	1	5
Grey Shrike-thrush	*Colluricincla harmonica*	1	0	0
Olive-backed Oriole	*Oriolus sagittatus*	1	0	0
Dusky Woodswallow	*Artamus cyanopterus*	1	0	1
Grey Butcherbird	*Cracticus torquatus*	5	9	5
Pied Butcherbird	*Cracticus nigrogularis*	6	8	4
Australian Magpie	*Cracticus tibicen*	6	9	5
Pied Currawong	*Strepera graculina*	0	1	0
Grey Fantail	*Rhipidura albiscapa*	0	1	3
Willie Wagtail	*Rhipidura leucophrys*	0	4	3
Australian Raven	*Corvus coronoides*	2	3	7
Restless Flycatcher	*Myiagra inquieta*	1	0	0
White-winged Chough	*Corcorax melanorhamphos*	0	2	1
Apostlebird	*Struthidea cinerea*	0	0	0

Table B.2 Species List of birds observed at Indicators or Ecosystem Condition sites

Common Name	Species Name	Merriwa East	Merriwa West	Namoi
Jacky Winter	*Microeca fascinans*	1	0	1
Eastern Yellow Robin	*Eopsaltria australis*	0	1	1
Horsfield's Bushlark	*Mirafra javanica*	1	0	0
Golden-headed Cisticola	*Cisticola exilis*	1	0	0
Rufous Songlark	*Cincloramphus mathewsi*	2	0	1
Silvereye	*Zosterops lateralis*	0	0	0
Welcome Swallow	*Hirundo neoxena*	0	2	0
Tree Martin	*Petrochelidon nigricans*	0	1	0
Common Starling	*Sturnus vulgaris*	2	1	0
Common Myna	*Sturnus tristis*	0	0	0
Mistletoebird	*Dicaeum hirundinaceum*	1	0	0
Double-barred Finch	*Taeniopygia bichenovii*	0	0	1
Diamond Firetail	*Stagonopleura guttata*	1	0	0

Table B.3 Incidental bird sightings outside IEC bird census points

Common Name	Species Name	BMA	Habitat	Easting	Northing
Australasian Grebe	*Tachybaptus novaehollandiae*	Namoi	Dam	225116	6562351
Tawny Frogmouth	*Podargus strigoides*	Merriwa East	Woodland	237766	6460808
Little Pied Cormorant	*Microcarbo melanoleucos*	Merriwa East	Riparian	241570	6464054
White-necked Heron	*Ardea pacifica*	Namoi	Dam	225116	6562351
Black-shouldered Kite	*Elanus axillaris*	Merriwa East	Grassland	240065	6461650
Whistling Kite	*Haliastur sphenurus*	Merriwa West	Riparian	218682	6460178
Brown Falcon	*Falco berigora*	Merriwa West	Woodland	225092	6470491
Masked Lapwing	*Vanellus miles*	Merriwa West	Woodland	225092	6470491
Shining Bronze-cuckoo	*Chalcites lucidus*	Merriwa West	Woodland	225092	6470491
Southern Boobook	*Ninox novaeseelandiae*	Merriwa West	Woodland	222055	6460698
Eastern Barn Owl	*Tyto javanica*	Namoi	Woodland	224937	6561791
Variegated Fairy-wren	*Malurus lamberti*	Merriwa West	Woodland	225092	6470491
Speckled Warbler	*Chthonicola sagittata*	Namoi	Grassland	224643	6563815
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	Namoi	Grassland	224643	6563815
Eastern Spinebill	*Acanthorhynchus tenuirostris*	Merriwa West	Woodland	225092	6470491
Painted Honeyeater	*Grantiella picta*	Merriwa East	Riparian	241570	6464054
Apostlebird	*Struthidea cinerea*	Namoi	Dam	225116	6562351
Silvereye	*Zosterops lateralis*	Merriwa West	Woodland	225092	6470491
Common Myna	*Sturnus tristis*	Namoi	Grassland	224311	6562767
Red-browed Finch	*Neochmia temporalis*	Merriwa West	Woodland	225092	6470491

Table B.4 SIMPER Analysis Summary of Bird Diversity

	Biodiversity Management Area		
Factor	**Merriwa East**	**Merriwa West**	**Namoi**
LMU1[1]	--	--	55.60
LMU2[1]	58.33	53.76	22.69
LMU3[1]	47.69	46.30	--
LMU2 x LMU3[2]	78.51	47.90	64.81
LMU1 x LMU2[2]	--	--	63.55
LMU1 x LMU3[2]	--	--	64.62
Grassland[3]	34.78	47.58	15.38
Woodland[3]	58.33	60.00	32.50
Riparian[3]	60.61	44.44	--
Low Diversity Grassland[3]	--	45.45	--
Callitris – Ironbark Woodland	--	--	76.19
Grassland x Woodland[4]	42.22	50.61	70.06
Woodland x Callitris – Ironbark Woodland[4]	--	--	58.34
Woodland x Riparian[4]	95.83	58.94	--
Grassland x Riparian[4]	62.98	71.79	--
Woodland x Low Diversity Grassland[4]	27.54	50.24	--
Grassland x Low Diversity Grassland[4]	29.41	46.70	--
Riparian x Low Diversity Grassland[4]	100.00	65.36	--

Notes: *1.Similarity between all habitats*

2. Dissimilarity between all habitats

3. Similarity between all LMU

4. Dissimilarity between all LMU

Table B.5 Reptiles observed during fauna survey

Common Name	Scientific Name	Merriwa East BMA	Merriwa West BMA	Namoi BMA
White's Skink	*Egernia whitii*			X
Tree Skink	*Egernia striolata*			X
Southern Rainbow Skink	*Carlia tetradactyla*		X	
Copper-tailed Skink	*Ctenotus taeniolatus*			X
Dark-flecked Garden Sunskink	*Lampropholis delicata*	X		
Eastern Brown Snake	*Pseudonaja textilis*		X	X
Yellow-faced Whipsnake	*Demansia psammophis*			X
Eastern Beared Dragon	*Pogona barbata*	X	X	X
Lace Monitor	*Varanus varius*		X	X
Eastern Snake-necked Turtle	*Chelodina longicollis*	X	X	X
Total Reptile Richness		**3**	**5**	**8**

Appendix C

Summary Tables for MNES Box Gum Grassy Woodlands

Table C.1 Habitat features for all monitoring sites for Matters of National Environmental Significance - Box Gum Grassy Woodlands

Community Composition and Species Richness

			Native over-storey	Native mid-storey	Native ground stratum (grasses)	Native ground stratum (shrubs)	Native ground stratum (other)	Exotic ground stratum (including grasses and shrubs)	Total	Total native species	Total important species	Total exotic species
LMU	**Habitat**	**Site**	**Specied ID and No. Species/m2**	**Specied ID and No. Species/m2**	**Specied ID and No. Species/m2**	**Specied ID and No. Species/m2**	**Specied ID and No. Species/m2**	**Specied ID and No. Species/m2**	**Specied ID and No. Species/m2**	**Specied ID and No. Species/m2**	**Specied ID and No. Species/m2**	**Specied ID and No. Species/m2**
1	**Woodland**	**24**	0.002	0.0225	0.0175	0	0.0275	0	0.0725	0.0725	0.0125	0
		25	0.002	0.0125	0.0175	0	0.0275	0.0075	0.07	0.0625	0.01	0.0075
		31	0.003	0.0225	0.0175	0	0.015	0.005	0.0675	0.0625	0.0025	0.005
		32	0.001	0.0075	0.01	0	0.0175	0.005	0.0425	0.0375	0.0025	0.005
2	**Grassland**	**2**	0	0	0.01	0.0025	0.055	0.045	0.1125	0.0675	0.015	0.045
		4	0	0	0.01	0.0025	0.0325	0.045	0.09	0.045	0.0075	0.045
		9	0	0	0.0125	0	0.045	0.0425	0.1	0.0575	0.015	0.0425
		17	0	0	0.0125	0	0.0425	0.035	0.09	0.055	0.015	0.035
		19	0	0	0.01	0	0.0275	0.03	0.0675	0.0375	0.0125	0.03
		21	0	0.0075	0.0175	0	0.025	0.0275	0.0775	0.05	0.0125	0.0275
		28	0	0.005	0.0175	0	0.0175	0.02	0.06	0.04	0.0075	0.02
	Woodland	**3**	0	0	0.015	0.0025	0.055	0.0425	0.115	0.0725	0.0175	0.0425
		10	0.001	0	0.015	0.0025	0.0325	0.02	0.0725	0.0525	0.0075	0.02
		13	0.001	0	0.0175	0	0.0225	0.0225	0.065	0.0425	0.01	0.0225
		16	0.001	0.0025	0.02	0.005	0.0525	0.0275	0.11	0.0825	0.02	0.0275
		18	0.001	0	0.01	0	0.0175	0.0375	0.0675	0.03	0.005	0.0375
		26	0.002	0.015	0.0225	0	0.025	0.0025	0.07	0.0675	0.0075	0.0025
		27	0.001	0.015	0.005	0	0.0225	0.005	0.05	0.045	0.0025	0.005
3	**Grassland**	**6**	0	0	0.01	0	0.035	0.0425	0.0875	0.045	0.005	0.0425
		7	0	0	0.0175	0	0.0075	0.04	0.065	0.025	0.0025	0.04
		12	0	0	0.01	0	0.0375	0.06	0.1075	0.0475	0.01	0.06
		14	0	0	0.0125	0	0	0.01	0.0225	0.0125	0.0025	0.01
		20	0	0	0.0125	0.0025	0.03	0.0375	0.0825	0.045	0.01	0.0375
		23	0	0.0025	0.0125	0.005	0.0225	0.035	0.0775	0.0425	0.0075	0.035
		29	0	0.005	0.0175	0	0.0175	0.03	0.07	0.04	0.01	0.03
	Woodland	**1**	0.001	0	0.0175	0.0025	0.0475	0.055	0.125	0.07	0.0125	0.055
		5	0.001	0	0.0175	0.005	0.0525	0.05	0.1275	0.0775	0.02	0.05
		8	0.001	0	0.015	0	0.0525	0.025	0.095	0.07	0.0225	0.025
		11	0.001	0	0.0125	0	0.0425	0.0425	0.1	0.0575	0.0075	0.0425
		15	0.001	0	0.015	0	0.0375	0.04	0.095	0.055	0.0075	0.04
		22	0.002	0.005	0.0075	0	0.0125	0.0275	0.0575	0.03	0.005	0.0275
		30	0.002	0.015	0.01	0	0.025	0.005	0.06	0.055	0.0075	0.005

Table C.1 Habitat features for all monitoring sites for Matters of National Environmental Significance - Box Gum Grassy Woodlands

			Community structure							*Over-storey regeneration/health*		
			Native over-storey	Native mid-storey	Native ground stratum (grasses)	Native ground stratum (shrubs)	Native ground stratum (other)	Exotic	Over-storey regeneration	Over-storey species stem diameter class (0 - 10cm)	Over-storey species stem diameter class (10 - 20cm)	Over-storey species stem diameter class (>20cm)
LMU	**Habitat**	**Site**	**% cover**	**% cover**	**% cover**	**% cover**	**% cover**	**% cover**	**No. Species**	**No./m2**	**No./m2**	**No./m2**
1	**Woodland**	**24**	22.2	10	47.5	12.5	5	1	1	0	0	0.015
		25	16.5	6.25	50	7.5	8.75	1	2	0	0.001	0.007
		31	30.3	6.25	16.25	40	5	0	2	0	0.003	0.011
		32	30.5	0	50	36.25	5	0	1	0	0	0.012
2	**Grassland**	**2**	0	15	51.25	2.5	7.5	21.25	0	0	0	0
		4	0	1.75	70	5.25	5	18	0	0	0	0
		9	0	0	70	5.5	6.25	20	0	0	0	0
		17	0	0	60	0	11.75	22.5	0	0	0	0
		19	0	0	57.5	1.75	5.5	24.75	0	0	0	0
		21	0	2.5	45	7	5	30	1	0	0	0
		28	0	0	55	4.25	5	30	0	0	0	0
	Woodland	**3**	20.3	0.5	70	2.25	11.25	9.25	2	0	0	0.004
		10	18.2	0	78.75	1.25	4	10	1	0	0	0.003
		13	11.7	0	60	0	8.75	18	1	0	0.001	0.002
		16	16.3	7.5	63.75	4	10.5	4.5	1	0	0	0.003
		18	6.5	0	21.25	0	2.25	73.75	1	0	0	0.004
		26	23.2	8.75	42.5	8.75	5	0	2	0	0	0.01
		27	27.0	3.75	47.5	8.75	5	0	1	0	0	0.009
3	**Grassland**	**6**	0	0	21.25	0	3.75	59.5	0	0	0	0
		7	0	0	25	0	3	50.25	0	0	0	0
		12	0	0	58.75	0	8	21.25	0	0	0	0
		14	0	0	66.25	0	5	22	0	0	0	0
		20	0	0	67.5	0.25	5.25	17.5	0	0	0	0
		23	0	0.25	58.75	0.25	5	20	0	0	0	0
		29	0	0	60	2.5	5	20	0	0	0	0
	Woodland	**1**	10.7	0	55	1.75	7.5	20	1	0	0	0.003
		5	20.2	0	27.5	5.5	13.25	32.5	2	0.001	0.003	0.006
		8	17.3	0	47.5	0	11	8.75	3	0	0	0.005
		11	7.2	0	45	0	10	33.75	1	0	0.001	0.002
		15	4.2	0	55	0	6.75	21.5	1	0	0	0.001
		22	9.5	1.25	67.5	6.75	4.25	5	1	0	0	0.001
		30	12.8	3.75	50	3.75	3.3	0	2	0	0	0.005

Table C.1 Habitat features for all monitoring sites for Matters of National Environmental Significance - Box Gum Grassy Woodlands

			Additional habitat features							
			Litter	Rock	Bare ground	Log	Tree hollows	Dead trees	Mistletoe	Flower/fruit
LMU	Habitat	Site	% cover	% cover	% cover	length	number	(% tree population)	(% tree population)	(% tree population)
1	Woodland	24	37.5	6.25	5.25	5.7	19	0	20	0
		25	25	8.75	8.75	3.75	4	0	87.5	0
		31	50	4.25	10	4.5	10	0	57.1	0
		32	37.5	0	1.25	4.1	21	0	83.3	0
2	Grassland	2	2	2	1	0	0	0	0	0
		4	5	0.25	1.75	0	0	0	0	0
		9	2.5	0	2.5	0	0	0	0	0
		17	1.75	3.25	0.75	0	0	0	0	0
		19	4.5	0	7.5	0	0	0	0	0
		21	20	5	3.5	0	0	0	0	0
		28	20	0.75	0	0	0	0	0	0
	Woodland	3	9.5	2.25	0.25	5.5	0	0	0	100
		10	3.5	3.75	0	2.7	2	0	0	100
		13	6.25	1.5	5.5	2.2	0	0	0	33.3
		16	13.25	3	5	2	4	0	0	100
		18	1.75	0	1.25	3.2	7	0	0	100
		26	40	5	12.5	4.6	4	0	60	0
		27	42.5	1.25	2.5	6.3	16	0	33.3	0
3	Grassland	6	15	1.75	0	0	0	0	0	0
		7	20	0	4.25	0	0	0	0	0
		12	0	12.5	2.5	0	0	0	0	0
		14	0	6.25	0.75	0	0	0	0	0
		20	5	4.5	0	0	0	0	0	0
		23	20	5	5	0	0	0	0	0
		29	20	5	5	0	0	0	0	0
	Woodland	1	10	5.75	0	1.625	0	0	0	0
		5	18.75	3	7.5	3	0	0	70	10
		8	25	2.75	2.5	1	0	0	0	60
		11	5.5	2.5	3.25	1.5	0	0	0	0
		15	10	1	6.25	0	0	0	0	100
		22	25	1.25	2.5	4.4	7	0	0	0
		30	37.5	0	7.5	7	11	20	0	0

Table C.2 SIMPER Analysis Summary of flora data for MNES Box Gum Grassy Woodland

	Biodiversity Management Area		
Factor	**Merriwa East**	**Merriwa West**	**Namoi**
LMU1[1]	--	--	41.99
LMU2[1]	46.96	60.50	59.02
LMU3[1]	39.99	47.42	43.71
LMU2 x LMU3[2]	59.23	50.05	65.53
LMU1 x LMU2[2]	--	--	64.53
LMU1 x LMU3[2]	--	--	73.67
Grassland[3]	38.59	60.50	67.00
Woodland[3]	48.37	47.42	40.43
Grassland x Woodland[4]	54.77	54.28	79.48

Notes: *1.Similarity between all habitats*

2. Dissimilarity between all habitats

3. Similarity between all LMU

4. Dissimilarity between all LMU

Table C.3 SIMPER Analysis Summary of Soil characteristics for MNES Box Gum Grassy Woodland

	Derived Native Grassland	Box Gum Grassy Woodland
Merriwa East[1]	80.49	89.54
Merriwa West[1]	85.30	84.93
Namoi[1]	67.03	74.29
Merriwa West x Merriwa East[2]	14.07	11.51
Merriwa West x Namoi[2]	43.43	53.20
Merriwa East x Namoi[2]	39.95	53.35
LMU1[1]	--	75.12
LMU2[1]	81.67	81.62
LMU3[1]	77.78	86.68
LMU1 x LMU2[2]	--	25.25
LMU1 x LMU3[2]	--	30.03
LMU2 x LMU3[2]	20.04	16.06

Notes: 1.Similarity within factors

2. Dissimilarity between factors

APPENDIX F

BASELINE ECOLOGICAL MONITORING BOX GUM GRASSY WOODLANDS DATA

Table F-1
Comparison of the Baseline Ecological Monitoring Data against the Biometric Vegetation Condition Benchmarks

	LMU	Native Plant Richness	Native Over-Storey Cover	Native Mid-Storey Cover	Native Ground Cover (Grasses)	Native Ground Cover (Shrubs)	Native Ground Cover (Other)	No. Trees with Hollows	Total Length Fallen Logs
Biometric Benchmark		**23**	**10-45**	**5-60**	**5-45**	**2-10**	**5-35**	**2**	**50**
Box Gum Grassy Woodlands	1	23	25	6	41	24	6	6	45
	2	22	18	3	55	4	7	2	47
	3	24	12	1	50	3	8	1	10
Derived Native Grassland	2	20	0	3	58	4	7	0	0
	3	15	0	0	51	0	5	0	0

APPENDIX G

WHITE BOX-YELLOW BOX-BLAKELY'S RED GUM GRASSY WOODLAND AND DERIVED NATIVE GRASSLAND IMPORTANT SPECIES LIST (DECCW, 2011)

Appendix 1: Important Species for Box-Gum Grassy Woodland

This species list identifies selected important plant species found in the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* ecological community listed under the *Environment Protection and Biodiversity Conservation Act 1999* that indicate that the community is in good condition. The species list was developed to complement the Listing Information Guide, and should be read in that context (Rehwinkel unpublished; Nadolny unpublished). Note that some species are useful indicators for only part of the range of the ecological community and this is indicated where possible. Further work is required to develop indicator lists for each IBRA region.

SCIENTIFIC NAME	SYNONYM	COMMON NAME	REGION
FERNS			
Cheilanthes distans		Bristly Cloak Fern	Southern NSW indicator
GRASSES			
Cymbopogon refractus		Barbed Wire Grass	
Dichanthium sericeum		Queensland Blue-grass	
Dichanthium setosum			Northern NSW indicator
Digitaria porrecta		Finger Panic Grass	Northern NSW indicator
Eulalia aurea		(Bory) Kunth	Northern NSW indicator
Sorghum leiocladum		Wild Sorghum	
Themeda australis	(*Themeda triandra*)	Kangaroo Grass	
HERBS			
Ajuga australis		Australian Bugle, Austral Bugle	Southern NSW indicator
Ammobium craspedioides		Yass Daisy	
Arachnorchis spp.		Spider Orchids	
Arthropodium milleflorum		Vanilla-lily, Pale Vanilla-lily	
Arthropodium minus		Small Vanilla Lily	
Asperula conferta		Common Woodruff	Southern NSW indicator
Asperula scoparia		Prickly Woodruff	
Brachyscome diversifolia	(*Brachycome diversifolia*)	Large-headed Daisy	
Brachyscome graminea	(*Brachycome graminea*)	Grass Dairy	
Brachyscome multifida	(*Brachycome multifida*)	Cut-leaved Daisy	
Brachyscome rigidula	(*Brachycome rigidula*)	Leafy Daisy	
Brachyscome spathulata	(*Brachycome spathulata*)	Spoon Daisy	
Brunonia australis		Pincushion, Blue Pincushion	
Bulbine bulbosa		Bulbine Lily, Native Onion, Native Leek, Golden Lily	
Bulbine glauca		Rock Lily	

SCIENTIFIC NAME	SYNONYM	COMMON NAME	REGION
Burchardia umbellata		Milkmaids	
Caesia calliantha		Blue Grass-Lily	
Calocephalus citreus		Lemon Beauty-heads	
Calochilus robertsonii		Purplish Beard Orchid	
Calochilus spp.		Beard Orchids	
Calotis scabiosifolia var *integrifolia*		Rough Burr-daisy	
Chrysocephalum apiculatum		Yellow Buttons, Common Everlasting	
Chrysocephalum semipapposum		Clustered Everlasting, Yellow Buttons	
Craspedia variabilis		Billy Buttons	
Desmodium brachypodum		Large Tick-trefoil	
Desmodium varians		Slender Tick-trefoil	Southern NSW indicator
Dianella longifolia		Smooth Flax Lily	
Dianella revoluta		Blueberry Lily, Black-Anther Flax-Lily, Spreading Flax-Lily, Blue Flax-Lily	
Dichopogon fimbriatus		Chocolate Lily, Nodding Chocolate Lily	
Dipodium punctatum		Hyacinth Orchid, Pink Hyacinth Orchid	
Diuris chryseopsis		Common Golden Moths, Small Snake Orchid	
Diuris dendrobioides		Long-tail Purple Diuris, Wedge Diuris	
Diuris maculata		Leopard Orchid, Nanny Goats, Leopard Diuris, Spotted Double-tail	
Diuris punctata		Purple Donkey-orchid, Purple Double-tails, Purple Diuris, Purple Cowslip, Dotted Double tails	
Diuris semilunulata	(*Diuris maculata*)	Donkey-ears	
Diuris sulphurea		Tiger Orchid, Hornet Orchid	
Eriochilus cucullatus		Parson's Bands	
Eryngium ovinum	(*Eryngium rostratum*)	Blue Devil	
Galium gaudichaudii		Rough Bedstraw	

SCIENTIFIC NAME	SYNONYM	COMMON NAME	REGION
Genoplesium spp.		Midge Orchids	
Glycine clandestina		Twining Glycine	
Glycine tabacina		Glycine Pea, Variable Glycine	
Goodenia hederacea		Forest Goodenia, Ivy Goodenia	Southern NSW indicator
Goodenia pinnatifida		Scrambled Eggs, Cut-leaf Goodenia	
Hymenochilus bicolor	(*Pterostylis bicolor*)	Bicolor Greenhood	
Hymenochilus cycnocephalus	(*Pterostylis cycnocephala*)	Swan Greenhood	
Hymenochilus muticus	(*Pterostylis mutica*)	Midget Greenhood, Blunt Greenhood, Dwarf Greenhood	
Hypericum gramineum		Small St John's Wort	
Isoetopsis graminifolia		Grass Cushion	
Laxmannia gracilis		Slender Wire-Lily	
Leptorhynchos elongatus	(*Leptorhynchus elongatus*)	Lanky Buttons, Hairy Buttons	
Leptorhynchos squamatus	(*Conyza squamata, Chrysocoma squamata, Leptorhynchus squamatus*)	Scaly Buttons	
Leucochrysum albicans		Hoary Sunray	
Linum marginale		Wild Flax, Native Flax	
Lotus australis		Austral Trefoil, Australian Trefoil	
Microseris lanceolata		Yam Daisy, Murnong	
Microtis parviflora		Slender Onion Orchid	
Microtis unifolia		Common Onion Orchid, Onion Orchid	
Oreomyrrhis eriopoda		Australian Carraway	
Plantago gaudichaudii		Narrow-leaf Native Plantain, Narrow Plantain	
Plantago varia		Variable Plantain, Small Plantain, Sagoweed	
Podolepis jaceoides		Showy Copper-wire Daisy	
Polygala japonica		Dwarf Milkwort	
Poranthera microphylla		Small Poranthera, Small-leaved Poranthera	Southern NSW indicator
Prasophyllum petilum		Tarengo Leek Orchid	
Prasophyllum spp.		Leek Orchids	
Ptilotus spp.		Hairy Tails, Hairy Heads	

SCIENTIFIC NAME	SYNONYM	COMMON NAME	REGION
Ranunculus lappaceus		Common Buttercup, Australian Buttercup	
Rutidosis leptorrhynchoides		Button Wrinklewort	
Rutidosis multiflora		Small Wrinklewort	
Sebaea ovata		Yellow Centaury	
Sida corrugata		Corrugated Sida	Southern NSW indicator
Stackhousia monogyna		Creamy Candles, Creamy Stackhousia	
Stylidium graminifolium		Grass Trigger-plant	
Stypandra glauca		Nodding Blue Lily	
Swainsona galegifolia		Smooth Darling Pea	
Swainsona oroboides		Variable Swainson-pea	
Swainsona queenslandica		Smooth Darling Pea	
Swainsona recta		Mountain Swainson-pea, Small Purple-pea	
Swainsona reticulata		Kneed Swainson-pea	
Swainsona sericea		Silky Swainson-pea	
Thelymitra malvina		Mauve-tuft Sun-orchid, Sun-orchid	
Thelymitra pauciflora		Slender Sun-orchid, Few-flowered Sun-orchid	
Thelymitra rubra		Pink Sun-orchid, Salmon Sun-orchid, Red Sun-orchid	
Thysanotus patersonii		Twining Fringe-lily	
Thysanotus tuberosus		Common Fringe-lily	
Tricoryne elatior		Yellow Rush-lily, Yellow Autumn-lily	
Triptilodiscus pygmaeus	(*Helipterum australe*)	Austral Sunray, Common Sunray	
Velleia paradoxa		Spur Velleia	
Viola betonicifolia		Showy Violet, Arrow-head Violet, Native Violet, Purple Violet	Southern NSW indicator
Wurmbea dioica	(*Anguillaria dioica*)	Early Nancy	
Zornia dyctiocarpa		Zornia	
SHRUBS			
Acacia decora		Western Silver Wattle, Showy Wattle, Western Golden Wattle,	Southern and eastern NSW indicator
Acacia genistifolia		Spreading Wattle, Early Wattle,	

SCIENTIFIC NAME	SYNONYM	COMMON NAME	REGION
		Wild Irishman	
Astroloma humifusum		Native Cranberry, Cranberry Heath	
Bossiaea buxifolia		Box-leaved Bitter-pea	
Bossiaea prostrata		Creeping Bossiaea, Prostrate Bitter-pea	
Daviesia genistifolia		Spiny Bitter-pea, Broom Bitter-pea	
Daviesia latifolia		Hop Bitter-pea	
Daviesia leptophylla	(*Daviesia virgata*)	Narrow-leaf Bitter-pea	
Daviesia mimosoides		Narrow-leaf Bitter-pea	
Dillwynia cinerascens		Grey Parrot-pea	
Dillwynia retorta		Heathy Parrot-pea	
Dillwynia sericea		Showy Parrot-pea	
Exocarpos strictus		Pale Ballart, Pale-fruit Ballart, Dwarf Cherry	
Gompholobium huegelii		Pale Wedge-pea	
Grevillea iaspicula		Wee Jasper Grevillea	
Grevillea lanigera		Woolly Grevillea	
Grevillea ramosissima		Fan Grevillea, Branching Grevillea, Prickly Parsley Bush	
Grevillea rosmarinifolia		Rosemary Grevillea	
Grevillea wilkinsonii		Tumut Grevillea	
Hardenbergia violacea		False Sarsaparilla, Purple Coral-pea, Native Lilac	
Hibbertia calycina		Lesser Guinea-flower	
Hibbertia riparia	(*Hibbertia stricta*)	Stream Guinea-flower, Erect Guinea-flower	
Hovea linearis		Creeping Hovea	
Indigofera adesmiifolia		Tick Indigo, Leafless Indigo, Broad-leaved Indigo	
Indigofera australis		Austral Indigo, Australian Indigo, Native Indigo, Hill Indigo	
Jacksonia scoparia		Winged Broom-pea, Dogwood, Broom	
Lespedeza juncea		Perennial Lespedeza	
Leucopogon fletcheri		Pendant Beard Heath	

SCIENTIFIC NAME	SYNONYM	COMMON NAME	REGION
Leucopogon fraseri		Beard Heath	
Leucopogon virgatus		Common Beard Heath	
Pimelea curviflora		Curved Rice-flower	
Pimelea glauca		Shrubby Rice-flower	
Pultenaea microphylla		Spreading Bush-pea	
Pultenaea procumbens		Heathy Bush-pea	
Pultenaea spinosa	(*Pultenaea cunninghamii*)	Bush-pea	
Pultenaea subspicata		Low Bush-pea	
Templetonia stenophylla		Leafy Templetonia, Leafy Mallee-pea	

APPENDIX H

FIELD METHODS FOR MONITORING BOX GUM GRASSY WOODLANDS

Details of the field methods for Vegetation Monitoring are provided below and a summary of the key variables that will be extracted from this data for analysis is provided in Table H-1.

50 x 20 m plot

Over-storey composition and species richness: Systematically cover the entire 50 x 20 m plot identifying all over-storey species (tallest woody stratum >1 m).

Over-storey regeneration: When identifying over-storey species, also record stem diameter class (0-10 cm, 10-20 cm or >20 cm) for each tree.

Additional habitat features: When identifying over-storey species, note the presence of tree hollows (minimum entrance width of 5 cm), mistletoe or flowers/fruit on each tree and any dead trees. Also record the length of fallen logs (minimum diameter 10 cm and minimum length 0.5 m) within the plot.

20 x20 m quadrat

Community species richness: Systematically cover the entire 20 x 20 m quadrat identifying and recording all native species in the mid-storey (all vegetation between the over-storey and >1 m including tall shrubs, under-storey trees and tree regeneration) and all native species in the ground stratum noting native grasses (plants belonging to the Family Poaceae), native shrubs (woody vegetation <1 m), other native species (other native non-woody vegetation in ground stratum e.g. forbs, herbs, lilies, rushes, sedges) and exotic species.

Community structure: Divide the 20 x 20 m quadrat into four 10 x 10 m quarters and estimate the % cover of native species in each stratum (mid-storey, ground stratum (grasses), ground-stratum (shrubs), ground stratum (other) and exotics) within each quarter. Average the four estimates to obtain an average % cover for each stratum in the 20 x 20 m quadrat.

Additional habitat features: Within each quarter of the quadrat, also estimate % cover of litter, rock and bare ground. Average the four estimates to obtain an average % cover for each habitat feature in the 20 x 20 m quadrat.

50 m transect

Community structure: At 10 points along each of the three 50 m transects (every 5 m) estimate % foliage cover directly overhead (over-storey) using reference images provided in the BioMetric 3.1 Operational Manual (Department of Environment, Climate Change and Water, 2011). Average the estimates to obtain an average % foliage cover for the plot.

Table H-1
Key Attributes used to Monitor Changes in the Vegetation/Habitat Condition

Attributes	Measurement Units	Sampling Units
SPECIES RICHNESS		
Native over-storey	Species ID and No. species/sampling unit	50 x 20 m plot
Native mid-storey	Species ID and No. species/sampling unit	20 x 20 m quadrat
Native ground stratum (grasses)	Species ID and No. species/sampling unit	20 x 20 m quadrat
Native ground stratum (shrubs)	Species ID and No. species/sampling unit	20 x 20 m quadrat
Native ground stratum (other)	Species ID and No. species/sampling unit	20 x 20 m quadrat
Exotic ground stratum	Species ID and No. species/sampling unit	20 x 20 m quadrat
Total	Species ID and No. species/sampling unit	20 x 20 m quadrat for mid-storey and ground strata, 50 x 20 m plot for over-storey
Total Native	Species ID and No. species/sampling unit	20 x 20 m quadrat for mid-storey and ground strata, 50 x 20 m plot for over-storey
Total Exotic	Species ID and No. species/sampling unit	20 x 20 m quadrat for mid-storey and ground strata, 50 x 20 m plot for over-storey
COMMUNITY STRUCTURE		
Native over-storey	% cover	3 x 50 m transects
Native mid-storey	% cover	20 x 20 m quadrat
Native ground stratum (grasses)	% cover	20 x 20 m quadrat
Native ground stratum (shrubs)	% cover	20 x 20 m quadrat
Native ground stratum (other)	% cover	20 x 20 m quadrat
Exotic	% cover	20 x 20 m quadrat
OVERSTOREY REGENERATION & HEALTH		
Over-storey species regeneration	No. species	50 x 20 m plot
Over-storey species stem diameter class (0-10 cm)	No./sampling unit	50 x 20 m plot
Over-storey species stem diameter class (10-20 cm)	No./sampling unit	50 x 20 m plot
Over-storey species stem diameter class (>20)	No./sampling unit	50 x 20 m plot
ADDITIONAL HABITAT FEATURES		
Litter	% cover	20 x 20 m quadrat
Rock	% cover	20 x 20 m quadrat
Bare ground	% cover	20 x 20 m quadrat
Log	Length	50 x 20 m plot
Tree hollows	Number	50 x 20 m plot
Dead trees	(% tree population)	50 x 20 m plot
Mistletoe	(% tree population)	50 x 20 m plot
Flower/fruit	(% tree population)	50 x 20 m plot