



## **Mt Gilead**

# **Biodiversity Certification Assessment Report & Biocertification Strategy**

Prepared for

**Mt Gilead Pty Ltd and Mr & Mrs Dzwonnik**

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# Abbreviations

Abbreviation	Description
ARA	Adjacent Remnant Area
APZ	Asset Protection Zone
AW	Alluvial Woodland
BAR	Biodiversity Assessment Report
BCAA	Biodiversity Certification Assessment Area
BBAM 2014	Biobanking Assessment Methodology 2014
BCAM	Biodiversity Certification Assessment Methodology
BCS	Biodiversity Certification Strategy
BVT	Biometric vegetation type
CCC	Campbelltown City Council
CCPD	Canopy cover projection density
CEEC	Critically Endangered Ecological Community
CMA	Catchment Management Authority
CPSWSGTF	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
CPW	Cumberland Plain Woodland
DEC	NSW Department of Environment and Conservation (now OEH)
DECC	NSW Department of Environment and Climate Change (now OEH)
DECCW	NSW Department of Environment, Climate Change and Water (now OEH)
DPE	NSW Department of Planning and Environment (formerly NSW Department of Planning)
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
IoM	Improve or Maintain
JBA	JBA Urban Planning Consultants
LEP	Local Environment Plan
LGA	Local Government Area
LG Act	NSW <i>Local Government Act 1993</i>
Lendlease Communities	Lendlease Communities (Mt Gilead) Pty Ltd

Abbreviation	Description
MALD	More appropriate local data
MDP	Metropolitan Development Program
Mt Gilead	Mt Gilead Pty Ltd
NPW Act	NSW <i>National Parks and Wildlife Act 1974</i>
NPWS	NSW National Parks and Wildlife Service (now part of OEH)
NSW	New South Wales
OEH	NSW Office of Environment and Heritage (formerly DECCW, DECC, DEC)
Old Mill Properties	Old Mill Properties Pty Ltd
PCL	Priority Conservation Lands
RF	Riparian Forest
RFEF	River Flat Eucalypt Forest
SEPP 44	State Environmental Planning Policy No 44 – Koala Habitat Protection
SSTF	Shale Sandstone Transition Forest
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>

# Definitions

The following table provides definitions for the terminology used in biocertification assessments. Where these terms have been used in the report they have been included in 'quotation marks'.

For this assessment, an additional term, 'retained land – existing conservation measures' has been included. This is to distinguish areas of retained land where two Biobank sites will be registered prior to this application for biodiversity certification being determined.

Definition	Description
Area of High Biodiversity Conservation Value	As described under Section 2.3 of the BCAM. Areas include critically endangered and endangered ecological communities (CEEC and EEC) not in low condition, threatened species that cannot withstand further loss, areas of vegetation that have regional or state conservation significance, and state and regional biodiversity corridors. Also termed Red Flags.
Biodiversity Certification Assessment Area	As described in the BCAM, it includes land where certification is proposed to be conferred and any surrounding or adjacent land. Surrounding and adjacent land may be proposed for biodiversity conservation, or neither certification or development (Retained Land).
Conservation Area	Land that is proposed for conservation measures.
Conservation Measures	The range of measures identified in Section 126L of the TSC Act
Credit Discounting	Applies where there are existing legal obligations to undertake conservation management actions on land.
Development Area	Land within the Biodiversity Certification area that is proposed for development
Ecosystems Credit	As described under the BCAM, the class of credit for biodiversity certification that are generated for conservation measures or required for the land proposed for certification. Ecosystem credits are also generated for some threatened species that are assumed to be present based on the location of the site and the vegetation types present.
Low Condition	As described in Section 2.3 of the BCAM. To meet the 'low condition' threshold a number of criteria described in the method must be met, including <50% of the lower benchmark value of over storey percent cover for the relevant vegetation type or native vegetation with a site value score of less than 34 (Site value score is described in Section 3.6.2 of the BCAM).
Managed and Funded Conservation Measure	As described under Section 8.1.1 of the BCAM. Examples include entering into a Biodiversity Banking Agreement with respect to the land under Part 7A of the TSC Act and the reservation of land under the <i>National Parks and Wildlife Act 1974</i> (NPW Act).
Managed Conservation Measure	As described under Section 8.1.2 of the BCAM. Examples include entering into a conservation agreement under Division 12, Part 4 of the NPW Act and entering into a planning agreement under the EP&A Act that makes provision for development contributions to be used for or applied towards the conservation or enhancement of the natural environment.
Moderate-Good Condition	As described in Section 2.3 of the BCAM. Any vegetation that is not in 'low condition' is in 'moderate to good' condition

Definition	Description
More appropriate local data	As described in 3.4 of the BCAM, the Director General may certify that more appropriate local data can be used instead of the data in the Vegetation Benchmark Database, where local data more accurately reflects local environmental conditions.
Planning Instrument Conservation Measure	As described under 8.1.3 of the BCAM. Application of this measure requires a number of conditions to be met that are described under the relevant Section of the method.
Biometric vegetation type	A plant community classification system used in BioMetric Tools, including the BioBanking Tool, Biodiversity Certification Tool and Property Vegetation Planning Tool
Red Flags	As described in Section 2.3 of the BCAM. See 'Areas of High Biodiversity Conservation Value' above.
Retained Land	Land within the Biodiversity Certification Assessment Area that is not land proposed for biodiversity certification or subject to proposed conservation measures.
Retained Land – existing conservation measures	Land within the Biodiversity Certification Assessment Area that is not land proposed for biodiversity certification or subject to proposed conservation measures, but which overlaps with the two Biobank sites that will be registered prior to this application for biodiversity certification being determined.
Species credit	As described in the BCAM, the class of credits for biodiversity certification that are generated for a conservation measure or are required for the land proposed for certification



# Executive Summary

Eco Logical Australia Pty Ltd (ELA) was commissioned by Old Mill Properties Pty Ltd (Old Mill Properties), on behalf of Mt Gilead Pty Ltd (Mt Gilead) and Lendlease Communities (Mt Gilead) Pty Ltd (Lendlease Communities) on behalf of S. and A. Dzwonnik to undertake a Biodiversity Certification Assessment of a planning proposal at Appin Road, Gilead, and prepare a Biodiversity Certification Strategy (BCS) in accordance with the Biocertification Assessment Methodology (BCAM) (Department of Environment, Climate Change and Water [DECCW] 2011). The purpose of the assessment is to obtain '*biodiversity certification*' of land proposed for residential development and associated infrastructure from the Minister for the Environment. Biocertification is conferred by the Minister if the '*conservation measures*' proposed in the biocertification application result in an overall '*improvement or maintenance*' in biodiversity values.

The '*Biodiversity Certification Assessment Area*' (BCAA) defined for the study encompasses a total area of 208.89 ha and includes 29.81 ha of native vegetation communities comprising three Biometric vegetation types (BVTs). These BVTs form components of the vegetation communities, Cumberland Plain Woodland (CPW) and Shale Sandstone Transition Forest (SSTF), which are listed as critically endangered ecological communities (CEECs) under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and *Commonwealth Environment Protection and Biodiversity Conservation Act* (EPBC Act) 1999, and River-Flat Eucalypt Forest (RFEF) which is listed as an endangered ecological community (EEC) under the TSC Act. The remaining 179.08 ha of the assessment area is exotic vegetation and cleared land. Whilst a number of threatened flora and fauna species have been recorded near or within the assessment area, only one vulnerable species, *Phascolarctos cinereus* (Koala), requires specific assessment under the BCAM. Koala is classified as a '*species credit*' species and impacts to these species cannot be assessed by the vegetation types. Koala has been assumed to be present for impact assessment purposes, and '*expert reports*' have been prepared stating that it is likely to occur in the two proposed Biobank sites that will be registered prior to this application for biodiversity certification being determined. These biobank sites are located within '*retained land – existing conservation measures*' in the BCAA.

The BCAA and proposed impacts are described in **Section 1**. The biodiversity values of the BCAA are described in the Biodiversity Assessment Report (BAR) in **Section 2**. Explanation for data used in the assessment is provided in **Section 3**. The credit calculations and strategy for achieving an 'improve or maintain' outcome are provided in **Sections 4** and **6**, respectively.

The application proposes to directly impact 165.7 ha of the assessment area of which 11.08 ha is mapped as native vegetation and threatened species habitat, and includes 1.45 ha of a CEEC (SSTF) in moderate to good condition and 0.15 ha of CPW within a riparian buffer which is categorised as a '*red flag area*' or '*area of high biodiversity conservation value*' by the BCAM.

Impacts to red flag areas that cannot be avoided require a '*variation*' from the Minister before Biocertification can be conferred. A request for a red flag variation is included in **Section 5**. The remaining areas to be impacted are not '*areas of high biodiversity conservation value*', or are cleared of native vegetation.

The application proposes to permanently protect and manage for conservation, 3.46 ha of lands in the BCAA (2.48 ha of which will generate credits) which are proposed to be conserved as a 90% conservation measure by the transfer of these lands to Campbelltown City Council (CCC) by 2025. This land will be categorised as 'Community Land - Natural Areas' under the *Local Government Act 1993* and will be subject to a Plan of Management. In addition to this conservation measure, it is proposed that 18.88 ha

of land within the BCAA is protected and managed for conservation in two Biobank sites (the Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites) that will be registered under Part 7A of the TSC Act prior to this application for biodiversity certification being determined. Mt Gilead will initially manage both biobank sites, with the Noorumba-Mt Gilead Biobank site proposed to be transferred to CCC by 2025 as an addition to the Noorumba Reserve Biobank site that is being registered by Council. These Biobank sites are located in '*retained land – existing conservation measures*'. The Biobank sites together include 4.63 ha of CPW, 8.18 ha of SSTF, and 0.44 ha of RFEF, as well as habitat for Koala with conservation management (removal of grazing and initial weed control), commenced in 2016).

Similarly, S&S Dzwonnik will manage the proposed Council Reserve Land for conservation until the land is transferred to Council, expected to be by 2025.

Separate assessments for these areas as Biobank Sites have already been completed and submitted to OEH who have now completed the audit and assessment process. Draft Biobank Agreements have been prepared by OEH and they are now ready to be registered. Interim conservation management of these areas has also been commenced by Mt Gilead. A BioBanking Agreement is recognised as a '*100% permanently managed and funded*' conservation measure under s.126L (i) of the TSC Act and Section 8.1.1 of the BCAM, and will provide in-perpetuity conservation protection and management on the land title.

The Biodiversity Certification Assessment has found that **139** biocertification '*ecosystem credits*' are required for direct impacts to two BVTs (30 credits for CPW and 109 for SSTF) and **292** '*species credits*' are required for impacts to Koala. The 90% conservation measure in '*land subject to conservation measures*' is able to generate **16** of the credits required for SSTF (resulting in a deficit of **93** ecosystem credits for SSTF, **30** ecosystem credits for CPW and **292** Koala species credits). In addition to these proposed conservation measures, a further **198** ecosystem credits and **133** Koala species credits will be generated by the two Biobank sites, Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites, within the BCAA. Some of these credits will be retired resulting in all ecosystem credits requirements being met and a **159** credit deficit for Koala. Not all ecosystem credits that will be generated by the two Biobank sites will be retired; there will be a surplus of ecosystem credits that can be used to offset impacts from other developments.

If an '*improve or maintain*' outcome is to be achieved, the deficit credits for Koala must be generated by other conservation measures '*outside*' the BCAA. It is proposed that these remaining Koala credits are purchased from the biodiversity credit market. A review of the credit registers indicates that there are currently three registered Biobank sites in NSW with Koala credits.

Indirect impacts have been considered in accordance with the BCAM and have been determined to be negligible on the basis that all direct impacts have been assessed on the assumption of complete loss of all biodiversity values, even where impacts are only partial loss as a result of establishing Bushfire Asset Protection Zones and all proposed conservation areas are buffered by perimeter roads.

Subject to the Minister's approval of the request for a red flag variation and the purchase of the additional **159** Koala credits, the proposal can meet an '*improve or maintain*' outcome and is eligible for biodiversity certification. If the Minister confers biocertification on the requested land, CCC as the consent authority for future development applications is no longer required to assess impacts to biodiversity values as these have already been addressed by the Minister and '*conservation areas*' will be required to be managed in perpetuity for conservation.

# 1 Preamble

## 1.1 Project background

Eco Logical Australia Pty Ltd (ELA) was commissioned by Old Mill Properties Pty Ltd (Old Mill Properties), on behalf of Mt Gilead Pty Ltd (Mt Gilead) and Lendlease Communities (Mt Gilead) Pty Ltd (Lendlease Communities) on behalf of Mr and Mrs Dzwonnik to undertake a Biodiversity Certification Assessment of a planning proposal at Appin Road, Gilead, and to prepare a Biocertification Certification Strategy (BCS). The land is located on three lots (Lot 61 DP 752042, Part Lot 2 DP1218887 and Lot 3 DP 1218887 (formerly part of Lot 1 and Lot 2 DP 807555 and Lots 59 DP 752042)) on Appin Road within the Campbelltown Local Government Area (LGA), approximately 5 km south of Campbelltown city centre (**Figure 1**). The lands are proposed to be developed following the rezoning of these lands from a 'deferred matter' to residential. The rezoning documents were publicly exhibited between April and June 2015 and rezoned during September 2017.

An application for biocertification must follow the Biodiversity Certification Assessment Methodology (BCAM) (Department of Environment, Climate Change and Water [DECCW] 2011) and meet the requirements of Section 126K of the *Threatened Species Conservation Act 1995* (TSC Act), i.e. be accompanied by a BCS.

The BCAM was developed by the New South Wales (NSW) Office of Environment and Heritage (OEH) and was gazetted by the NSW government in February 2011. The methodology may be applied to land for which '*biocertification is sought*', and is conferred by the Minister for the Environment if the '*conservation measures*' proposed in the biocertification application result in an overall '*improvement or maintenance*' in biodiversity values. This is referred to under the methodology as satisfying the '*improve or maintain test*' (IoM test).

The methodology provides an equitable, transparent and scientifically robust framework with which to address the often competing demands of urban development and biodiversity conservation. If the Minister for the Environment is satisfied that an IoM outcome has been achieved, he/she may confer biocertification on 'land'. If the Minister confers biocertification on land, a consent/approval authority does not have to take biodiversity issues into consideration when assessing development applications, i.e. for the purpose of s.5A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), the development or activity is not subject to an Assessment of Significance for threatened species, populations or ecological communities.

Only a '*Planning Authority*' as defined by section 126G of the TSC Act may apply to the Minister for biocertification. CCC is a Planning Authority as defined by section 126G. CCC is seeking biocertification of the land identified in this assessment report in parallel with an application to rezone the land as an amendment to Campbelltown Local Environment Plan (LEP) 2014 (CCC 2015).

This Biocertification Strategy and the associated credit calculations were undertaken by accredited assessors Bruce Mullins (Accreditation Number 0156) and Enhua Lee (Accreditation Number 0176), who was supported by other ELA staff (Joanne Daly and Robert Humphries), and field ecologists who undertook ecological investigations of the Biodiversity Certification Assessment Area (BCAA) as part of previous investigations for rezoning of lands in the BCAA from 'deferred matter' to new zoning (ELA 2014) (Belinda Failes, Rodney Armistead and Mitchell Palmer). Brief cvs for the project team members are provided in **Appendix A**.

## 1.2 Description of project timelines, management and governance

The application for biocertification is being undertaken in parallel with an application to rezone the subject land as an amendment to Campbelltown Local Environment Plan (LEP) 2014 (CCC 2015).

The BCAA has been rezoned in accordance with the Standard Instrument – Principal Local Environmental Plan and consistent with the Campbelltown LEP 2014 to a predominantly R2 residential zone including roads with a neighbourhood centre (151.37 ha), along with areas for public open space (21.13 ha) and conservation (18.88 ha). A total of 17.51 ha is proposed to be retained as rural land.

Rezoning will facilitate development of up to 1,700 new dwellings in a low density environment. The dwellings are proposed in a range of lot sizes, with 600 m<sup>2</sup> the average lot size, and will expand the type and choice of dwellings available in the Campbelltown LGA. This outcome is consistent with local and regional strategies and objectives to promote housing diversity.

Detailed information on the planning proposal can be found in the final planning proposal prepared by JBA Urban Planning Consultants (JBA 2014).

The planning proposal was placed on exhibition by CCC between 28 April and 30 June 2015 (**Appendix B**) and was rezoned in September 2017. Preliminary subdivision plans are expected to be submitted in 2018. Subject to all approval being in place, construction is proposed to commence in two stages starting with Stage 1 in 2018/19 and subject to demand for lots, be completed by 2022/23.

## 1.3 Community Consultation and Stakeholder Engagement

The planning proposal to rezone the subject land at Gilead has undergone extensive community and stakeholder consultation, including with the DPE and the OEH, since 2010 (refer to **Figure 2** and **Appendix B**).

The planning proposal was placed on public exhibition between 28 April and 30 June 2015 by CCC. Further, consistent with section 126N of the TSC Act, the proposal to seek biocertification of land at Appin Road, Gilead will be placed on public exhibition and a report prepared responding to any submissions received.

## 1.4 Biodiversity certification assessment area and proposal

The Biodiversity Certification Assessment Area (BCAA) encompasses a total area of 208.89 ha and is located close to Campbelltown city centre within the Campbelltown LGA in south-western Sydney. The site is accessed off Appin Road and includes land proposed for biodiversity certification (and therefore proposed for development; '*land to be certified*'), '*conservation areas*' i.e. land subject to conservation measures, and '*retained land*' i.e. land that is not proposed for development or subject to conservation measures. Portions of retained land within the BCAA overlap with the two Biobank sites that will be registered prior to this application for biodiversity certification being determined and are therefore referred to as '*retained land – existing conservation measures*'.

The BCAA includes approximately 29.81 ha of native vegetation. Vegetation within the BCAA includes three Biometric vegetation types (BVT), two of which are listed as Critically Endangered Ecological Communities (CEECs) under the TSC Act and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and one of which is listed as an Endangered Ecological Community (EEC) under the TSC Act (**Table 1**). The remaining areas comprise exotic pasture which fits the definition of 'cleared land' as defined by the BCAM (DECCW 2011a) i.e. areas where there is no canopy or shrub layer and the ground cover is greater than 50% exotic cover.

The regional location of the BCAA is shown in **Figure 1**. The areas proposed to be impacted through rezoning (land to be certified or ‘*development areas*’), land subject to conservation measures or ‘*conservation areas*’, and ‘*retained land*’ in the BCAA are shown in **Figure 2** and **Figure 3**. Details of the proposed land uses within the BCAA are shown in **Figure 4** and **Table 2** and comprise urban development and associated infrastructure (roads, water, sewage, utilities), asset protection zones (APZs), recreational facilities within passive and active open space areas (playing fields etc) and land proposed for conservation of biodiversity values. It is noted that the land proposed for biocertification includes the bushfire asset protection zones (APZ) which are generally fully accommodated within the permit roads and building setbacks and do not impact on the land proposed for conservation measure or the proposed biobank sites (**Figure 4**).

Also shown in **Figures 3** and **4** are the locations of an existing Biobank site (Beulah Biobank Site), a soon to be registered Biobank site (Noorumba Reserve Biobank Site), the two Biobank sites that will be registered prior to this application for biodiversity certification being determined (overlapping ‘*retained land – existing conservation measures*’), and potential future Biobank sites adjacent to the BCAA. Noorumba Reserve has been included as a Western Sydney Priority Area lying on ‘Priority Conservation Lands’ (PCLs) (also referred to as Priority Areas) for the protection of the CEEC, Cumberland Plain Woodland (CPW), in the CPW Recovery Plan (DECCW 2011b) and updates to the layer. As such, it has been identified by the OEH as a priority site for registration of a Biobank site (OEH 2014b).

The proposal is to rezone the land proposed for biocertification to R2 (Low Density Residential), B1 (Neighbourhood Centre) and SP2 (Infrastructure), the land proposed for conservation to RE1 Public Recreation with a Biodiversity protection overlay noted on a map in the LEP, and the ‘retained’ areas to RE1 Public Recreation and RU2 Rural Landscape. Currently, all land within the BCAA is private land, zoned as a ‘deferred matter’ under the Campbelltown LEP (2011) (**Figure 2**). Some land in ‘*retained land*’ (i.e. within ‘*retained land – existing conservation measures*’) will be registered as Biobank sites, subject to Biobank Agreements under Part 7A of the TSC Act as described in **Section 6** of this report – Biodiversity Certification Strategy. A Biobank Agreement is a ‘*Permanently Managed and Funded Conservation Measure*’ as outlined in s.126L(i) of the TSC Act and section 8.1.1 of the BCAM.

**Table 1: Biometric vegetation types and their conservation status in the BCAA**

Biometric vegetation type	Area (ha)	TSC Act	EPBC Act
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	0.44	RFEF (EEC)	
Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	8.75	CPW (CEEC)	Part CPSWSGTF (CEEC)*
Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	20.62	SSTF (CEEC)	Part SSTF (CEEC)
Cleared land	179.08	NA	NA
<b>Total</b>	<b>208.89</b>		

\* CPSWSGTF = Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

**Table 2: Proposed biocertification land uses in the BCAA**

Development footprint	Area (ha)	% of BCAA	Area of native vegetation (ha)	% of native vegetation
Land proposed for Biodiversity Certification (Development)	165.70	79.32	11.08	37.17
Land proposed for conservation	2.48	1.19	2.48	8.32
Retained lands (land excluded from this assessment)	40.71	19.49	16.25	56.51
<b>Total</b>	<b>208.89</b>	<b>100</b>	<b>29.81</b>	<b>100</b>

## 1.5 Biocertification Assessment Process and Implications

Under the BCAM, the impact of development and conservation measures on biodiversity values is quantified using '*biodiversity credits*' which are defined by each of the BVTs (ecosystem credits) and threatened species present (species credits). In this regard, the methodology determines the number of credits that are required to offset the adverse impacts of development on biodiversity values and the number of credits that can be generated by undertaking recognised '*conservation measures*' as outlined in s126L of the TSC Act that will improve biodiversity values within the BCAA. Where the number of credits that are created is equal to, or exceeds the number required, the '*improve or maintain*' test described under the methodology is considered to be satisfied, provided '*red flags*' have been avoided, or a red flag variation has been approved by the Director General of the OEH.

'*Red flags*' are regarded as '*areas of high biodiversity conservation value*' in section 2.3 of the BCAM, and include vegetation types that are >70% cleared in the Catchment Management Authority Area (CMA), CEECs and EECs listed under the TSC Act and/or EPBC Act, vegetation recognised as having regional or state biodiversity conservation significance, and certain threatened species that are regarded as not being able to withstand further loss in the CMA.

The BCAA includes two red flag entities that will be impacted by the proposal:

- One CEEC, '*Shale Sandstone Transition Forest in the Sydney Basin Bioregion*' (SSTF) involving impacts to 1.45 ha.
- Impacts to vegetation within a riparian buffer 20m either side of a minor creek (0.15 ha)

The measures taken to avoid, minimise and mitigate impacts to this '*red flag*' are provided in **Section 5**. As all impacts have not been avoided, this assessment report includes a red flag variation request (**Section 5**).

## 1.6 Assessment Methodology/Consultation with the OEH

In accordance with the OEH's Biodiversity Certification Guide for applicants (OEH 2015a), CCC and ELA consulted with the OEH prior to and throughout the assessment to ensure that all decisions and assumptions meet the intent of the BCAM. The OEH was also consulted on the proposed impacts to '*red flags*' and the likelihood that these would be supported.

A summary of discussions and outcomes are provided below:

- The proposed biocertification approach:



- areas of high conservation value (CEECs, riparian areas and biodiversity links), and species credits species to be considered (*Phascolarctos cinereus* (Koala)). The OEH agreed that there were two CEECs, and one species credit species, to be considered, and there were no state or regional biodiversity links on site;
- the boundaries of the BCAA, focussing on the inclusion/exclusion of the two Biobank sites. The OEH agreed that the two Biobank sites that will be registered prior to this application for biodiversity certification being determined could be included within '*retained land – existing conservation measures*' in the BCAA, and surplus credits could be retired at a later date as per other Biobank sites, rather than retired in their entirety as per surplus credits in conservation lands in biocertification assessments;
- The version of the Biocertification calculator tool to be used for calculations. Version 1.9 was initially used but calculations were updated in May 2017 using version 1.09\_HN556\_201216 together with amendments to the benchmarks for the number of hollow bearing trees and length of fallen logs for CPW and SSTF being 1 and 50 respectively for both vegetation communities. It is noted that the SSTF is now classified as a Grassy Woodland Vegetation Formation rather than a Dry Sclerophyll Forest Formation;
- In-principle support from the OEH regarding red flag impacts. The OEH indicated it would support a red flag variation given the current condition of the red flag vegetation to be removed and the areas of CEEC proposed to be conserved in the '*conservation areas*' and in one of the Biobank sites (Macarthur-Onslow Mt Gilead Biobank Site); and
- The OEH assessment requirements, preparation and exhibition of the BCS, and the application by CCC for conferral of biocertification to the Minister for Environment. The OEH indicated that the BCAM should be followed, as well as Guidelines for the preparation of Biodiversity Assessments and Strategies.
- Following advice from OEH in early 2016 regarding the assessment of potential breeding habitat for the Southern Myotis (i.e. any hollow bearing trees within 200m of permanent water should, be considered potential breeding habitat) and a recent record (December 2013) of the endangered Green and Golden Bell Frog at Biriwiri Creek, approximately 7km north of the BCAA, targeted survey for the GGBF and an assessment of potential breeding habitat for Southern Myotis was undertaken on 30 November and 7<sup>th</sup> and 12<sup>th</sup> of December 2016.

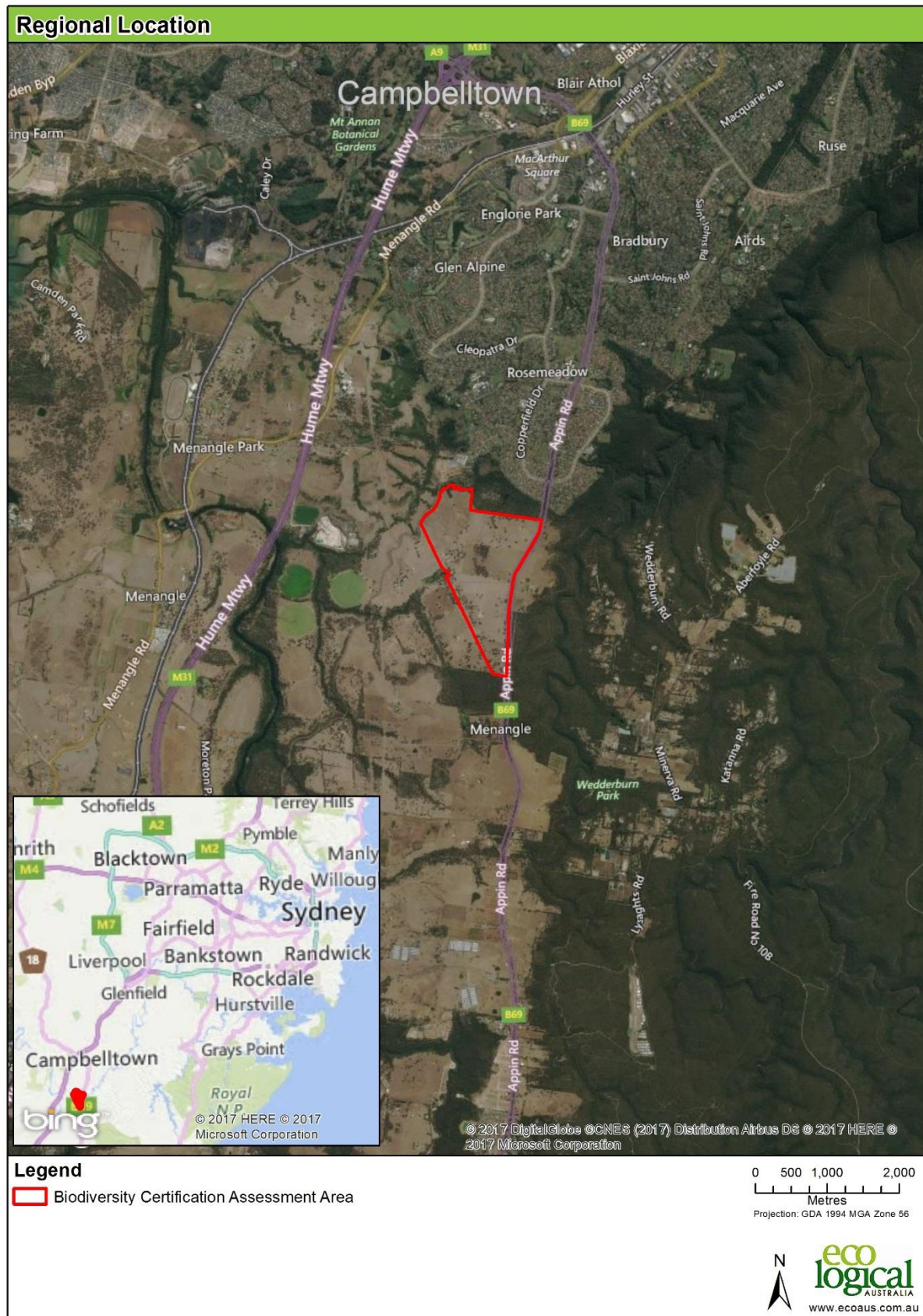


Figure 1: Regional location of the Mt Gilead Biodiversity Certification Assessment Area

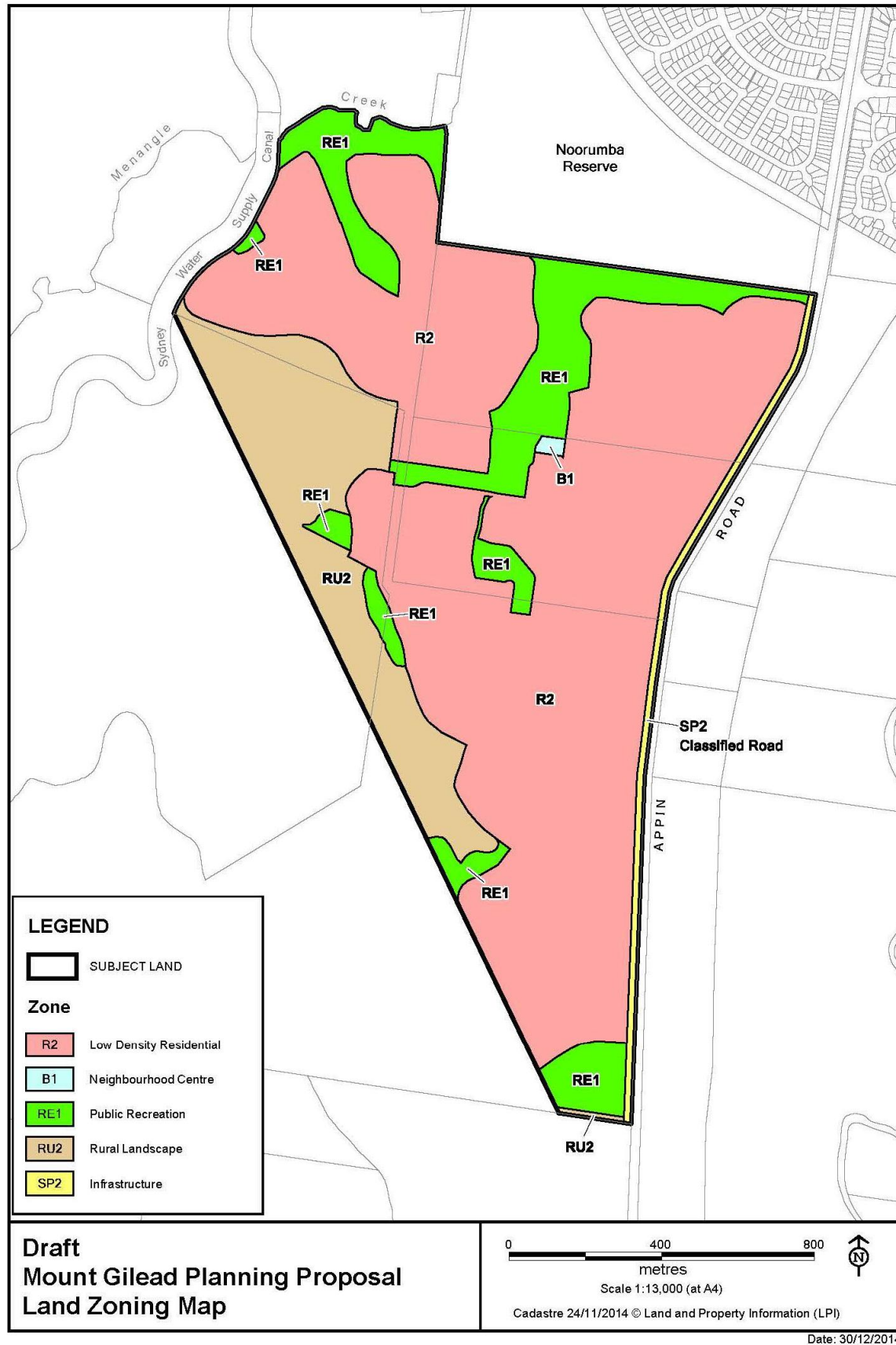
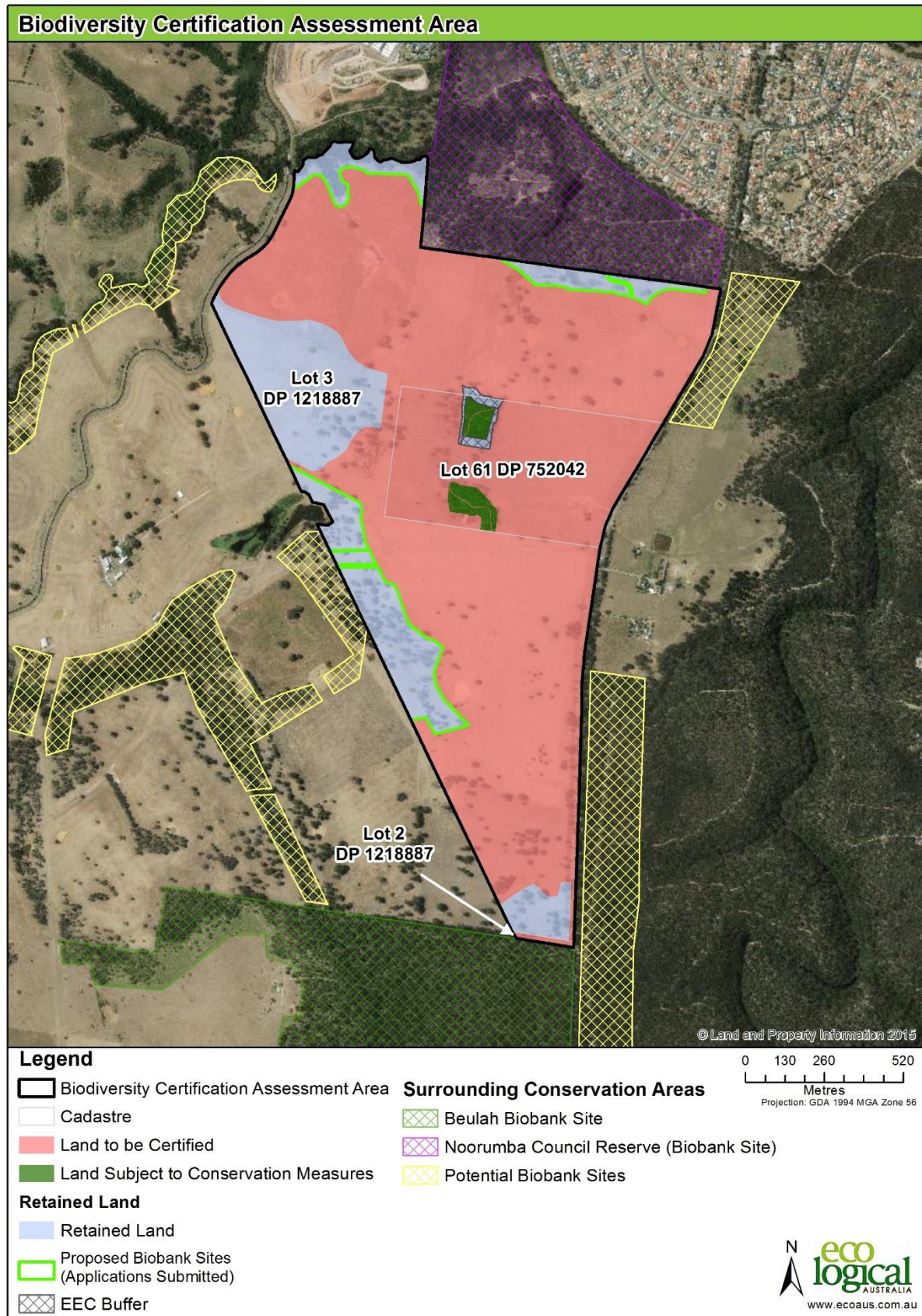


Figure 2: Proposed Land Zoning Map (Source CCC 2015)





**Figure 3: Mt Gilead Biodiversity Certification Assessment Area and location of existing conservation areas, two Biobank sites that will be registered within the BCAA, and proposed Biobank sites outside the BCAA**



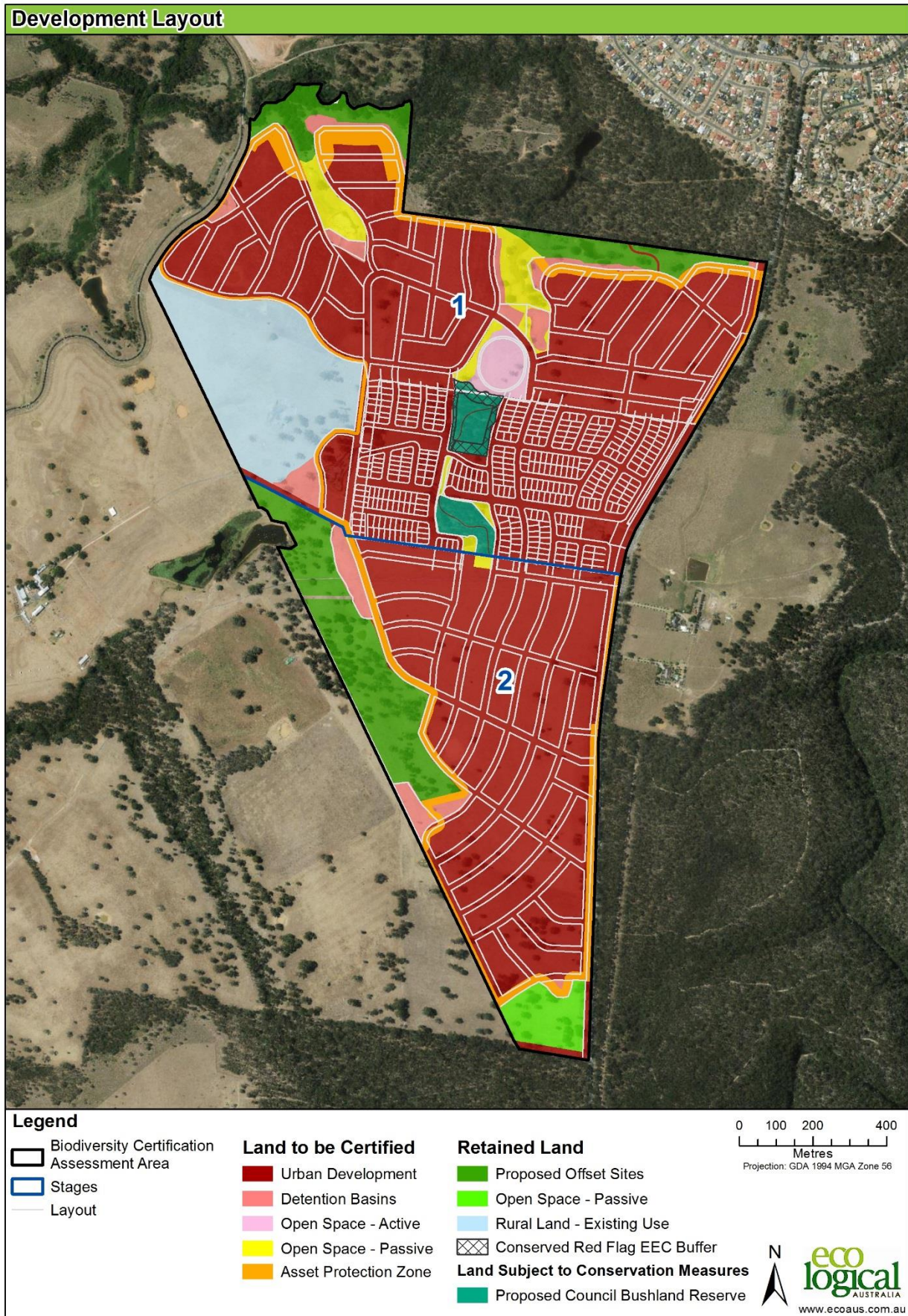


Figure 4: Proposed land use within the BCAA

## 2 Biodiversity Values Assessment Report—methodology and results

An application for biodiversity certification must include an assessment of the biodiversity values of the BCAA undertaken in accordance with the BCAM. The results of the assessment of ecological values are to be included in a report titled '**Biodiversity Assessment Report**'. This section addresses this requirement.

An assessment of the biodiversity values of the BCAA was undertaken by ELA in 2013 as part of an ecological assessment for the rezoning proposal (ELA 2014, CCC 2015). This built on work undertaken by ELA in 2006, which validated vegetation communities present and their condition in the BCAA and adjacent lands and mapped Koala habitat (ELA 2006). The information collected by ELA in 2006 and 2013 (ELA 2006 and 2014) was used to prepare this Biodiversity Assessment Report (BAR). However, as part of preparing this Biodiversity Assessment Report (BAR) in accordance with the BCAM, additional surveys were undertaken by ELA in 2015 and 2016 including data for two separate Biobank site assessments (ELA 2015a and 2015b), further plots within the BCAA to further validate and refine the vegetation communities and zones, and targeted surveys for the Green and Golden Bell Frog (*Litoria aurea*) and Southern Myotis (*Myotis macropus*) (ELA 2016 and **Appendix H**). This was done to ensure data collected in overlapping areas of the BCAA and the two Biobank sites that will be registered prior to this application for biodiversity certification being determined i.e. within '*retained land – existing conservation measures*' in the BCAA, are consistent for the Biobank sites and the BCAA for these areas.

Note that ELA's 2015 survey for Biobank sites (ELA 2015a and b and outlined in Section 2.1.4) was undertaken following review of previous survey effort (Section 2.1.1), determination of BVTs and number of biometric plots required after changes to the BCAA boundary since the 2013 survey (ELA 2014) (Section 2.1.2), and assessment of species requiring survey for determination of species credits (Section 2.1.3). The 2015 survey data in some instances replaced survey data collected in 2013, with four plots in the 2015 and 2013 surveys located at the same areas in the BCAA.

### 2.1 Methods

#### 2.1.1 Literature and data review

The two previous reports (ELA 2006 and 2014) were reviewed for vegetation types/condition and biodiversity values in the BCAA. The study area of ELA (2006) were larger than the BCAA and included the BCAA in its entirety. Given only some of the results of ELA (2014) were used in this biocertification assessment, with data from the 2015 and 2016 surveys also used, results of ELA (2006 and 2014) are summarised in subheadings below, as well as in **Table 3**, rather than in Section 2.2 Results, although relevant results from ELA (2006 and 2014) are also reported in Section 2.2 Results. Survey effort is shown in Section 2.1.4 to show total survey effort used for the assessment (previous effort plus ELA's 2015 and 2016 survey effort).

Relevant legislation and standard technical resources including the *Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities* (Department of Environment and Conservation [DEC] 2004) and the *Biobanking assessment methodology (BBAM 2014)* (OEH 2014a) underpinned the survey methodologies and provided background information for the ecological assessment. As such, these resources were also reviewed.



In addition to the database searches of the *Atlas of NSW Wildlife* and *EPBC Protected Matters Search Tool* undertaken by ELA (2014), ELA performed more recent searches of these databases, and used the biocertification credit calculator v 1.9 and version 1.09\_HN556\_201216 to determine ecosystem and species credit threatened species, validating these against the threatened species profile ecological data from the *BioNet Atlas of NSW Wildlife* (see Step 1 in Section 2.1.3).

#### *Mt Gilead Flora and Fauna Assessment – Stage 2 (ELA 2006)*

ELA (2006) targeted flora and fauna within the Mt Gilead property (approximately 810 ha), which contained the BCAA as well as land to the west. Field survey was undertaken on 16<sup>th</sup> and 28<sup>th</sup> February 2006 and the 1<sup>st</sup> and 6<sup>th</sup> March 2006 (total of 56 person hours) and was designed to validate vegetation communities and their condition, identify threatened flora species present, map recovery potential, assess fauna habitat features present, including for Koala (feed trees), and assess riparian health. The overall aim of the survey was to determine and document the ecological significance of the area for input into proposed rezoning documentation. No intensive survey methods such as vegetation plots or fauna trapping were undertaken; flora and fauna species were recorded opportunistically. However, some more detailed survey was undertaken for aquatic habitat/health and Koala (**Table 3**).

Four vegetation communities were confirmed in the study area: Alluvial Woodland (AW), Riparian Forest (RF), Cumberland Plain Woodland (CPW), and Shale Sandstone Transition Forest (SSTF). Shale Sandstone Transition Forest was the dominant vegetation community in the study area. The condition of the vegetation communities ranged from poor to good given the history of disturbance in the study area.

A total of 170 flora species, including a possible record one threatened species, *Eucalyptus benthamii* (Camden White Gum) were recorded. No threatened fauna species were recorded. Suitable habitat for threatened flora and fauna species was considered to be present. Key habitat features for fauna were:

- Diverse vegetation communities (forest, woodland, grassland).
- Diverse vegetation community structures (forest, shrubby woodland, grassy woodland, grassland, riparian, wetland).
- Large numbers of hollow-bearing trees.
- Woody debris and leaf litter in many remnant vegetation communities.
- Outcropping rock, rock crevices and, significantly, rock on rock.
- Ephemeral and permanent rivers, creeks and tributaries.
- Dams and “wetlands” with open water and emergent vegetation.
- Instream woody debris, rocks and vegetation along river, creeks and tributaries

#### *Mt Gilead Rezoning: Ecological Assessment (ELA 2014)*

ELA (2014) undertook an ecological assessment of a 210 ha area, which overlapped the BCAA. Field survey was undertaken over five days on 25<sup>th</sup> and 26<sup>th</sup> March, 4<sup>th</sup> April, 27<sup>th</sup> June, and 20<sup>th</sup> September 2013. Survey followed the Biobanking and Biocertification methodologies (DECC 2009; DECCW 2011a). It involved undertaking biometric plots and riparian and aquatic habitat assessments, and also targeted flora and fauna species identified by the biodiversity credit calculator and a review of NSW Wildlife Atlas data as requiring field survey. Targeted surveys were undertaken in accordance with survey guidelines. A summary of the field survey is provided in **Table 3**. Survey effort for the initial rezoning proposal is shown in **Figure 5**.

Three vegetation communities were recorded: CPW, SSTF, and River-Flat Eucalypt Forest (RFEF). The vegetation communities were highly modified through a long history of grazing, pasture improvement and weed invasion, and erosion was present in places, although some patches of SSTF were in good condition.

A total of 154 flora species, comprising 67 native species and 87 introduced species, and 82 fauna species, were recorded. Fauna species recorded were comprised of 58 birds, 13 microbats, five other mammals, three frogs, one reptile, and two fish. No threatened flora species were recorded, but six threatened bat species and one threatened bird species were recorded. These were *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat), *Mormopterus norfolkensis* (East-coast Freetail Bat), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Saccolaimus flaviventris* (Yellow-bellied Sheath-tail Bat), *Myotis macropus* (Southern Myotis), *Scoteanax rueppellii* (Greater Broad-nosed Bat), and *Glossopsitta pusilla* (Little Lorikeet). One migratory fauna species, *Ardea ibis* (Cattle Egret), was also recorded. There was potential for other threatened species, such as Koala, to be present given the presence of food trees in the study area and nearby records. However, for species such as *Meridolum comeovirens* (Cumberland Plain Land Snail), habitat was scant to absent. Targeted surveys did not record this species within the BCAA despite records from Nooromba Reserve (OEH 2014b, ELA 2017) and in remnant Cumberland Plains Woodland on the eastern side of Appin Road (ELA unpublished data).

The majority of the watercourses were considered substantially to slightly modified and erosion was noted in many of the watercourses. Aquatic habitat was limited, and where present was marginal. Fringing vegetation where present provided suitable habitat for amphibians, birds and fish. The overall rating of the riparian and aquatic condition varied from degraded to moderate.

**Table 3: Previous survey effort and results for validating vegetation communities present and for threatened flora and fauna species**

Previous studies	Survey area	Effort	Results
ELA (2006)	Mt Gilead property (810 ha). This contains the BCAA	<ul style="list-style-type: none"> <li>- Four-day survey on 16<sup>th</sup> and 28<sup>th</sup> February 2006 and the 1<sup>st</sup> and 6<sup>th</sup> March 2006 (total of 56 person hours).</li> <li>- Vegetation communities and their condition were validated, and their recovery potential was assessed through random meander.</li> <li>- Searches of threatened flora were undertaken through random meander.</li> <li>- Fauna habitat features were recorded opportunistically.</li> <li>- Targeted Koala searches were undertaken at six sites.</li> <li>- Riparian health was assessed, with aquatic survey undertaken at five sites.</li> </ul>	<ul style="list-style-type: none"> <li>- Four vegetation communities were confirmed: Alluvial Woodland, Riparian Forest, Cumberland Plain Woodland, and Shale Sandstone Transition Forest.</li> <li>- One threatened flora species, <i>Eucalyptus benthamii</i>, was recorded on the bank of the Nepean River.</li> <li>- No threatened fauna species were recorded, but key habitat features were present which could support a range of common and threatened fauna species.</li> <li>- Potential Koala habitat as defined by the State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44) was recorded</li> </ul>
ELA (2014)	Parts of Mt Gilead property (210 ha). This contains the BCAA	<ul style="list-style-type: none"> <li>- Five-day survey on 25<sup>th</sup> and 26<sup>th</sup> March, 4<sup>th</sup> April, 27<sup>th</sup> June, and 20<sup>th</sup> September 2013.</li> <li>- Vegetation communities and their condition were validated through random meander to demarcate vegetation zones.</li> <li>- 18 Biometric plots were undertaken in eight vegetation zones, which included 'cleared' areas.</li> <li>- Searches for flora species were undertaken via random meander in suitable habitat and were all undertaken during appropriate survey times identified by the biodiversity credit calculator.</li> <li>- Birds were surveyed over 20-30 minute intervals at four sites over four mornings, depending on whether one or two observers were present.</li> <li>- Microbat surveys were undertaken using two ultrasonic Anabat detectors at three sites (one Anabat at two sites and one Anabat at one site) targeting areas</li> </ul>	<ul style="list-style-type: none"> <li>- Three vegetation communities were recorded: River-Flat Eucalypt Forest, Cumberland Plain Woodland, and Shale Sandstone Transition Forest.</li> <li>- No threatened flora species were recorded.</li> <li>- Seven threatened species (six bats and one bird) were recorded: Eastern Bentwing Bat, East-coast Freetail Bat, Eastern False Pipistrelle, Yellow-bellied Sheathail Bat, Southern Myotis, Greater Broad-nosed Bat, and Little Lorikeet.</li> <li>- One migratory species was recorded: Cattle Egret.</li> <li>- There was potential for Koala to be present, but a low likelihood for Cumberland Plain Land Snail to be present.</li> </ul>

Previous studies	Survey area	Effort	Results
		<p>where bats are likely to be present over two consecutive nights over a period of 12 hours between 1800 hours and 0600 hours.</p> <ul style="list-style-type: none"> <li>- Habitat features for fauna across the study area, such as hollow-bearing trees, rocks and rocky outcrops, water bodies, were opportunistically recorded. As some features were assessed to be unsuitable for the frog target species (<i>Heleioporus australiacus</i> (Giant Burrowing Frog) and <i>Litoria aurea</i> (Green and Golden Bell Frog)), targeted survey for these were not undertaken.</li> <li>- Riparian and aquatic habitat assessments included mapping the top of bank using a differential GPS, classifying the condition and recovery potential of stream reaches, categorising each stream using the Strahler method, and identifying heavily degraded streams or areas of overland flow that do not meet the definition of 'river' and are suitable for removal. Assessments were undertaken over one and a half days.</li> </ul>	<ul style="list-style-type: none"> <li>- The overall rating of the riparian and aquatic condition varied from degraded to moderate.</li> </ul>

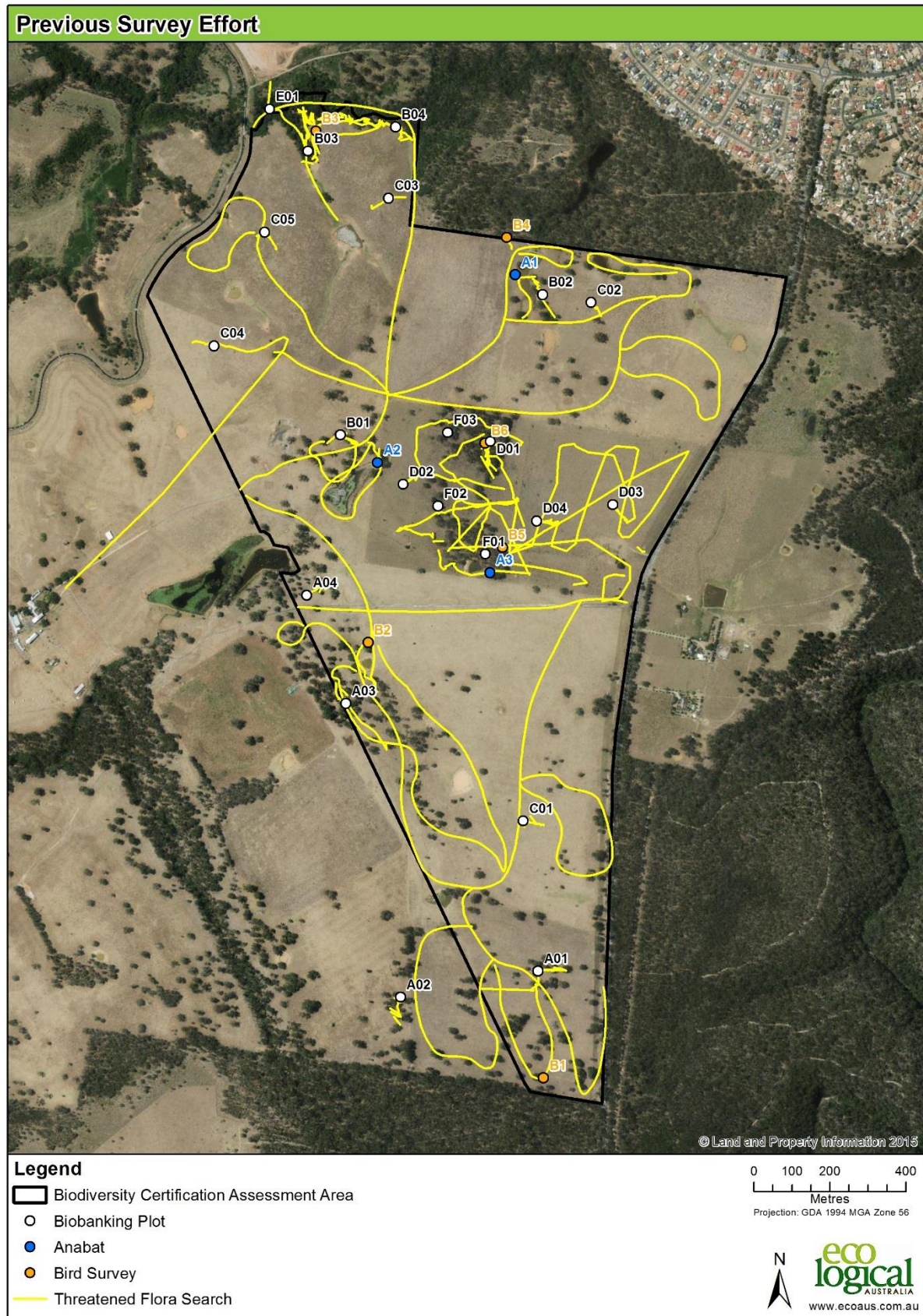


Figure 5: Previous flora and fauna species survey effort in the BCAA (ELA 2014)

### 2.1.2 Biometric vegetation types, condition and threatened status

As indicated in 2.1.1, ELA (2006 and 2014) identified four and three vegetation communities in their respective study areas. Of these, three vegetation communities were mapped within the BCAA.

Through a desktop comparison of vegetation communities with BVTs for vegetation communities recorded by ELA (2006), the best fit BVTs present in the BCAA were determined (**Table 4**). No comparisons were required for vegetation communities recorded by ELA (2014) as ELA (2014) provided equivalent BVTs. The results of the analysis identified three BVTs in the BCAA. These BVTs correspond to three threatened ecological communities listed under the TSC and EPBC Acts (**Table 4**). **Figure 6** shows the indicative BVTs in the BCAA based on this assessment and displays ELA (2014) vegetation mapping.

**Table 4: Vegetation communities and equivalent Biometric vegetation types in the BCAA and relationship to threatened ecological communities**

Vegetation community (ELA 2006)	Biometric vegetation type equivalent (OEH VIS)	TSC / EPBC Acts*
Alluvial Woodland	HN526 - Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	RFEF (EEC)
Cumberland Plain Woodland	HN528 - Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	CPW (CEEC)
Shale Sandstone Transition Forest	HN556 - Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	SSTF (CEEC)



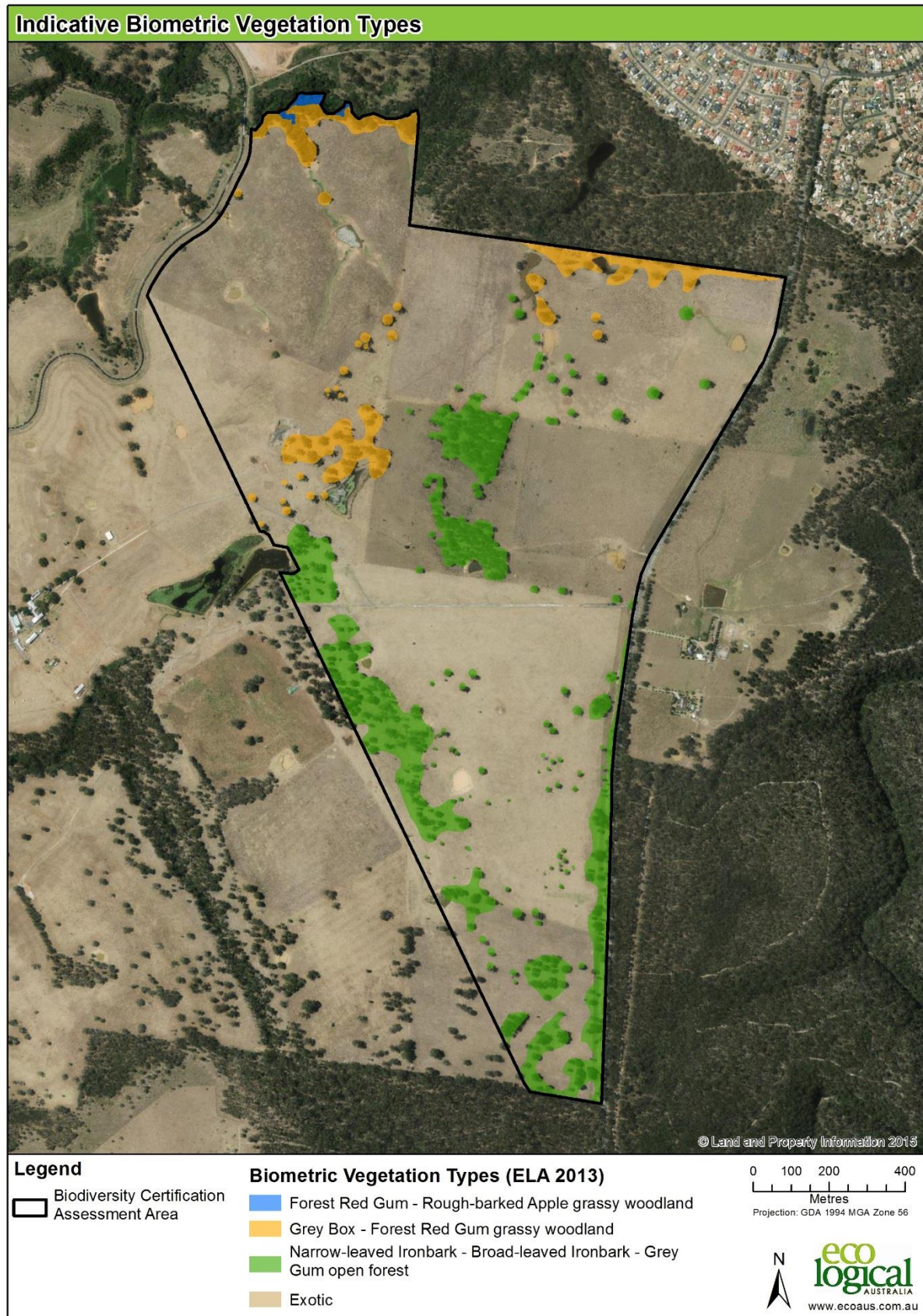


Figure 6: Indicative Biometric vegetation types in the BCAA based on ELA (2014)

### 2.1.3 Determination of species credit species requiring survey

'Species credits' are the class of biodiversity credit created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. All threatened flora and approximately half to two thirds of all threatened fauna species are classified as species credits by the BCAM. Furthermore, some species credit species are also 'red flag species' which the BCAM defines as "a species that cannot withstand further loss in the CMA because it is extremely rare/critically endangered, restricted or its ecology is poorly known".

The BCAM requires targeted survey for threatened flora and fauna that are considered to be 'species credit' species on the land that will be impacted by development. Alternatively, species credit species can be assumed to be present. Where a survey or expert report confirms that a species credit species is present or likely to use potential habitat on land proposed for biodiversity certification, then a survey must also be undertaken or 'expert report' prepared for that species on land to be used as an offset confirming its presence or likely presence. The biocertification credit calculator will use the survey results to calculate the number of credits required to offset the loss of the threatened species on land to be certified and the number of credits generated on land subject to conservation measures to determine whether the 'improve or maintain' test is satisfied provided a 'red flag species' is not impacted.

Species that require species credits for the land proposed for biodiversity certification or are being used to generate species credits for a proposed conservation measure were identified and assessed in accordance with the seven steps outlined in Section 4.3 of the BCAM. The results of the candidate species identification and assessment process are presented in **Appendix C**.

#### Step 1. – Identify candidate species for initial assessment

A list of candidate species was filtered into the BCAA using biocertification credit calculator version 1.9 and 1.09\_HN556\_201216, and validated against the threatened species profile ecological data from the BioNet Atlas of NSW Wildlife. This list is presented in **Appendix C**.

#### Step 2. – Review list to include additional species

The list of candidate species was reviewed to include additional species for assessment. This was undertaken using the results of previous surveys of the BCAA (ELA 2006 and 2014), and additional database searches undertaken by ELA which included:

- An updated search of the Atlas of NSW Wildlife database to identify records of threatened flora and fauna species located within 10 km radius of the site.
- A search of the EPBC Act protected matters search tool website to generate a report to assist to determine whether matters of national environmental significance (NES) were located within 10 km radius of the site.

#### Step 3. – Identify candidate species for further assessment

The list of candidate species was reviewed to identify only those species that required further assessment in the BCAA, based on the habitat assessment and surveys undertaken as part of ELA 2014. The species that were removed and a justification supporting the removal of these species from the candidate list are provided in **Appendix C**.

Despite a record of *Pomaderris brunnea* recorded 500m west of the BCAA by ELA in 2015, and a possible record of *Eucalyptus benthamii* recorded along the Nepean River approximately 2km west of the BCAA in 2005 (ELA 2006), no threatened flora species were recorded by ELA (2006, 2014, 2015a or b) in the BCAA and it was considered unlikely that any threatened flora would occur (given the condition of the vegetation on site). Consequently there were no flora species identified for further assessment. However,

potential threatened flora were surveyed for during all additional plots and traverses undertaken for the biocertification assessment in 2015 and 2016.

Whilst the Koala has not been recorded within the BCAA, in consultation with OEH it was agreed to 'assume' the presence of Koala given food tree species present and records around the BCAA. Targeted assessment of potential breeding sites for Southern Myotis and Green and Golden Bell Frog were also undertaken.

Other than the above species, ELA (2014) did not record habitat for threatened fauna species which could potentially occur and accordingly there were few candidate fauna species identified for further assessment.

While there are records of Cumberland Plain Land Snail directly adjacent to the BCAA in Noorumba Reserve (OEH 2014b and ELA 2017) and on the eastern side of Appin Road (ELA unpublished), habitat within the BCAA for this species was sparse to absent and the species was considered unlikely to occur (ELA 2014).

Similarly, Squirrel Gilder has recently been recorded to the west of the BCAA (ELA unpublished) in a gully line with a dense mid story of Acacias. This habitat is not present within the BCAA.

Accordingly only Koala, Southern Myotis, Green and Golden Bell Frog were identified as a candidate species. There are records over the past 20 years within the locality, and primary and secondary food tree species as listed in the Koala Recovery Plan (Forest Red Gum, Grey Box and Grey Gum; DECC 2008b) are present in the BCAA. Koala habitat mapping in ELA (2006) also identified areas with a high proportion of Koala food trees (as listed in Schedule 2 of SEPP 44) in the BCAA.

*Steps 4 and 5. – Identify potential habitat for species requiring further assessment and determine whether species is present*

As described above, no candidate species were identified as requiring targeted survey to determine abundance for threatened flora species. Areas of potential breeding habitat were identified for Southern Myotis and Green and Golden Bell Frog (**Appendix H**) and were subject to targeted survey (**Figure 9**).

*Step 6 – identify the threatened species that trigger a red flag*

There were no species confirmed as likely to have habitat on site that trigger a red flag.

*Step 7 finalise the boundary of the species polygon and area of impact*

A 'habitat polygon' including known records and habitat for Koala was identified and the number of species credits required was calculated.

The 'habitat polygon' was based on ELA's expert opinion of the habitat areas combined with the BVTs recognised by the Threatened Species Profile Database (BioNet) as being habitat for Koala. Consultation with the OEH confirmed that cleared areas did not constitute Koala habitat.

#### **2.1.4 Field assessment**

##### Vegetation communities and plots

Field assessment was designed to meet BCAM requirements for mapping and surveying BVTs and to gather data for use in both this biocertification assessment and the two proposed Biobank sites, while using existing data previously gathered by ELA (2014) where relevant. Field assessment therefore focussed on mapping and surveying BVTs, collecting biometric plots and undertaking additional targeted survey for Southern Myotis and Green and Golden Bell Frog. Based on discussions with OEH, Koala

was assumed to be present for this assessment. Previous survey effort by ELA (2014) was outlined in **Table 3**.

ELA senior and graduate ecologists, Bruce Mullins, Dr Enhua Lee, and Mitch Palmer, respectively, used previous mapping by ELA to target on-ground validation of the BVTs and collect additional biometric plots on 9<sup>th</sup> and 10<sup>th</sup> April 2015 and 29 August 2016. This led to a revision of the BVTs boundaries, and number of 'vegetation zones', which are based on BVTs and their condition and are further stratified using ancillary codes as per the BCAM (DECCW 2011a). An ancillary code is an optional field which splits zones further to reflect a more homogenous condition state. The ancillary code was used in the BCAA to identify zones that had sparse, olive dominated, native or exotic understories, or were thinned, in good condition, or comprised of scattered paddock trees.

Based on the area and number of vegetation zones, the BCAM required a minimum of 12 Biometric plots/transects (DECCW 2011a; **Table 5**), however, 20 were used in the assessment (**Table 5**). The field survey targeted locations that were considered likely to be representative of the mapped BVTs in their various condition states, which could be used for both the Biobank and biocertification assessment.

Field assessment involved vegetation assessment, with nine biometric plots conducted on 9<sup>th</sup> and 10<sup>th</sup> April 2015 and four on 29<sup>th</sup> August 2016 in accordance with the requirements of the BCAM. The BCAM allows for survey of BVTs to occur at any time of year (other than to determine whether a BVT is in moderate to good or low condition), and as such, survey timing was appropriate and was in accordance with the methodology.

Of the nine biometric plots undertaken in April 2015, four (A01, B01, B02 and G01) were located at the same locations as plots undertaken by ELA (2014) and data collected replaced data previously collected at these locations. Nine biometric plots (D01, D02, E01, E02, E03, H01, H02, A5 2016 and A6 2016) were located at new locations; there were no corresponding plots at these locations undertaken by ELA (2014). Plots undertaken by ELA (2014) that were used in this assessment were B1\_2013, C2\_2013, D1\_2013, F3\_2013, F2\_2013, F1\_2013, A1\_2013, and D2\_2013. These were not resurveyed or replaced as they were located in parts of the BCAA that did not overlap with the two Biobank sites. For all biometric plots surveyed, locations that were considered likely to be representative of the mapped BVTs in their various condition states were targeted.

The final mapped BVTs and zones, together with the location of plots are shown in **Figure 7** together with a cumulative survey effort map for threatened flora that includes lands adjacent to the BCAA (**Figure 8**). Note that an additional three biometric plots were undertaken for the Biobank sites that are not used in this biocertification assessment due to their being representative of 'cleared' areas which will be improved under biobanking (see ELA 2015). Additional plots were also collected as part of the rezoning process (2013) but were not used in the biocertification assessment (**Figure 8**).

### Threatened Fauna

Following advice from OEH in early 2016 regarding the assessment of potential breeding habitat for the Southern Myotis (i.e. any hollow bearing trees within 200m of permanent water should, be considered potential breeding habitat) and a recent record (December 2013) of the endangered Green and Golden Bell Frog at Biriwiri Creek, approximately 7km north of the BCAA, targeted survey for the GGBF and an assessment of potential breeding habitat for Southern Myotis was undertaken on 30 November and 7<sup>th</sup> and 12<sup>th</sup> of December 2016.

Details of the survey method, locations and results) are provided in **Appendix H** and summarised in **Figure 9**. The survey effort included the mapping of all HBTs within 200m of permanent water, diurnal

assessment of these trees during the breeding season with the aid of a ‘cherry picker’ to visual inspect all accessible hollows, spotlight observations and anabat recording of bat activity at each cluster of hollows before and after dusk for sign of bats leaving potential roost sites and a diurnal and nocturnal assessment of potential GGBF habitat using spotlighting and call playback.

Whilst Southern Myotis was recording foraging in the BCAA (as it was in ELA 2014), there was no evidence of any roost or breeding sites within the BCAA.

Similarly the Green and Golden Bell Frog was not recorded in the BCAA.

**Table 5: Vegetation zones in the BCAA, plot requirements, and plots completed**

Veg zone ID	BioMetric vegetation type	Condition	Ancillary code	Area	Plots required (BCAM)	Plots completed
1	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain	Low	Sparse	0.44	1	1 (A01)
2	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain	Moderate to good	Olive	2.29	1	2 (B01, B02)
3	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain	Low	Native	2.91	1	2 (D01, D02)
4	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain	Low	Scattered paddock trees	3.55	1	2 (B1_2013, C2_2013)*
5	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain	Moderate to good	Good North	2.04	1	1 (D1_2013)*
6	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain	Moderate to good	Thinned South	0.45	1	1 (F3_2013)*
7	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain	Moderate to good	Thinned North	0.78	1	1 (F2_2013)*
8	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain	Low	Good South	1.99	1	1 (F1_2013)*
9	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain	Low	Native	1.95	1	3 (G01, H01, H02)
10	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain	Low	Exotic	8.08	1	3 (E01, E02, E03)



Veg zone ID	BioMetric vegetation type	Condition	Ancillary code	Area	Plots required (BCAM)	Plots completed
11	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain	Low	Scattered paddock trees	5.33	1	3 (A1_2013*, A5_2016, A6_2016)
<b>Total</b>					<b>12</b>	<b>20</b>

\* Plots undertaken by ELA (2014)

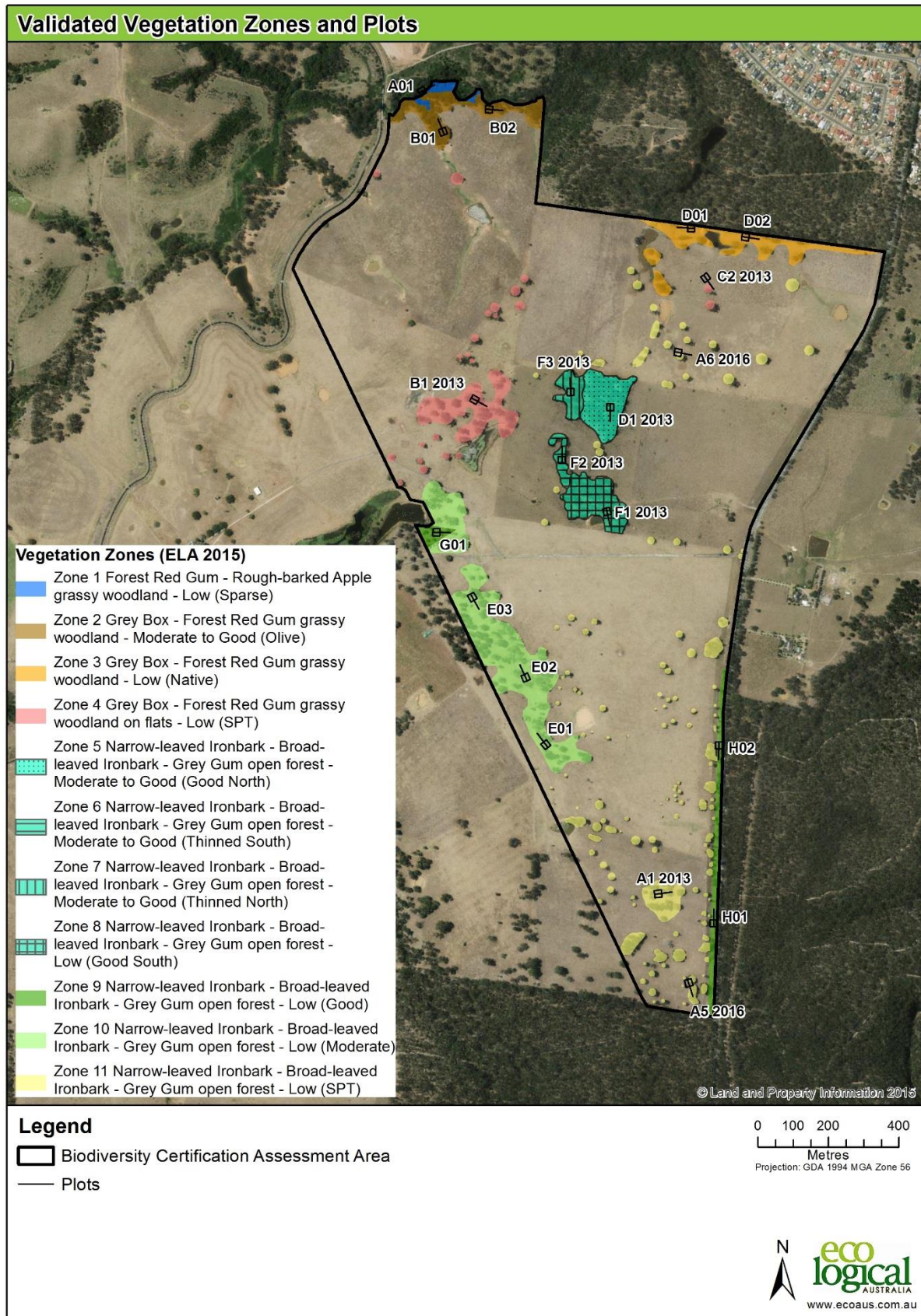


Figure 7: Validated Biometric Vegetation Types in BCAA and location of plots used in credit calculations



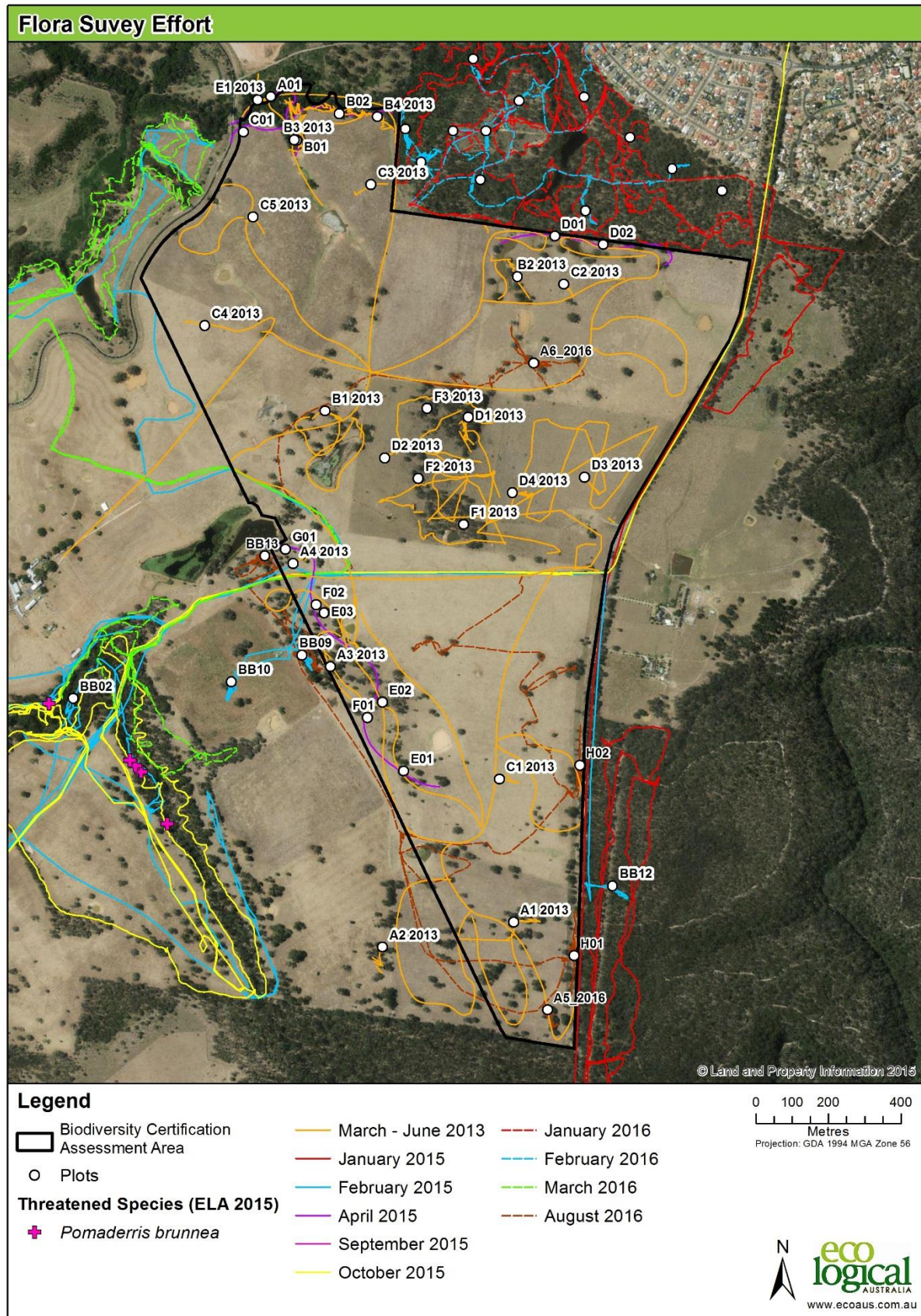


Figure 8: Combined threatened flora survey effort and plots for rezoning, biocertification and EPBC Act assessments



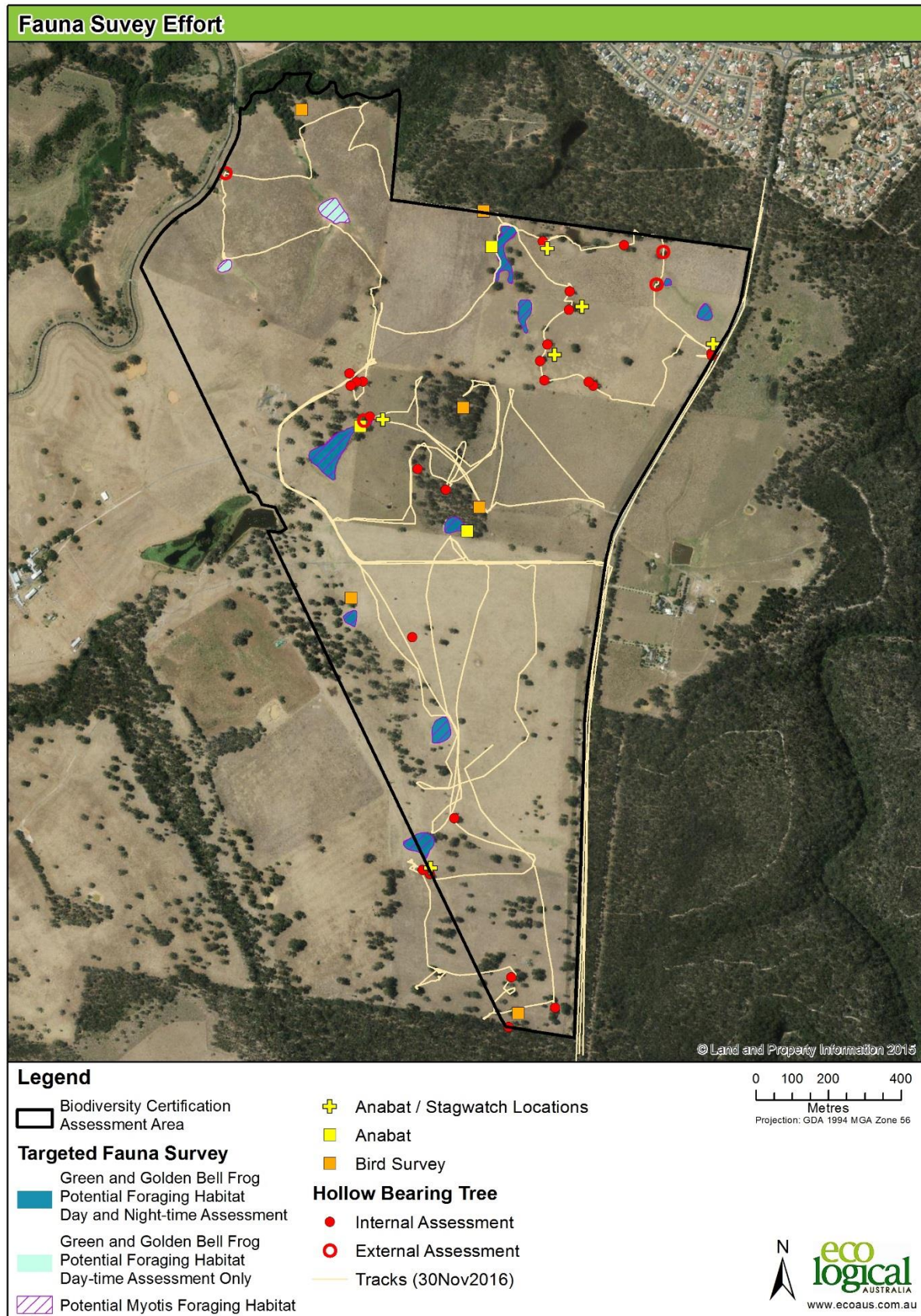


Figure 9: Combined threatened fauna survey effort for rezoning, biocertification and EPBC Act assessments

## 2.2 Results

### 2.2.1 Vegetation types and condition

Field survey confirmed three BVTs in the BCAA, and the presence of 11 'vegetation zones'. Field survey generally confirmed the boundaries of vegetation communities mapped by ELA (2006 and 2014), although the boundaries of some were refined and some patches were re-allocated to vegetation zones with corrected ancillary codes (see **Figure 7**).

Full profiles of each BVT within the BCAA, including the different ancillary codes identified, are provided in **Appendix D**.

### 2.2.2 Flora species

A total of 227 flora species were recorded in the biometric plots used for this assessment and adjacent lands. A full list of species recorded in plots is provided in **Appendix E**.

#### *Threatened flora species*

No threatened flora species were recorded in the BCAA by ELA during field survey in either 2006, 2013, 2015 or 2016. However, as outlined in Section 2.1.1, a possible specimen of *Eucalyptus benthamii* was recorded over 2 km away to the west on other parts of the Mt Gilead property (ELA 2006) and ELA has recorded multiple *Pomaderris brunnea* in a gully line 500 m to the west of the BCAA in 2015 and 2016 as part of studies for a separate proposal.

The BCAA did not contain suitable habitat for any threatened flora species, largely due to the highly degraded nature of most parts of the site.

### 2.2.3 Fauna species

As outlined in Section 2.1.1, a total of 82 fauna species, comprising 58 birds, 13 microbats, five other mammals, three frogs, one reptile, and two fish, were recorded in the BCAA (ELA 2014). A full list of species recorded by ELA is provided in **Appendix F**. A detailed anabat report is provided in **Appendix G**.

In addition, the 2016 Green and Golden Bell Frog and Southern Myotis survey (**Appendix H**) recorded two additional frog species (Peron's Tree Frog, *Litoria peronii*, and Bleating Frog, *L. dentata*) and two bat species (the vulnerable Large-eared Pied Bat, *Chalinolobus dwyeri*, and Eastern Broad Nosed Bat, *Scotorepens orion*) (**Appendix H**).

#### *Threatened and migratory fauna species*

As outlined in Section 2.1.1, seven threatened species and one migratory species were recorded in the BCAA (ELA 2014). These were Eastern Bentwing Bat, East-coast Freetail Bat, Eastern False Pipistrelle, Yellow-bellied Sheath-tail Bat, Southern Myotis, Greater Broad-nosed Bat, Little Lorikeet, and Cattle Egret. As these species were recorded opportunistically or use the BCAA broadly, their locations are not displayed on a map.

There was potential for Little Eagle, Swift Parrot, Powerful Owl, Koala, Large-eared Pied Bat, Grey-headed Flying Fox, and some migratory species to occur in the BCAA given the presence of suitable habitat.

Of the above species, only one species, Koala, is a species credit species and has been identified as being impacted by the land to be certified. The other species that have been recorded or have the potential to occur within the BCAA which are species credits species (Eastern Bentwing Bat, Southern Myotis, Grey-headed Flying Fox) have no breeding habitat within the land to be certified so do not require further assessment as species credit species.



### *Species Credit Habitat Maps*

A total of 31.24 ha of habitat for Koala, was mapped on land proposed for biocertification, ‘*conservation areas*’ and ‘*retained land*’ in the BCAA (**Figure 10**).

### **2.2.4 Red flags**

*Vegetation types and other areas recognised as having regional or state biodiversity conservation significance.*

‘*Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*’ comprises the EEC, RFEF, and ‘*Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion*’ and ‘*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion*’ comprise the CEECs, CPW and SSTF, respectively. These are red flag communities if they are in moderate to good condition.

There were only four vegetation zones that were assessed as being in moderate to good condition in the BCAA. These were comprised of ‘*Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion*’ and ‘*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion*’. As such, there is a small portion of CPW and SSTF in the BCAA that is red flag vegetation.

In addition, there is vegetation within riparian buffers of minor creeks present in the BCAA, and these are red flag areas in accordance with the BCAM.

The distribution of all red flag vegetation across the BCAA is shown in **Figure 11**.

### *Threatened species*

There were no red flag threatened species that cannot withstand further loss recorded in the BCAA.

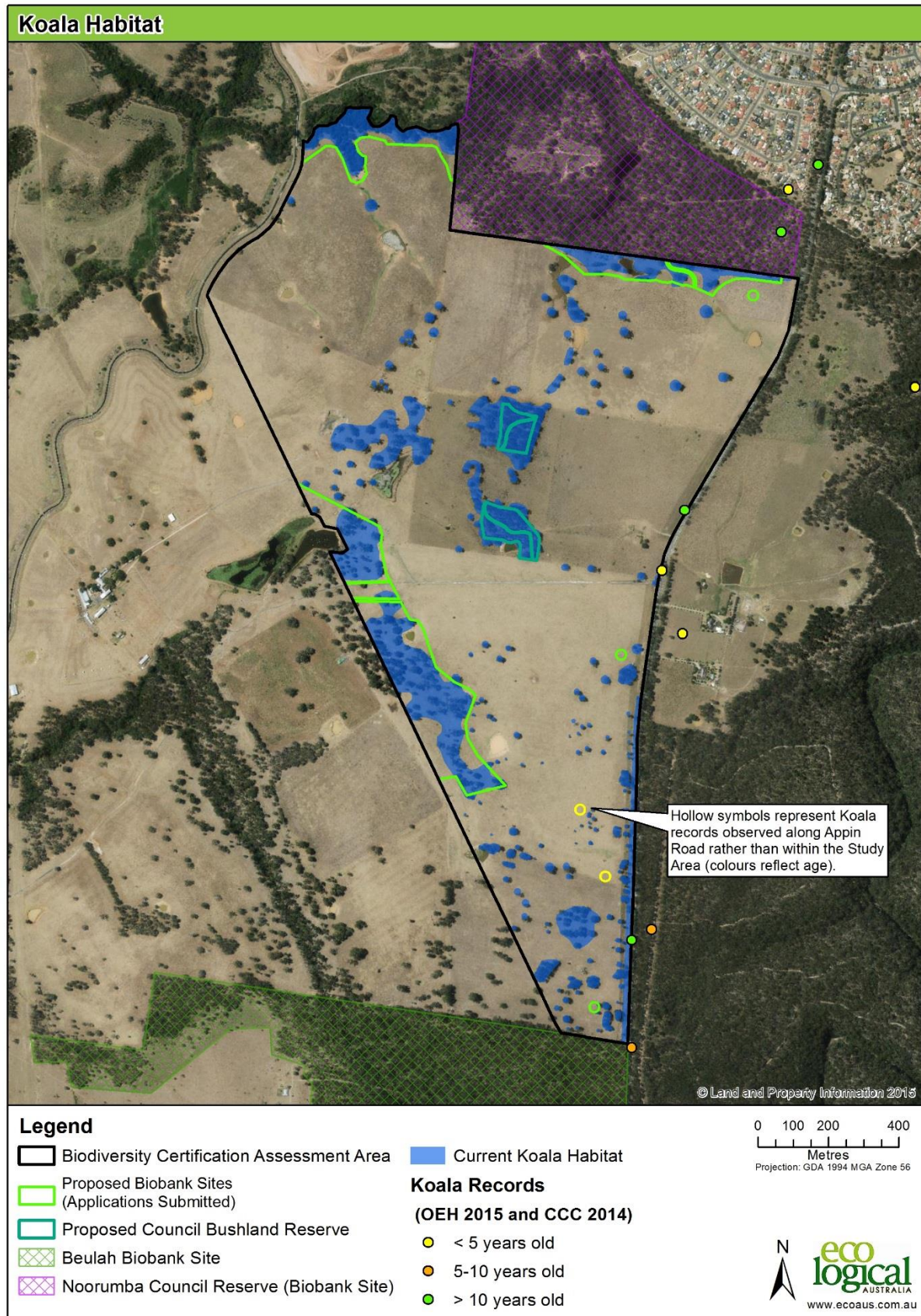
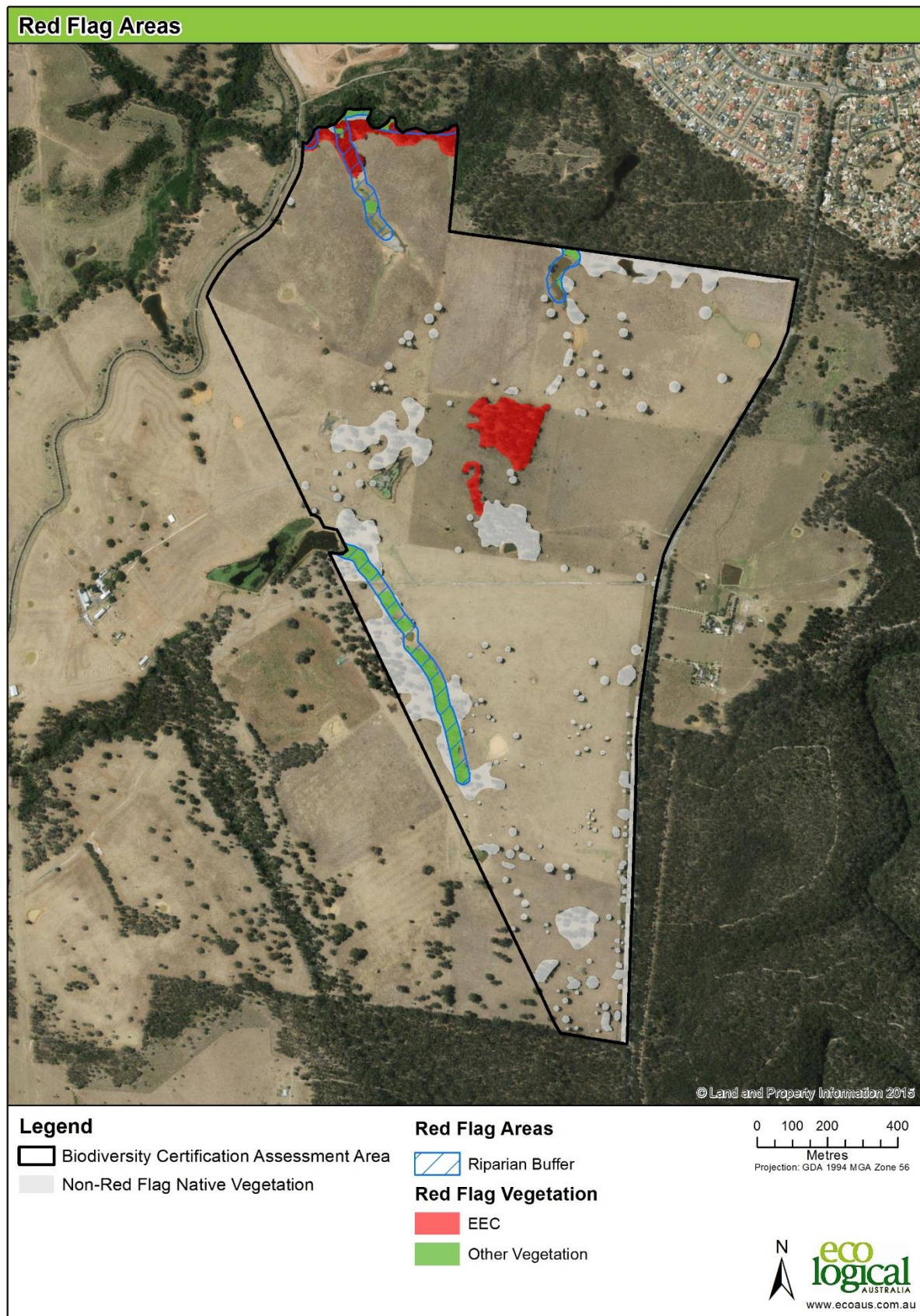


Figure 10: Koala habitat polygon in the BCAA and records for Koala in adjacent areas





**Figure 11: Red flag vegetation within the BCAA**

Note other vegetation shown in this figure is in low condition and therefore not red flagged.

### 3 More Appropriate Local Data used in the Biocertification Assessment

The BCAM outlines the methods by which general biodiversity values are assessed and measured in the BCAM to determine whether the conferral of biodiversity certification on land, as demonstrated in the application for biodiversity certification, improves or maintains biodiversity values (DECCW 2011a). These methods, along with the methods by which measurements of threatened species, assessments of indirect impacts on biodiversity values, and calculations of ecosystem and species credits are made, were followed in the Biocertification Assessment (**Section 4**).

According to the methodology, BVTs are used as surrogates for assessing general biodiversity levels. Information on each BVT, including a description, the vegetation class and formation to which it belongs, and percent cleared value, are contained within the Vegetation Types Database held by the OEH. A range of quantitative measures that represent the benchmark conditions for vegetation types are contained within the Vegetation Benchmark Database, also held by the OEH. The Vegetation Benchmark Database is organised by CMA, and as such, information for the same BVTs that may occur across different CMAs are repeated across CMAs, although the range of measures representing benchmark conditions can differ between CMAs to reflect variations in BVTs across their range.

Generally, default data contained in the Vegetation Benchmark Database are used when undertaking an assessment of, and measuring, general biodiversity values. However, the BCAM specifies that the Director General may certify that *'more appropriate local data'* (MALD) can be used instead of the data in this database, *'where local data more accurately reflects local environmental conditions'* (section 3.4 of the BCAM). Benchmark data that more accurately reflect the local environmental conditions for a BVT may be collected from local reference sites, or obtained from relevant published sources. Data other than benchmark data may also be obtained from relevant published sources. The Director General must provide justifications for certifying the use of local data. The certified local data can then be used in applying the methodology.

ELA considered that some of the benchmark values for *'Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion'* and *'Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion'*, as contained in the Vegetation Benchmark Database, were not accurate reflections of the benchmark condition of these BVTs. This is because the database contained low or benchmark values that were not consistent with the vegetation types i.e. zero values for hollow-bearing trees and length of fallen logs, which would be expected to have some hollows and logs when in benchmark condition.

ELA has previously consulted with the OEH on this matter with regard to *'Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion'*. An outcome of a previous discussion between ELA and Tim Hagar of the OEH was that *'local'* benchmark data for the number of trees with hollows and for the length of fallen logs could be added for this BVT, with one and 50 m added for the number of trees with hollows and the length of fallen logs, respectively. This was to be consistent with other woodland/open forest vegetation types on the Cumberland Plain, and is consistent with the assessment undertaken for the Brownlow Hill Stages 1 and 2 Biobank Sites and other assessments undertaken by the OEH on the Cumberland Plain.

ELA also consulted with the OEH on this matter with regard to *'Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion'* (email

correspondence with Tim Hager and John Seidel on 20 April 2015). The OEH advised that 'local' benchmark data for the number of trees with hollows and for the length of fallen logs could be added for this BVT, with one and 30 m added for the number of trees with hollows and the length of fallen logs, respectively. However, more recently, the Vegetation Information System (VIS) has been updated and these benchmarks have now been amended to one and 50 m for the number of trees with hollows and the length of fallen logs, respectively. It is also noted that the VIS now classifies SSTF as a Grassy Woodland Vegetation Formation rather than a Dry Sclerophyll Forest Formation.

As this is an error in the Biobanking Tool datasets, it is not considered that a formal application for the use of local benchmark data is required to be submitted to the OEH for approval. Accordingly, the local (or amended) benchmark values for the number of trees with hollows and the length of fallen logs in the two BVTs were used in this Biocertification Assessment (**Section 4**).



## 4 Biocertification Credit Assessment

This section details the results of the biodiversity certification assessment conducted to the requirements of the BCAM. Information is technical in nature, and relies on a broad understanding of the BCAM to understand the methods applied. Readers should make themselves familiar with the BCAM before reviewing this section of the document.

### 4.1 Biodiversity certification assessment area

The BCAA is shown in **Figure 3** and is comprised of:

- Lands proposed for biodiversity certification – impacts to native vegetation and threatened species habitat in these areas ‘requires’ biodiversity credits;
- Land proposed for conservation – generates biodiversity credits; and
- Lands where the current land use will be retained (retained lands) – neither requires nor generates biodiversity credits.

The footprint proposed for biocertification is 165.7 ha (11.08 ha of which comprises native vegetation as defined by the BCAM) (**Table 6** and **Figure 3**). The land proposed for conservation totals 2.48 ha, all of which has been mapped as native vegetation (with a further 0.98 ha of red flagged vegetation in a buffer areas classified as ‘retained’ land that will not generate credits but will be managed for conservation (see **Section 4.7**). 40.71 ha of land has been identified as neither impacted or subject to conservation measures, and has therefore been assessed as ‘retained land’ (i.e. credits are neither required nor generated).

**Table 6: Land use breakdown**

Development footprint	Area (ha)	% of BCAA	Area of native vegetation (ha)	% of native vegetation
Land proposed for Biodiversity Certification (Development)	165.70	79.32	11.08	37.17
Land proposed for conservation	2.48	1.19	2.48	8.32
Retained lands (land excluded from this assessment)	40.71	19.49	16.25	56.51
<b>Total</b>	<b>208.89</b>	<b>100</b>	<b>29.81</b>	<b>100</b>

### 4.2 Vegetation mapping and zones

As outlined in **Section 2.1.2**, three BVTs were identified in the BCAA (**Table 7**). There was 29.81 ha of vegetation mapped in total, with the dominant vegetation type being ‘*Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin*’ (20.62 ha). The BCAA also supported 8.75 ha of ‘*Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin*’, 0.44 ha of ‘*Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*’ and 179.08 ha of ‘cleared’ land, which in the context of the BCAM includes exotic vegetation.

**Table 7: Area of vegetation within the BCAA**

Biometric vegetation type	Area (ha)
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	0.44
Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	8.75
Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	20.62
Cleared	179.08
<b>Total</b>	<b>208.89</b>

The three vegetation types were separated into 11 vegetation zones for this assessment (**Table 8**). Four zones were mapped in ‘moderate to good’ condition and eight vegetation zones were mapped in ‘low condition’.

Table 8: Area of vegetation zones assessed within the BCAA

Veg zone ID	Biometric vegetation type	Condition <sup>1</sup>	Ancillary code	Land proposed for biodiversity certification	Area (ha)		
					Land proposed for conservation	Retained land <sup>2</sup>	Total
1	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Low	Sparse	0	0	0.44	0.44
2	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Moderate to good	Olive	0	0	2.29	2.29
3	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Low	Native	0.57	0	2.34	2.91
4	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Low	Scattered paddock trees	2.02	0	1.53	3.55
5	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Moderate to good	Good North	0.23	1.00	0.81	2.04
6	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Moderate to good	Thinned South	0.44	0.01	0	0.45

Veg zone ID	Biometric vegetation type	Condition <sup>1</sup>	Ancillary code	Area (ha)			
				Land proposed for biodiversity certification	Land proposed for conservation	Retained land <sup>2</sup>	Total
7	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Moderate to good	Thinned North	0.78	0	0	0.78
8	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Low	Good South	0.52	1.47	0	1.99
9	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Low	Native	1.54	0	0.41	1.95
10	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Low	Exotic	0.23	0	7.85	8.08
11	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Low	Scattered paddock trees	4.75	0	0.58	5.33
<b>Total</b>				<b>11.08</b>	<b>2.48</b>	<b>16.25</b>	<b>29.81</b>

<sup>1</sup> Condition as defined by the BCAM<sup>2</sup> Not assessed as area neither requires or generates credits

### 4.3 Transect/Plot data and site value scores

Appendix 4 of the BCAM defines the minimum number of transects/plots required per vegetation zone area (DECCW 2011a). Data from a total of 20 BioMetric vegetation transects/plots were collected across the BCAA, with a transect/plot requirement of 12 transects/plots (**Table 5**). The collected transect/plot data is provided in **Appendix I**.

Current site value and future site value scores were calculated for each vegetation zone using the transect/plot data collected. The BCAM credit calculator was used to produce the current and future site value scores for development and conservation areas (**Table 9**). Note that some changes were made to default settings for future site scores. Additional gains within conservation areas were calculated above default for three site attributes: the length of fallen logs (vegetation zones 5 and 8), native mid-storey cover, and native groundcover (grass)(vegetation zone 8) as shown in **Figure 20**, in line with the rules set out in Appendix 4 of the BCAM. This was done as it is proposed that logs will be brought into the conservation areas from the adjoining development areas. Also, supplementary planting of mid-storey species is proposed. This will both increase native mid-storey cover and decrease native grass cover (through shading which will thin native grass) over time.

**Table 9: Site value scores allocated to each vegetation zone**

Veg zone ID	Biometric vegetation type	Ancillary code	Current site value score (if left as Retained Land)	Future site value score (after Development)	Future site value score (if proposed for Conservation)
1	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Sparse	13.02	N/A	N/A
2	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Olive	38.02	N/A	N/A
3	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Native	26.04	0	N/A
4	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Scattered paddock trees	22.40	0	N/A
5	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Good North	63.54	0	82.00



Veg zone ID	Biometric vegetation type	Ancillary code	Current site value score (if left as Retained Land)	Future site value score (after Development)	Future site value score (if proposed for Conservation)
6	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Thinned South	36.46	0	54.00
7	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Thinned North	36.28	0	59.00
8	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Good South	25.52	0	49.00
9	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Native	26.04	0	N/A
10	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Exotic	25.00	0	N/A
11	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Scattered paddock trees	19.79	0	N/A

#### 4.4 Landscape Score

The credit calculator calculated a landscape value score of **8.5** for the land to be certified, and a score of **4.7** for the land subject to conservation measures. The landscape value is calculated from the sum of the scores obtained from the following three attributes:

- percent native vegetation cover in the landscape
- connectivity value
- adjacent remnant area determined according to the Mitchell landscape in which most of the land proposed for biocertification occurs.

Scores for each landscape attribute for 'land to be certified' and 'land subject to conservation measures', as well as an explanation of how the scores were determined, are provided in the sub sections below.

#### 4.4.1 Percent Native Vegetation Cover Score

The percent native vegetation cover calculation was completed within a single 1,000 ha circle (**Figure 12**). The area of vegetation cover was digitised from an aerial photograph at a scale of approximately 1:10,000. The results of the assessment are contained in **Table 10**.

A pre-certification score of **15** was determined with 451 ha ( $451/1,000 = 45.1\%$ ) native vegetation mapped within the 41-50% native vegetation cover class. Vegetation clearance would result in 440 ha of vegetation cover (44.0%) remaining in the assessment circle. The post certification score is also **15** because vegetation cover falls within the same 10% increment (41-50%).

**Table 10: Native vegetation cover in assessment circle**

Circle	Pre-certification			Post-certification		
	Area of vegetation within assessment circle (ha)	Native vegetation cover class (%)	Score	Area of vegetation within assessment circle (ha)	Native vegetation cover class (%)	Score
1 (1,000ha)	451 (45.1%)	41-50%	15	440 (44.0%)	41-50%	15

The land subject to conservation measures (post-biodiversity certification) is 2.48 ha, all of which is currently vegetated land. Therefore (using Table 3 of the BCAM) a gain of **2.2** is recorded for the percent native vegetation score after conferral of biodiversity certification.

#### 4.4.2 Connectivity Value

The current connectivity value of the site was assessed according to Section 3.7.2 of the BCAM. There are three components of connectivity; these are areas approved as a 'state' or 'regional' biodiversity links by the Director General, the hierarchy and riparian zone width of water courses in accordance with Appendix 1 of the BCAM and an assessment of vegetation connectivity. At a meeting with the OEH on January 2015, the OEH officers confirmed that there were currently no state or regional biodiversity links relevant to the BCAA.

'Minor creeks' and 'minor watercourses', defined as a 'local biodiversity link', and patches of vegetation that conform to the criteria of a local biodiversity link (moderate to good condition, has a patch size >1 ha which is separated by <30 m), occur on land to be developed (**Figure 13: Connectivity**). They do not occur on land subject to conservation measures. According to Table 4 of the BCAM the score for a local biodiversity link is **6**. As a local biodiversity link is located on land proposed for biodiversity certification and will be impacted it was allocated a score of zero after development (**Table 11**). The vegetation on land subject to conservation had a width greater than 30 m but did not link with areas of native vegetation in moderate to good condition greater than 30 ha. Given this, there was no local link on land subject to conservation measures, and a score of zero was allocated.

**Table 11: Connectivity scores allocated for the assessment**

Connectivity score	Pre-certification	Post-certification
Land to be certified	6	0
Land subject to conservation measures	0	0

#### 4.4.3 Adjacent Remnant Area

The BCAA predominantly occurs on the Cumberland Plain Mitchell Landscape which is 89% cleared. The vegetation on site is not well connected given the areas of moderate to good vegetation are separated by areas of low condition vegetation and cleared land, resulting in an adjacent remnant area (ARA) of 2.83 ha (**Figure 13**). This receives a score of **2.5** for Mitchell Landscapes within the 70-90% cleared range.

The land subject to conservation measures also occurs within the same Cumberland Plain Mitchell Landscape with the same ARA of 2.83 ha. Therefore the score allocated for the conservation lands is also **2.5**.

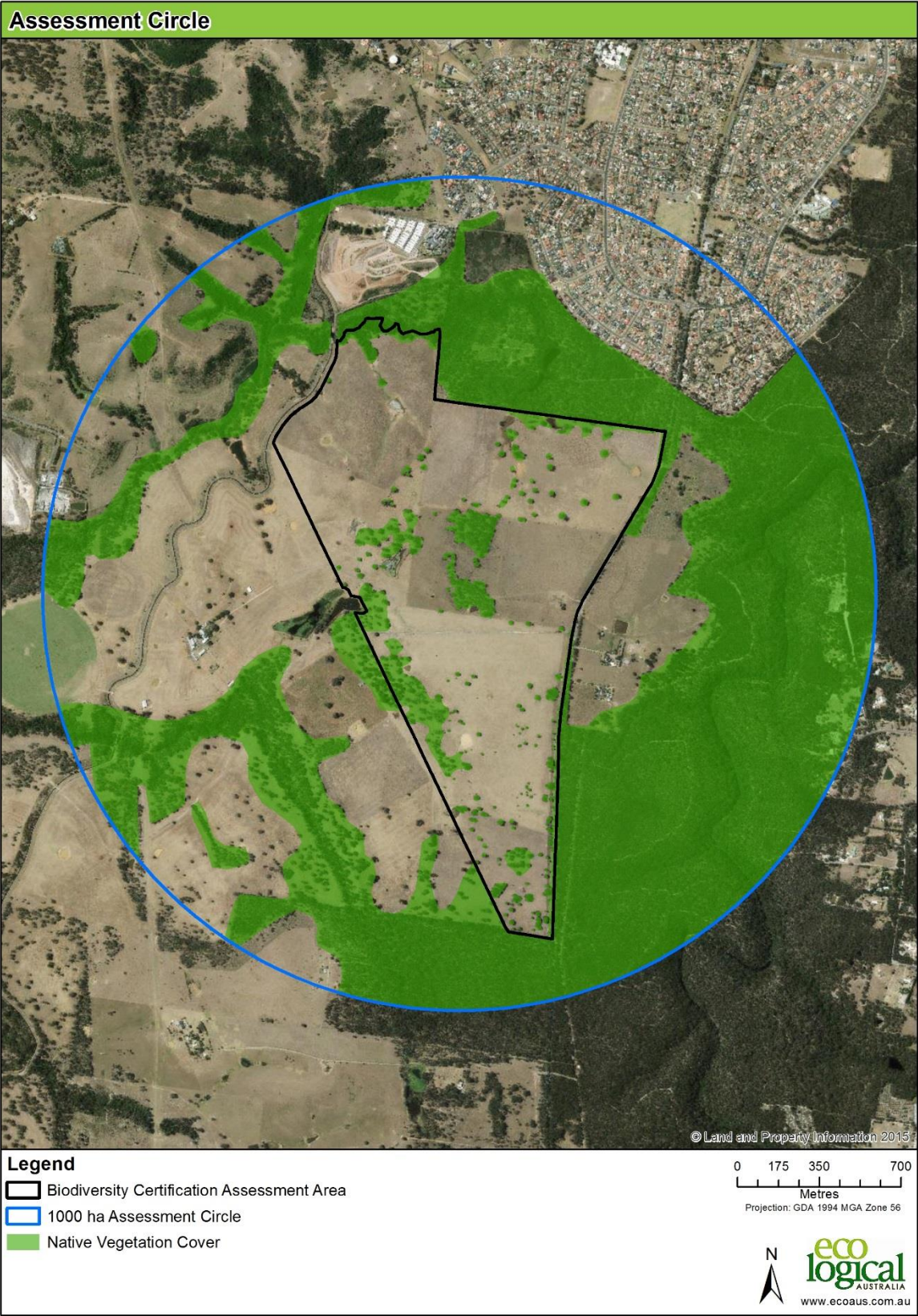
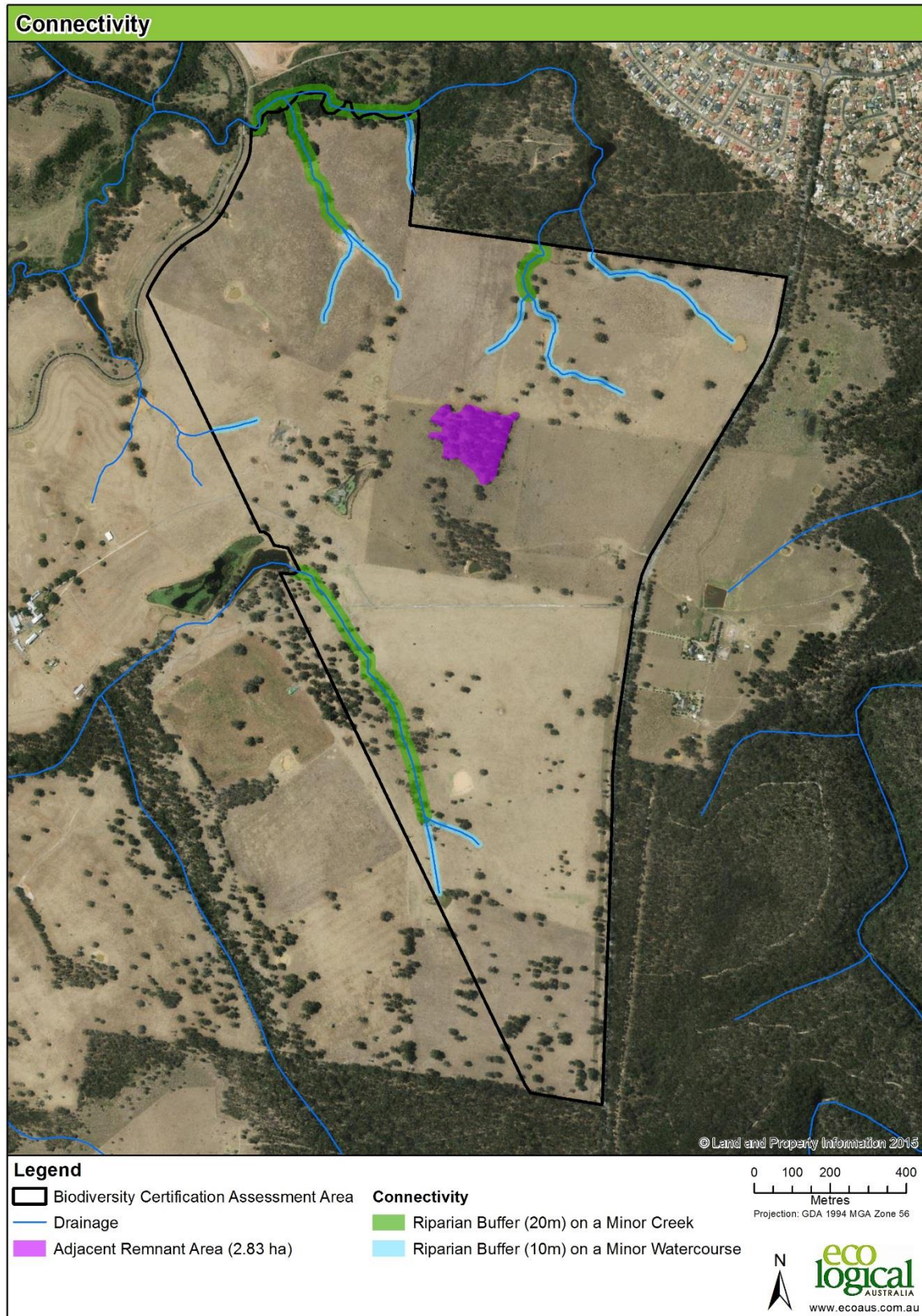


Figure 12: Assessment circle





**Figure 13: Connectivity**

Note: the vegetation surrounding the ARA is in Biometric low condition or > 30m apart and therefore not part of the ARA calculation.



## 4.5 Red Flags

The BVTs, 'Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion' has been identified as comprising an EEC (RFEF), while 'Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion' and 'Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion' have been identified as comprising two CEECs (CPW and SSTF). These are also classified as over-cleared vegetation types (>70% of original extent in the CMA cleared; DECC 2008a). These vegetation types are therefore 'red-flagged' when in moderate to good condition under the BCAM.

Seven zones of the vegetation types identified as CEECs/EECs were in 'low' condition because the site value score for these vegetation zones was less than 34/100. Accordingly, these vegetation zones are not red flagged.

Only four zones (zones 2, 5, 6 and 7) comprising 5.56 ha of vegetation, had a site value score greater than 34/100.

There were also 3.04 of vegetation within a 20 m buffer area of a minor creek within the BCAA which classifies as red flag vegetation.

The area of impacted red flagged vegetation is shown in **Table 12** and **Figure 16**. Red flag areas should be avoided and can only be impacted in accordance with certain rules outlined in Section 2.4 of the BCAM.

A total of 8.6 ha of red flagged vegetation/areas is present within the BCAA of which 1.45 ha of EECs in moderate to good condition (16.86% of red flagged EECs) and 0.15 ha of vegetation within riparian buffers (4.93%) would be impacted by the proposal. A red flag variation request prepared in accordance with the criteria set out in Section 2.4 of the BCAM is provided in **Section 5**. It is noted that a red flag variation request must be assessed and approved by the OEH before biodiversity certification can be conferred.

In accordance with the procedures outlined by the OEH in undertaking a biocertification assessment, the OEH were consulted to determine whether a red flag impact and request for variation of this magnitude would likely be approved by the Director-General of the OEH. At a meeting with the OEH in January 2015, OEH officers indicated that a red flag variation for this area was likely to be approved.

**Table 12: Impacts to red flagged vegetation**

Red flag vegetation (BVTs)	CEEC name	% Cleared within CMA	Red Flag Area within BCAA (ha)	Red Flag Area impacted (ha)	Proportion impacted (%)
Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	95%	2.29	0	0
Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	80%	3.27	1.45	44.34

Red flag vegetation (BVTs)	CEEC name	% Cleared within CMA	Red Flag Area within BCAA (ha)	Red Flag Area impacted (ha)	Proportion impacted (%)
Vegetation within riparian buffers	NA	NA	3.04	0.15	4.93%
<b>Total</b>			<b>8.6</b>	<b>1.60</b>	<b>18.60</b>

#### 4.6 Indirect Impacts

The BCAM requires that any application for formal biodiversity certification must demonstrate how the “*proposed ownership, management, zoning and development controls of the land proposed for biodiversity certification is intended to mitigate any indirect impacts on biodiversity values*” (DECCW 2011a).

Indirect impacts have been considered in accordance with the BCAM and have been determined to be negligible on the basis that all direct impacts have been assessed on the assumption of complete loss of all biodiversity values including where these losses are only partial e.g. for Asset Protection Zones (APZs) and the outer perimeter of the proposed residential footprint largely adjoins cleared rural land (and thus negligible in direct impacts) or areas that will be used for recreational purposes and include landscape plantings and active ongoing management. In effect the APZ areas will provide a buffer between the development lands and the adjacent (off-site) conservation areas, thereby mitigating and buffering any indirect impacts such as increased weeds, run-off, changed noise and light conditions.

There is potential for some indirect impacts resulting from the fragmentation of movement corridors or loss of foraging opportunities for some species. For example, removal of vegetation, including scattered paddock trees, and their replacement with residential housing, could impede the movements of the species credit species, Koala, as well as other fauna species, in an east-west and north-south direction. However, movement corridors will remain in the local landscape in the form of retained areas and proposed BioBank sites. In addition, there are a number of proposed Biobank sites and other reserves adjacent to the BCAA (**Figure 2**). The proposed Biobank site south west of the BCAA will continue to link vegetation within the Macarthur-Onslow Mt Gilead Biobank Site that lies in ‘*retained land – existing conservation measures*’ to vegetation in the south of the BCAA, which further links to vegetation east of Appin Road. Also, the proposed Biobank sites to the north west and north east of the BCAA will continue to link vegetation within the Noorumba-Mt Gilead Biobank Site that lies within ‘*retained land – existing conservation measures*’ to vegetation west and east of the BCAA.

Whilst all impacts within the land to be certified have been calculated on the assumption of complete loss, the following mitigation measures have been included to minimise impacts and address indirect impacts to areas proposed for conservation and retained areas:

- Any hollow-bearing trees that potentially contain roosting and breeding habitat for threatened microbats will be identified and retained in non-conservation areas where possible; and
- Any trees and hollows removed under the supervision of a fauna ecologist from trees, including hollow-bearing trees, that cannot be retained will be relocated to within ‘*conservation areas*’ and ‘*retained land – existing conservation measures*’.

#### 4.7 Buffers on Red flag areas

Where a proposed conservation measure is used to protect land that is a red flag area, the area of the proposed conservation measure must include a buffer to mitigate any negative indirect impacts from development following the conferral of biocertification. The buffer area may be secured via a conservation measure and used to offset the impacts of biodiversity certification, or it may be a retained area in the biocertification assessment area (and not generate any credits) (see Section 6 of the BCAM).

In consultation with OEH it was determined that an appropriate buffer for the red flag vegetation in the proposed conservation area would be 30 m and this could be partly comprised by any perimeter roads separating development from the proposed conservation area and should be classified as a 'retained area' within the BCAA.

A retained area has been identified around the red flag vegetation in the proposed conservation area shown in **Figure 15**, it is noted that this reduces the conservation area by 0.98 ha, however, this retained area will still be managed as part of the conservation area as outlined in **Section 6.3 and 6.7**.

The roads surrounding this conservation buffer area will be fully curbed and guttered with piped stormwater management that will not flow into the conservation area of buffer area.



Figure 14: Impacted Red Flag vegetation



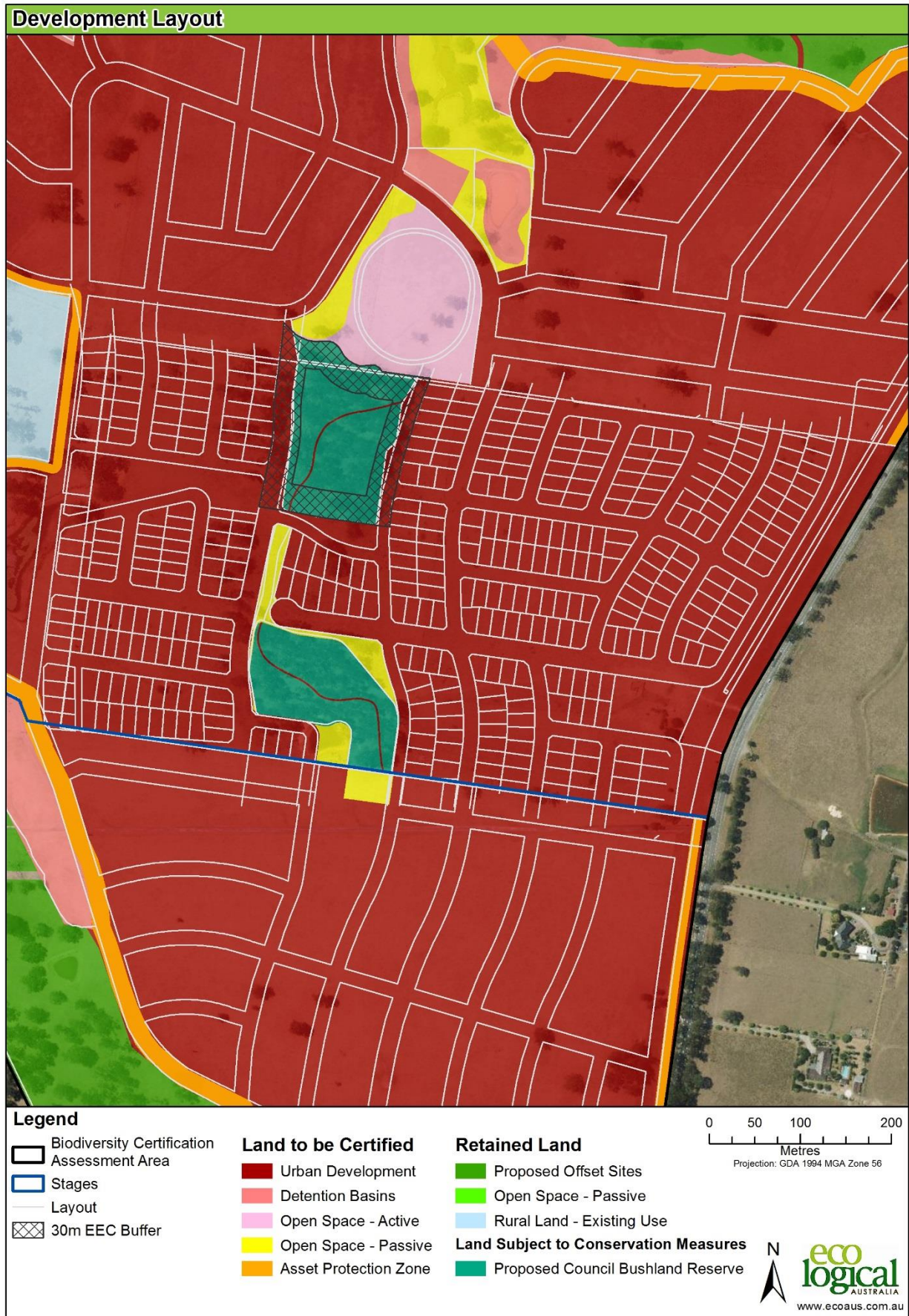


Figure 15: Buffers to areas of conserved red flag vegetation



## 4.8 Credit Calculations

### 4.8.1 Ecosystem Credits

Ecosystem credits have been calculated for the loss of vegetation resulting from the proposed development. In total, **139** ecosystem credits are required for the proposed rezoning and subsequent development of the area (**Table 13**).

As defined in the BCAM, different levels of protection and management for conservation lands results in the generation of a different number of credits as outlined below:

- Areas that are managed and funded in perpetuity (i.e. Biobank sites or national parks) – 100% credit entitlement – potentially generating 18 credits;
- Areas that are managed in perpetuity (e.g. classification and management of land as community land 'Natural Area' under the Local Government Act 1993 and adoption of a Plan of Management etc) – 90% credit entitlement – potentially generating 16 credits; and
- Areas that are secured through a planning instrument (i.e. environmental zoning) – 25% credit entitlement – potentially generating 5 credits.

It is proposed that the land subject to conservation measures within the BCAA will be secured by transferring the land to Campbelltown City Council, as described in **Section 6** of this report – Biodiversity Certification Strategy, thus generating **16** ecosystem credits as a 90% conservation measure. **Table 13** shows the number of credits generated per vegetation zone for the different levels of protection and management for conservation lands.

There will thus be a deficit of 123 credits (30 CPW credits and 93 SSTF credits) (**Table 13**). The remaining credits required will be generated by the two proposed Biobank sites that will be registered prior to this application for biodiversity certification being determined, Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites, and retired in accordance with the commitments in **Section 6** of this report.

The two biobank sites will generate 74 CPW and 119 STF credits respectively (see ELA 2015a and b), i.e. meeting the full credit deficit.

### 4.8.2 Species credits

Species credit requirements have been calculated for Koala, which has been assumed to be present for this assessment in the '*land to be certified*', and a species polygon for likely habitat has been mapped. No other threatened fauna or flora species requiring species credits were detected and therefore have not been calculated for species credit requirements.

A total of **292** species credits are required for Koala for the land proposed to be certified (**Table 14**).

The two Biobank sites that will be registered prior to this application for biodiversity certification being determined, Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites (ELA 2015a and b), will generate 48 and 85 credits for Koala, respectively (100% conservation measures for Biobank sites). This leaves a deficit of 159 credits which will need to be secured from outside of the BCAA. **Section 6** of this report makes commitments regarding the purchase of these credits from a registered Biobank site.

It is noted that whilst the proposed 2.48 ha conservation area has been mapped as Koala habitat within the BCAA, with the potential to generate 16 Koala credits (**Figure 10**), a claim for 16 Koala credits has not been made for credits.

Table 13: Final ecosystem credit results

Veg zone ID	Biometric vegetation type	Condition	Ancillary code	Credits required	Credits generated			Credit status			Credit status summary for vegetation types based on 90% conservation measure
					100%	90%	25%	100%	90%	25%	
1	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Low	Sparse	-	0	0	0	0	0	0	0
2	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Moderate to good	Olive	-	0	0	0	0	0	0	-30
3	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Low	Native	7	0	0	0	-7	-7	-7	
4	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	Low	Scattered paddock trees	23	0	0	0	-23	-23	-23	
5	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Moderate to good	Good North	7	7	6	2	0	-1	-5	-93
6	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Moderate to good	Thinned South	8	0	0	0	-8	-8	-8	
7	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Moderate to good	Thinned North	14	0	0	0	-14	-14	-14	
8	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Low	Good South	7	11	10	3	4	3	-4	
9	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Low	Native	20	0	0	0	-20	-20	-20	
10	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Low	Exotic	3	0	0	0	-3	-3	-3	
11	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Low	Scattered paddock trees	50	0	0	0	-50	-50	-50	
Total				139	18	16	5	-121	-123	-134	-123

Table 14: Final species credit results

Habitat	Area impacted (ha)	Credits required
Koala	11.08	292

## 5 Red Flag Variation Request

### 5.1 Impact on Red Flagged Areas

The Biodiversity Assessment Report for the ecological values within the BCAA (**Section 2**) identified ‘red flags’ as defined by the BCAM, some of which would be impacted by the land proposed for biocertification. The BCAM requires each of the criteria set out in Section 2.4 of the BCAM to be addressed in order for the Director-General to be satisfied that impacts to these ‘red flags’ are able to be offset. This section addresses this requirement.

A red flag is triggered under the BCAM when there is an impact on any of the following:

- a vegetation type >70% cleared in the CMA for which it is mapped (not in ‘low condition’)
- a CEEC or EEC listed under the TSC Act or EPBC Act (not in ‘low condition’)
- a threatened species that cannot withstand further loss
- areas of vegetation recognised as having regional or state biodiversity conservation significance (including vegetation within a riparian buffer 20m either side of a minor creek as defined by Appendix 1 of the BCAM)

The Biodiversity Certification Operational Manual (OEH 2015c) states that each red flag area within the proposed biodiversity certification area should be numbered and listed in a table and shown on a map. Each red flag area impacted will require a separate red flag variation request unless the responses are the same for each entity, i.e. vegetation type is the same, patches are of similar condition, patches have the same connectivity etc.

The BVTs recorded within the BCAA are equivalent to ‘River-Flat Eucalypt Forest on the Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregion’ (RFEF), which is an EEC listed on the schedules of the TSC Act, and ‘Cumberland Plain Woodland in the Sydney Basin Bioregion’ (CPW) and ‘Shale Sandstone Transition Forest in the Sydney Basin Bioregion’ (SSTF), which are CEECs listed on the schedules of the TSC Act. Parts of the BVTs are also equivalent to CPW and SSTF listed under the EPBC Act. Areas of CEECs and EECs are only considered as red flags if they are in moderate to good condition. Four out of 11 vegetation zones are in moderate to good condition, and three of these (zones 5, 6 and 7) will be impacted, totalling 1.45 ha. Vegetation zone 2 will not be impacted. There are no other vegetation types >70% cleared in the Hawkesbury Nepean CMA.

There is 3.04 ha of vegetation within the riparian buffer of a minor creek within the BCAA of which two patches (0.046 ha in vegetation zone 3 CPW) and 0.103 ha in vegetation zone 4 CPW will be impacted.

There are no threatened species requiring species credits that cannot withstand further loss that will be impacted.

In accordance with the procedures outlined by the OEH in undertaking a biocertification assessment, the OEH were consulted in 2014 and 2015 to determine whether a red flag impact and request for variation of this magnitude would likely be approved by the Director-General of the OEH. At meetings with the OEH in 2015 the OEH officers advised that the impacts to the red flag areas were likely to be supported due to the small areas involved and the extent of these vegetation types proposed for conservation measures within the BCAA.

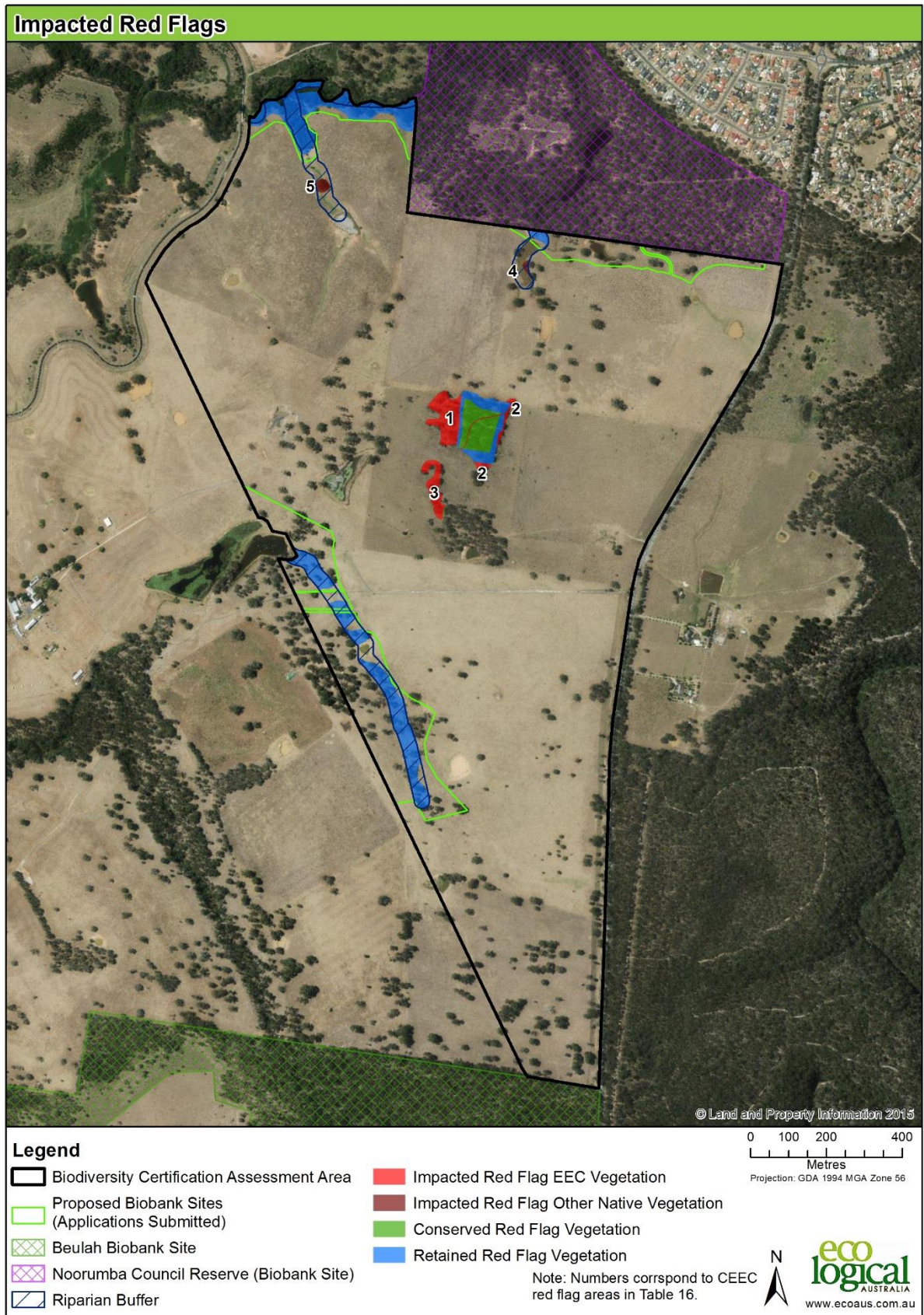
Impacts on red flagged areas according to vegetation zones are shown in **Table 15**. The distribution of red flag vegetation on land proposed for biodiversity certification is discussed below for each of the red

flag variation criteria outlined in section 2.4 of the BCAM, and are shown in **Figure 16**, along with red flag vegetation that will be conserved or retained.

**Table 15: Impacted red flag vegetation**

Veg zone ID	Biometric vegetation type	CEEC	Condition	EEC Area impacted (ha)	Vegetation within Riparian Buffer impacted (ha)
3	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	<i>Cumberland Plain Woodland in the Sydney Basin Bioregion</i>	Low		0.046
4	Grey-Box – Forest Red Gum grassy woodlands on flats of the Southern Cumberland Plain, Sydney Basin Bioregion	<i>Cumberland Plain Woodland in the Sydney Basin Bioregion</i>	Low		0.103
5	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Moderate to good (Good North)	0.23	
6	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Moderate to good (Thinned South)	0.44	
7	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Moderate to good (Thinned North)	0.78	
<b>Total</b>				<b>1.45</b>	<b>0.149</b>





**Figure 16: Impacted, conserved and retained red flag vegetation**

Note: The scattered trees in the assessment area do not constitute red flags as their site value score < 34.



## 5.2 Red Flag Variation Criteria

The presence of Red Flags within the proposed development area means that Biocertification of the land cannot be conferred unless a red flag variation is granted by the Director General of the OEH. An application for a red flag variation must satisfactorily address the criteria in Section 2.4 of the BCAM (DECCW 2011a) for a proposal to be regarded as improving or maintaining biodiversity values.

Firstly, as outlined in Section 2.4.1 of the BCAM, the feasibility of options to avoid impacts on red flag area(s) where biodiversity certification is conferred must be addressed.

In addition, the following criteria, as outlined in Section 2.4.2 of the BCAM, must be addressed for a vegetation type which is greater than 70% cleared or is a CEEC or EEC:

1. Viability must be low or not viable (Section 2.4.2.1 of the BCAM)
2. Contribution to regional biodiversity values must be low (Section 2.4.2.2 of the BCAM)

The following criteria, as outlined in Section 2.4.4 of the BCAM must be addressed for areas with regional or state biodiversity conservation significance:

- a) The width of a riparian buffer with regional or state biodiversity significance must not be substantially reduced
- b) The ecosystem functioning of a state or regional biodiversity link, considering migration, colonisation and interbreeding of plants and animals between two or more larger areas of habitat, must not be substantially impacted,
- c) The water quality of a major or river, major or minor creek, or a listed SEPP 14 wetland must not be significantly impacted

The remaining red flag variation criteria (Sections 2.4.3 and 2.4.4 – species that cannot withstand further loss) do not need to be addressed in this application as there are no red flag species that will be impacted in the BCAA.

The following sections provide the information required for the OEH to assess a red flag variation for the impacted areas of the CEEC, SSTF (**Section 5.2.1, 5.2.2**).

### 5.2.1 Avoiding and Minimising Impacts on Red Flags (Criteria 2.4.1 of the BCAM)

*The Director General must be satisfied that the feasibility of options to avoid impacts on red flag areas has been considered in the application for biodiversity certification. An application for biodiversity certification can address this requirement by demonstrating that:*

- a) all reasonable measures have been taken to avoid adverse impacts on the red flag areas and to reduce impacts of development on vegetation remaining within the biodiversity certification area*
- b) appropriate conservation management arrangements cannot be established over the red flag area given its current ownership, status under a regional plan and zoning and the likely costs of future management.*

#### **a) All reasonable measures to avoid adverse impacts**

The land within the BCAA has been identified for some time on the former Metropolitan Development Program (MDP) as a future greenfield release area. A preliminary planning proposal was endorsed by

Campbelltown City Council in July 2012 and the Department of Planning and Infrastructure made a Gateway Determination in September 2012 (CCC 2015).

CCC and the proponents have been liaising with the OEH since 2012 regarding the final planning proposal. The main issue discussed during these consultations was the need to reduce impacts to CPW and SSTF within the BCAA. The current proposal is consistent with this advice, and the application has largely excluded from the development footprint areas that contain patches of CPW and SSTF in moderate to good condition. These areas are now within the 'land subject to *conservation measures*' or in proposed Biobank sites mapped in this assessment as '*retained land – existing conservation measures*'.

**b) Appropriate conservation management arrangements cannot be established over the red flag area given its current ownership, status under a regional plan and zoning, and the likely costs of future management**

The majority of the site is zoned R2 Low Density Residential and RE1 Public Recreation. The land was previously zoned RU2 under the default zoning of Campbelltown LEP 2002 and is currently used primarily for agricultural production – cattle grazing. Under its current use and recent rezoned status, the land is not required to be managed for conservation.

**5.2.2 Assessment criteria for red flag areas that contain CEECs (Criteria 2.4.2 of the BCAM)**

*Viability (Criteria 2.4.2.1 of the BCAM)*

The BCAM states that:

*The application for biodiversity certification must demonstrate to the satisfaction of the Director General that the viability of biodiversity values in the red flag area is low or not viable.*

*For the purpose of the methodology, viability is defined as the ability of biodiversity values at a site to persist for many generations or long time periods. The ecological viability of a site and its biodiversity values depend on its:*

- *condition*
- *the area of the patch of native vegetation and its isolation*
- *current or proposed tenure and zoning under any relevant planning instrument*
- *current and proposed surrounding land use*
- *whether mechanisms and funds are available to manage low viability sites such that their viability is improved over time*

*In making an assessment that the viability of biodiversity values in the red flag area is low or not viable, the Director General must be satisfied that one of the following factors applies:*

*a) The current or future uses of land surrounding the red flag area where biodiversity certification is to be conferred reduce its viability or make it unviable. Relatively small areas of native vegetation surrounded or largely surrounded by intense land uses, such as urban development, can be unviable or have low viability because of disturbances from urbanisation, including edge effects; or*

*b) The size and connectedness of the vegetation in the red flag area where biodiversity certification is to be conferred to other native vegetation is insufficient to maintain its viability. Relatively small areas of isolated native vegetation can be unviable or have low viability; or*

c) The condition of native vegetation in the red flag area where biodiversity certification is to be conferred is substantially degraded, resulting in loss of or reduced viability. Native vegetation in degraded condition can be unviable or have low viability. 'Degraded condition' means substantially outside benchmark for many of the vegetation condition variables as listed in Table 1 of the methodology (s.3.6.2), without the vegetation meeting the definition of low condition set out in section 2.3. Vegetation that is substantially outside benchmark due to a recent disturbance such as a fire, flood or prolonged drought is not considered degraded for the purposes of the methodology; or

d) The area of a vegetation type in a red flag area on land where biodiversity certification is conferred is minor relative to the area containing that vegetation type on land subject to proposed conservation measures.

In summary, 1.45 ha of red flag SSTF, which occurs in three vegetation zones will be impacted.

Note that different criteria/factors (a, b, c or d) are considered in assessing the viability of the separate CEEC red flag areas. Not all CEEC red flag areas are discussed under the different factors given viability is dependent on a number of factors, with some factors at play for some CEEC red flag areas and not others. However, each CEEC red flag area is discussed under at least one of the factors to demonstrate that viability of biodiversity values in red flag areas is low or not viable. **Table 16** summarises the criteria that are satisfied by the CEEC red flag area, with detail provided under each criteria.

**Table 16: Criteria satisfied by CEEC red flag areas**

CEEC red flag areas	Section 2.3.2.2. criteria satisfied
SSTF1 (corresponds to impacted vegetation in vegetation zone 7)	A - current and/or future proposed land use surrounding red flag area reduces viability
SSTF2 (corresponds to impacted vegetation in vegetation zone 5)	A - current and/or future proposed land use surrounding red flag area reduces viability C - red flag area is substantially degraded
SSTF3 (corresponds to impacted vegetation in vegetation zone 6)	A - current and/or future proposed land use surrounding red flag area reduces viability C - red flag area is substantially degraded

#### a) Current or Future Land Use surrounding the red flag area

Lands surrounding the red flag areas are currently used for grazing, although unlike other areas within the BCAA, lands immediately surrounding the red flag areas have not been as extensively pasture improved.

The current land use surrounding the red flag areas SSTF1 and SSTF2, and SSTF3 reduce the viability of SSTF in these areas. The red flag areas occur as small patches and are surrounded by open, exotic grassed areas. Current land use is likely to result in on-going long-term impacts on the edges of the patches, particularly SSTF3 as it is long and narrow in shape. These impacts, termed "edge effects" describe the various consequences on vegetation and wildlife, which occur as a result of vegetation

sharing a border with a developed/cleared area. The type of edge effects likely to impact the vegetation patches at these locations include nutrient enrichment and weed invasion. Indeed, red flag areas SSTF1 and SSTF3, are already subject to weed invasion, with these areas recording 18% and 40% exotic plant cover (see 'EPC' [Exotic Plant Cover] column in tables presented in **Appendix H**).

**b) Size and connectedness**

The size and connectedness of the vegetation in the impacted red flag areas would be sufficient to maintain their viability given they are contiguous with other areas of SSTF (including red flagged vegetation as well as vegetation that is not red flagged) providing that they are actively managed. Together, red flag areas SSTF1, SSTF2 and SSTF3 and other areas of SSTF adjacent to red flag areas total 5.26 ha. They occur within 500 m of native vegetation present to the north in Noorumba Reserve, within 300 m of SSTF present to the south west in '*retained land – existing conservation measures*' that contains the two Biobank sites that will be registered prior to this application for biodiversity certification being determined, and within 550 m of SSTF present to the south east, to the east of Appin Road. However, under the current zoning and land use these areas are not actively managed for conservation and are not required to be actively managed.

As such, this factor cannot be applied in demonstrating that the viability of biodiversity values in SSTF is low or not viable.

**c) Vegetation substantially outside of benchmark condition**

Red flag areas SSTF 2 and SSTF3 were considered to be 'degraded', despite their being in biometric 'moderate-good' condition.

The site value scores for the vegetation zones that contained red flag areas SSTF1 and SSTF3 (vegetation zones 7 and 6, respectively) were low at 36.28 and 36.46 (i.e. very close to a site value score of 34 which is considered low condition and therefore not red flagged). Plot data for vegetation zones 6 and 7 showed that the majority of vegetation condition variables were outside benchmark. Native overstorey, mid-storey, and groundcover (other) cover values were below benchmark, while native groundcover (grass) cover values were above benchmark. Also, values for the number of hollow-bearing trees, overstorey regeneration, and length of fallen logs were below benchmark for these vegetation zones containing red flag areas SSTF 1 and SSTF3. Details of plot data are presented in **Appendix H**.

**d) Relative area of red flag vegetation impacted compared to area within land subject to conservation measures**

The areas and proportions of red flagged SSTF impacted and conserved in the BCAA are detailed in **Table 17**. Also included in **Table 17** are details of the relative amount of red flagged SSTF impacted compared to red flagged SSTF in 'land subject to conservation measures'.

The OEH has previously indicated that a 5-10% range of CEECs impacted compared to CEECs in land subject to conservation measures represents a 'relatively minor' impact. The amount of red flagged '*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion*' that will be impacted (1.45 ha) compared to the amount conserved (1.01 ha) is well above this range of minor impact (69.75%), however this does not include the 0.98 ha of red flagged vegetation in the 30 m red flag buffer area, categorised as retained that will effectively be managed for conservation. Given this, this factor cannot be applied in demonstrating that the viability of biodiversity values in SSTF is low or not viable.

**Table 17: Red Flagged CEECs on development and conservation land and proportion of red flagged CEECs impacted relative to conserved**

Biometric vegetation type	CEEC name	Area of red flagged veg within BCAA (ha)	Area of red flagged veg impacted (ha)	Proportion of red flagged veg in BCAA impacted (%)	Area of red flagged veg conserved (ha)	Proportion in BCAA conserved (%)	Proportion impacted relative to conserved (%)
Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	3.27	1.45	44.3	1.01	30.9	69.75

*Contribution to Regional Biodiversity Values (Criteria 2.4.3.2 of the BCAM)*

The BCAM states that:

*The application for biodiversity certification must demonstrate to the satisfaction of the Director General that the red flag area on land proposed for biodiversity certification makes a low contribution to regional biodiversity values.*

*In making an assessment that the contribution of the red flag area to regional biodiversity values is low, the Director General must consider the following factors for each vegetation type or critically endangered or endangered ecological community regarded as a red flag area:*

*a) relative abundance: that the vegetation type or critically endangered or endangered ecological community comprising the red flag area is relatively abundant in the region; and*

*b) percent remaining is high: that the percent remaining of the vegetation type or critically endangered or endangered ecological community comprising the red flag area is relatively high in the region; and*

*c) percent native vegetation (by area) remaining is high: that the percent remaining of all native vegetation cover in the region is relatively high.*

*'Region' for the purposes of section 2.4.2.2 means the CMA subregion in which the red flag area is located and any adjoining CMA subregions.*

The contribution to regional biodiversity values was assessed for the red flagged CEEC, SSTF, in the BCAA, using regional datasets where available. Under the BCAM the 'region' is defined as both the CMA subregion where the red flag area is located (in this case the Cumberland subregion of the Hawkesbury Nepean CMA) and adjoining CMA subregions: the Cumberland (Sydney Metro), Burragorang, Pittwater, Sydney Cataract (Hawkesbury/Nepean), Sydney Cataract (Sydney Metro), Wollemi, and Yengo CMA subregions as shown in **Figure 17**.



The use of regional vegetation datasets in this assessment, while the best data currently available, does have limitations. The data in some cases is several years old and therefore the extant mapping may require revision.

In addition, most regional vegetation mapping products only map patches greater than a minimum size (for example 0.5 ha) and generally only map vegetation in reasonably good condition. It is highly likely that smaller patches of the red flag vegetation type exists in the relevant regions, however have not been included in this assessment as the patches are too small to map, or the condition is disturbed and therefore has not been mapped.

Information on the contribution to regional biodiversity values, including an assessment of the relative abundance of the red flagged vegetation type, the percent remaining of the vegetation type, and percent native vegetation remaining in the region, is provided below.

#### a) Relative Abundance

The first measure for the contribution to regional biodiversity values criteria is a measure of relative abundance of the red flagged vegetation types in the 'region'.

Analysis was conducted into the relative abundance of the red flagged vegetation types across the entire 'region'. The associated data layers that were assessed included:

- Sub CMA Cumberland and Yengo (Hawkesbury Nepean) (Cumberland Plain western Sydney vegetation mapping; NPWS 2002);
- Sub CMA Cumberland (Sydney Metro) (Cumberland Plain western Sydney vegetation mapping; NPWS 2002);
- Sub CMA Pittwater (Cumberland Plain western Sydney vegetation mapping; NPWS 2002);
- Sub CMA Burragorang and Wollemi (Hawkesbury-Nepean) (Native Vegetation of the Warragamba Special Area; NPWS 2003a); and
- Sub CMA Sydney Cataract (Hawkesbury-Nepean and Sydney Metro) (Native Vegetation of the Woronora, O'Hares and Metropolitan Catchments; NPWS 2003b).

ELA is confident that the data used capture the majority of the BVT '*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion*' as the extent of this BVT is restricted to the 'region' as defined by the BCAM and is largely incorporated into the mapping used. The results of the analysis can be seen in **Table 18** and the distribution of the BVT is displayed in **Figure 18**.

The results for the '*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion*' are summarised below:

- 11,555 ha (of which 5,886 ha is in condition class A, B or C) is recorded within the Cumberland (Hawkesbury Nepean) sub CMA, in which the BCAA is located. The clearing of 1.45 ha of red flagged vegetation represents 0.01% of the total extent of the BVT in the Cumberland (Hawkesbury Nepean) sub CMA and 0.025% in condition A, B or C.
- 21,769 ha (of which 9,949 ha is in condition class A, B or C) is recorded within the region in which the BCAA is located, 1.45 ha to be impacted by this proposal represents 0.007% of the extant '*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the*

*Cumberland Plain, Sydney Basin Bioregion* or 0.015% of the extent of condition class A, B or C in the region.

The above information indicates that the impact to the red flagged vegetation/CEECs from the proposal is 'relatively minor' when compared to the amount mapped in the analysed regions.

Table 18: Relative abundance of red flag vegetation/CEECs in surrounding regions

Biometric vegetation type	Area impacted (ha)	Vegetation condition#	Area in Sub CMA (ha)								Total area in sub CMAs (ha)
			Cumberland (HN)	Cumberland (SM)	Burraborang	Pittwater	Sydney Cataract (HN)	Sydney Cataract (SM)	Wollemi	Yengo	
Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	1.45	ABC	5,886	593	977	14	49	485	119	1,826	9,949
		Cmi & Txs	5,420	711	1,113	7	54	466	176	1,436	9,383
		Unknown	249	0	874	0	1,106	0	208	0	2,437
Total			11,555	1,304	2,964	21	1,209	951	503	3,262	21,769

# Vegetation condition follows NPWS (2002) with A, B, C being patches >0.5 ha in area and canopy cover projection density (CCPD) > 10%. Cmi, Txs being patches > 0.5 ha and CCPD < 10%.



**Figure 17: 'Region' derived from adjacent CMA subregions**





Figure 18: Regional distribution of red flag vegetation/CEECs

**b) Percent Remaining is high**

There are few data sources available to determine the percent remaining of the vegetation type in the 'region'. While the database for BVTs (DECC 2008a) has estimates for the percent remaining of each vegetation type, estimates are for entire CMAs, not for individual CMA subregions. Information at the subregion level is required to estimate the percent remaining of the vegetation type in the 'region' given the definition of 'region' includes the CMA subregion in which the BCAA occurs and adjoining CMA subregions.

Given the lack of data sources to determine the percent remaining of the vegetation type in the 'region', information on the percent remaining of the vegetation type in the Hawkesbury Nepean CMA and the Sydney Metro CMA from the BioMetric Vegetation Types database (DECC 2008a) is provided. It is acknowledged that the percent remaining of the vegetation type in these CMAs may not be an accurate reflection of the percent remaining in the 'region'. To supplement information, the National Parks and Wildlife Service's (NPWS) Cumberland Plain western Sydney vegetation mapping (NPWS 2002) was also used. The pre-1750 data for each vegetation type was compared to the extent remaining to determine the percent remaining for the red flagged vegetation type.

The results of the analysis are shown in **Table 19**. The BVTs database (DECC 2008a) records '*Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin*' as being 80% cleared within the both the Hawkesbury Nepean and Sydney Metro CMAs, therefore leaving 20% of the vegetation type remaining. Using the vegetation types in Western Sydney mapping for the Cumberland CMA sub-region (NPWS 2002), 22.6% of the '*Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin*' with canopy cover >10%, remains (i.e., condition A, B, C), though with the inclusion of all remaining vegetation (i.e. including condition Tx), 44% remains. Note that the mapping by NPWS (2002) does not include derived native grasslands in these percent remaining figures, which also meets the biometric condition 'moderate-good' definition. Thus, a proportion of the Tx category meets the biometric condition 'moderate-good' definition and thus would be red flagged.

**Table 19: Percent remaining of each vegetation type/CEEC**

Biometric vegetation type	Area impacted (ha)	% remaining in Hawkesbury Nepean CMA (DECC 2008a)	% remaining in the Sydney Metro CMA (DECC 2008a)	% remaining in the Cumberland Plain (ABC condition) (NPWS 2002)	% remaining in the Cumberland Plain (ABC & Tx condition) (NPWS 2002)
Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	1.45	20	20	22.6	44.0

**c) Percent Native Vegetation (by area) is high**

The area of native vegetation was calculated for the region, being the Cumberland (Hawkesbury/Nepean (HN)), Cumberland (Sydney Metro (SM)), Wollemi, Burrigorang, Sydney Cataract (HN), Sydney Cataract (SM), Pittwater and Yengo CMA subregions, is shown in **Table 20** and **Figure 19**. The OEH state-wide vegetation extent layer was used for the assessment (Keith and Simpson 2006) and was intersected with the six CMA subregions to determine the proportion of each region with native vegetation cover.

**Table 20: Native vegetation cover of CMA subregions**

Native vegetation cover	Burraborang (ha)	Cumberland (ha)	Pittwater (ha)	Sydney Cataract (ha)	Wollemi (ha)	Yengo (ha)	Total (ha)
Cleared	41,567 (18%)	231,218 (84%)	44,079 (35%)	17,095 (12%)	21,260 (4%)	29,613 (9%)	384,831 (24%)
Vegetated	192,769 (82%)	44,200 (16%)	80,915 (65%)	131,254 (88%)	485,884 (96%)	293,273 (91%)	1,228,296 (76%)
<b>Total</b>	<b>234,335 (100%)</b>	<b>275,418 (100%)</b>	<b>124,994 (100%)</b>	<b>148,349 (100%)</b>	<b>507,144 (100%)</b>	<b>322,886 (100%)</b>	<b>1,613,127 (100%)</b>

In total, 76% (1,228,296 ha) of the assessment region contains native vegetation cover. The proportion of vegetation cover for five of the CMA subregions is high, with Burraborang containing 82%, Pittwater containing 65%, Sydney Cataract containing 88%, Wollemi containing 96% and Yengo containing 91% vegetation cover. As stated earlier, the vegetation types impacted are predominantly located on the Cumberland Plain, and therefore very little of the vegetation types are likely to extend into the surrounding five CMA subregions. This assessment demonstrates that the majority of the CMA subregions assessed are relatively well vegetated, however when considering the two Cumberland CMA subregions, which are between 7-17% vegetated, native vegetation cover is low.



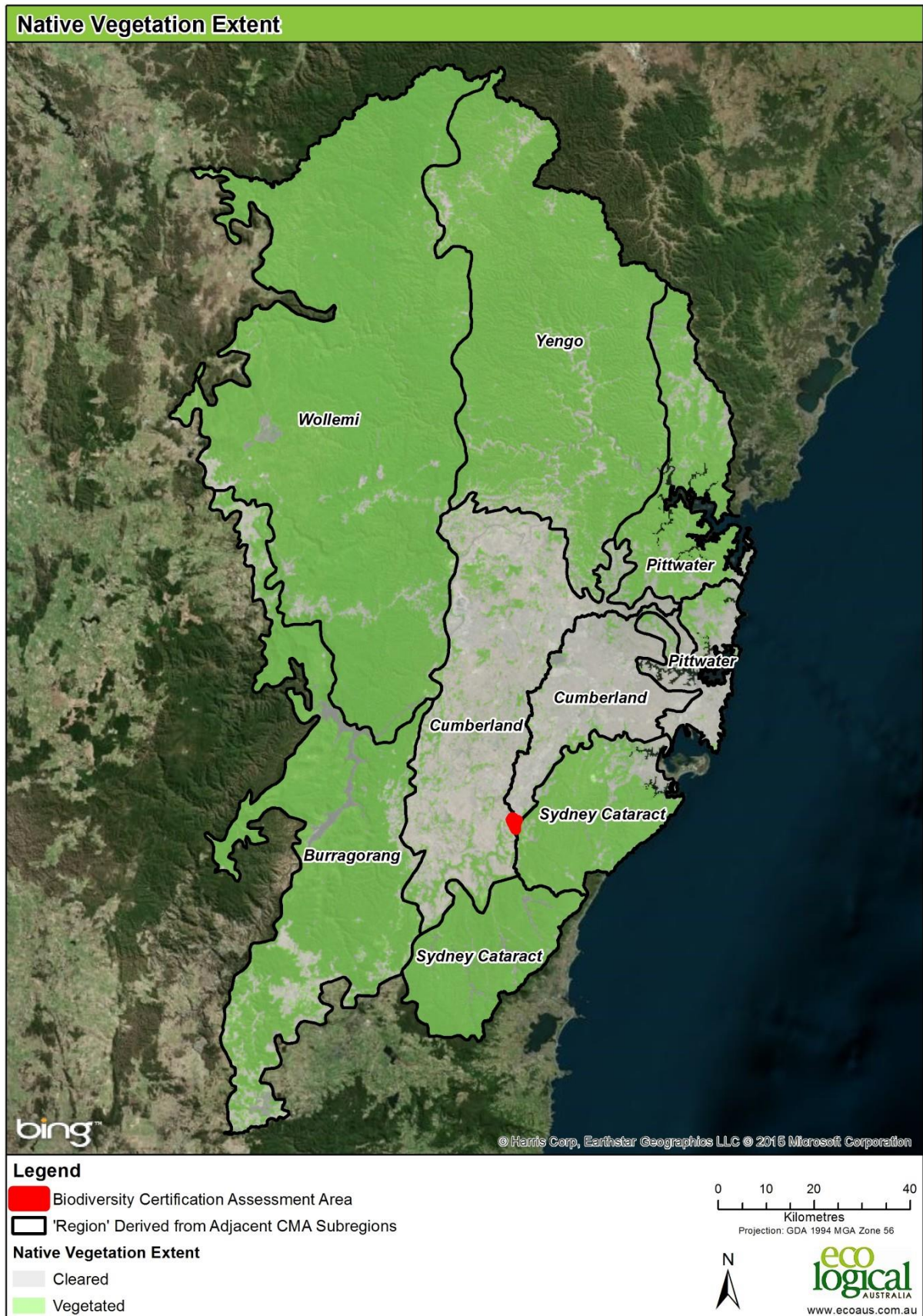


Figure 19: Native vegetation extent



### 5.2.3 Additional Assessment criteria for areas with regional or state biodiversity conservation significance (Criteria 2.4.4)

*Width of riparian buffer with regional or state biodiversity significance (Criteria 2.4.4a)*

*The width of a riparian buffer with regional or state biodiversity significance (i.e. the riparian buffers on major or minor creeks and rivers) must not be substantially reduced.*

The proposal will not reduce the riparian buffer on two ‘minor creeks’ that meet the definition of ‘areas of vegetation having state or regional biodiversity conservation significance’.

The riparian buffers comprise land zoned RE1 Public Recreation and will be transferred to Campbelltown City Council as ‘community land’ and will be subject to landscape plantings and passive community use (walking paths, cycle ways and open space) and are expected to increase the area of vegetation within these buffers.

*Ecosystem functioning of a state or regional biodiversity link (Criteria 2.4.4b)*

*The ecosystem functioning of a state biodiversity link or a regional biodiversity link must not be substantially impacted, considering migration, colonisation and interbreeding of plants and animals between two or more larger areas of habitat.*

There are no registered state or regional biodiversity links as defined by section 3.7.2 of the BCAM that will be impacted by the application for biocertification therefore the ecosystem functioning of a state biodiversity link or a regional biodiversity link will not be substantially impacted.

*Water quality of major river, minor river, major creek, minor creek or a listed SEPP 14 wetland (Criteria 2.4.4c)*

The water quality of a major river, minor river, major creek, minor creek, or a listed SEPP 14 wetland must not be significantly impacted.

The BCAA does not include a SEPP 14 wetland, therefore the water quality of a listed SEPP 14 wetland will not be impacted.

The BCAA includes ‘minor creeks’ where remnant native vegetation (0.15 ha of canopy of scattered paddock trees) will potentially be impacted by earth works and construction of stormwater detention basins and thus have been included as ‘impacted’ or land to be certified.

Surface run-off will be managed through proposed stormwater infrastructure and a stormwater management strategy which will direct surface flows to specifically designed stormwater detention basins to ensure that post development peak discharges are equal to or less than pre development discharges (Worley Parsons 2014). These detention basins will be constructed within the riparian buffers to retain water intermittently after prolonged heavy rain. These minor creeks are currently within a rural landscape and subject to ongoing agricultural land use including cropping and cattle grazing and associated run-off. They are in poor condition, with predominantly exotic ground cover and scattered remnant paddock trees comprising degraded CPW vegetation. The riparian buffers comprise land zoned RE1 Public Recreation and will be transferred to Campbelltown City Council as ‘community land’ and will be subject to landscape plantings and passive community use (walking paths, cycle ways and open space) and are expected to have improved water quality post development.

## 6 Biocertification Strategy

Section 126K of the TSC Act states that biocertification may only be conferred on land by the Minister if the applicant has a biocertification strategy.

Section 126K (2) states that a biocertification strategy is a policy or strategy for the implementation of conservation measures to ensure that the overall effect of biodiversity certification is to improve or maintain biodiversity values. The Biocertification strategy is to be used as the basis for the assessment of the application for biodiversity certification.

A biodiversity strategy is to include the following:

- a) the land proposed for biodiversity certification
- b) the land proposed for biodiversity conservation
- c) the proposed conservation measures
- d) any person or body proposed as a party to the biodiversity certification

This section addresses these requirements.

### 6.1 Land proposed for biodiversity certification

The land proposed for biodiversity certification is shown in **Figure 3** in **Section 1** of this report.

### 6.2 Land proposed for biodiversity conservation

The land proposed for biodiversity conservation is shown in **Figure 3** in **Section 1** of this report.

Also shown in **Figure 3** are areas of '*retained land*', some of which i.e. '*retained land – existing conservation measures*', overlaps with the proposed Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites which will be registered prior to this application for biodiversity certification being determined.

### 6.3 Proposed conservation measures

#### *Conservation measures within the 'BCAA'*

It is proposed that the land subject to conservation measures within the BCAA (2.48 ha plus 0.98 ha of retained red flag buffer area) will be secured by transferring the land to Campbelltown City Council by 2025 and will be managed in accordance with a Plan of Management adopted under the *Local Government Act 1993* (LG Act). The land will be classified as community land under the LG Act, and categorised as a 'natural area' with an adopted plan of management under Division 2 of Part 2 of Chapter 6 of that Act that will manage the land primarily for nature conservation. Permanently managed conservation measures are a 90% Conservation Measure as outlined in section 8.1.2 of the BCAM and will generate 90% of the calculated credits as shown in **Table 21**.

The management plan for the conservation area will include actions to improve biodiversity values by the implementation of the following management actions:

- The erection and maintenance of boundary fencing to prevent in appropriate access
- Council Reserve signage outlining the management objectives of the site
- The active management and reduction of weeds

- The application of fire, where appropriate;
- Replanting or supplementary planting where natural regeneration is insufficient to bring back to benchmark condition within a reasonable timeframe - vegetation zone 8 (**Figure 20**);
- Addition of logs and nesting boxes to supplement the current low level of logs and hollows in Vegetation Zone 5 and 8 (**Figure 20**).
- Control of rabbits and foxes (as required).
- The retention of regrowth/native vegetation, dead timber, and rocks.

The in perpetuity cost of these management actions has been estimated using the biobanking in perpetuity cost spreadsheet and agreement reached with Council regarding the transfer of these funds once initial management has been undertaken by the current land owners to reach maintenance management.

The current land owners, Mr and Mrs Dzwonnik and Lendlease Communities (Mount Gilead) Pty Ltd, will be responsible for the initial temporary stock fencing of the conservation area, establishment of the walking path, initial weed and feral animal control, revegetation/supplementary planting and the bringing in of fallen timber from the adjacent development area. The boundary of the offset area will also be fenced following the subdivision of the adjacent land with post and chain markers prior to land transfer.

Campbelltown Council will be responsible for the on-going maintenance of these activities in perpetuity from the date that the land is transferred to Council and the land is gazetted as a natural area – bushland. Council will also install the Council Reserve signs.

The land subject to this conservation measure will generate **16** ecosystem credits for HN556 '*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest on the edges of the Cumberland Plain*'. It will not generate any credits for HN528 '*Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain*'.

A Biocertification Agreement will be entered into between CCC, S&A Dzwonnik (the current land owners), Lendlease Communities (Mount Gilead) Pty Ltd and the Minister stating that the land will be transferred by S&A Dzwonnik to Lendlease Communities (Mount Gilead) Pty Ltd and then to CCC, prior to 2025, classified as 'Community Land – Natural Area', and a plan of Management will be prepared and Adopted by 2025.

The number of credits generated is less than the credits required for impacts to HN556 '*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest on the edges of the Cumberland Plain*' (109 credits) and HN528 '*Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain*' (30 credits). Additional credits for both vegetation types (**93** credits for HN556 and **30** credits for HN528) as well as Koala (**133** credits) will be purchased and retired from the two proposed Biobank sites within the BCAA.

#### *Purchase of biodiversity credits from 'existing' Conservation measures 'within' the BCAA*

Three areas within '*retained land – existing conservation measures*' are the proposed Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites which will be registered prior to this application for biodiversity certification being determined. These will be subject to the terms of BioBanking Agreements under Part 7A of the TSC Act, which will include annual conservation management in perpetuity, submission of an annual report to the OEH regarding these management obligations, and audit by the OEH. A BioBanking Agreement is a 'Permanently Managed and Funded' or 100% Conservation Measure as outlined in s126L(i) of the TSC Act and section 8.1.1 of the BCAM.

Assessment of the sites found that they will generate more than the required **93** credit deficit for HN556 '*Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest on the edges of the Cumberland Plain*' and the required **30** credit deficit for HN528 '*Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain*'. The BioBank sites will also generate **133** Koala credits, resulting in a residual **159** credit deficit for this species which will need to be secured from outside of the BCAA.

A Biocertification Agreement will be entered into between Mt Gilead Pty Ltd, S&A Dzwonnik, Lendlease Communities (Mount Gilead) Pty Ltd and the Minister stating that **30** of the **93** HN556, **30** HN528 and **133** Koala credits will be purchased and retired prior to the commencement of Stage 1 with the remaining **63** HN556 credits and **159** Koala credits retired prior to the commencement of Stage 2 as outlined in **Tables 22 and 23**.

#### *Conservation measures 'outside' the BCAA*

The remaining **159** Koala species credits will be purchased from a registered BioBank site outside of the BCAA. ELA is aware of a number of registered Biobank sites in the locality that will be able to supply these credits.

A Biocertification Agreement will be entered into between Lendlease Communities (Mount Gilead) Pty Ltd and the Minister stating that these additional **159** Koala credits will be purchased and retired by the end of 2020 (or prior to the commencement of Stage 2).

## **6.4 Existing management obligations**

The proposed conservation lands are currently zoned as a 'deferred matter' under Campbelltown LEP 2014 and accordingly reverts to its previous zoning under Campbelltown LEP 2002 which is Rural Land. There are no covenants or conservation funding arrangements for the land proposed for conservation measures or any existing requirements to actively manage the site for biodiversity conservation. The entire conservation area is to be managed for ecosystem and species credits.

Similarly, the proposed Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites which will be registered prior to this application for biodiversity certification being determined are zoned deferred matters, and have no covenants or existing requirements to actively manage the sites for biodiversity conservation. The Biobank sites will be managed for ecosystem and species credits.

## **6.5 Any person or body proposed as a 'party' to the biodiversity certification**

A Biocertification Agreement will be entered into between CCC, S&A Dzwonnik (the current land owners), Lendlease Communities (Mount Gilead) Pty Ltd and the Minister stating that the land will be transferred by S&A Dzwonnik to Lendlease Communities (Mount Gilead) Pty Ltd and then to CCC, prior to 2025, classified as 'Community Land – Natural Area', and a plan of Management will be prepared and Adopted by 2025.

Campbelltown City Council will be responsible for adopting the Plan of Management in accordance with the Local Government Act prepared for the management of the land subject to conservation measures.

Mt Gilead Pty Ltd has prepared and submitted the applications for registration of the two Biobank Agreements for Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites. These Biobank sites will be registered prior to this application for biodiversity certification.



Mt Gilead Pty has committed to making the **123** ecosystem (93 HN556 and 30 HN528) and **133** Koala credits available to meet the credit requirements of this Biocertification application as outlined in **Table 21, 22, 23 and 24**.

The subsequent implementation, monitoring, reporting and review of the terms of the BioBanking Agreements will be the responsibility of Mt Gilead and any future owners of the Biobank sites who would assume all responsibility for the implementation of the requirements of the Biobank Agreement.

A Biocertification Agreement will be entered into between Mt Gilead Pty Ltd, Lendlease Communities (Mount Gilead) Pty Ltd and the Minister stating that **30** of the **94** HN556, **30** HN528 and **133** Koala credits will be purchased and retired prior to the commencement of Stage 1 with the remaining **63** HN556 credits retired prior to the commencement of Stage 2 as outlined in **Tables 22 and 23**.

A Biocertification Agreement will be entered into between Lendlease Communities (Mount Gilead) Pty Ltd and the Minister stating that these additional **159** Koala credits will be purchased and retired by the end of 2020 (or prior to the commencement of Stage 2).

#### 6.5.1 Timing of credit retirement

It is proposed to “retire” biodiversity and species credits in accordance with the staged development of the certified land as outlined in **Table 23** and **Table 24** and shown in **Figure 21** and includes the 16 credits generated by the 90% conservation measure. The proportion and types of credits to be retired is based on the area of vegetation to be cleared (and corresponding number of credits) in each stage of development.

A likely time frame is provided; however, this will be subject to the demand for housing lots and may occur sooner or later than indicated. No clearing of mapped vegetation will occur in each stage until Mt Gilead and/or S. and A. Dzwonnik accordingly have provided proof of the retirement of the required quantum of credits in accordance with **Table 23** and **Table 24**. This proof will be in the form of a ‘certificate’ of credit retirement issued by the OEH. Development in areas with no mapped native vegetation may occur prior to the purchase and retirement of credits.

The requirements for the retirement of credits from the Macarthur-Onslow Mt Gilead and Noorumba-Mt Gilead BioBank sites are expressed in this strategy as credits calculated using the BBAM which have been treated as being equivalent to the required number of BCAM credits. As part of the sites will be secured as Biobank sites it will be the credits calculated using the Biobanking Assessment Methodology 2014 (BBAM 2014; OEH 2014a) that are actually retired. Whilst there is usually the requirement to convert BCAM credits into an equivalent amount of BBAM 2014 credits, there is no requirement for this in this instance. This is because the number of credits generated by the Biobank sites is already known. Conversions are usually required due to not knowing the amount of BBAM credits generated; calculations under BBAM generally generate less credits than calculations under BCAM.

Management of the two Biobank sites that will be registered prior to this application for biodiversity certification being determined and will occur prior to the commencement of any clearing of vegetation.



**Figure 20: Management actions within land proposed for conservation measures**

Table 21: Summary of ecosystem credit surplus/deficit

Biometric Vegetation Type	Credits Required	Credits generated (90% Measure)	Credit Status within BCAA	Proposed Biobank Sites	Credit Status Existing Conservation Measures
HN526 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	0	0	0	4	4
HN528 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	30	0	-30	75	45
HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	109	16	-93	119	26
	<b>139</b>	<b>16</b>	<b>-123</b>	<b>198</b>	<b>75</b>

Table 22: Summary of species credit surplus/deficit

Habitat	Credits	Credits generated (90% Measure)	Credit Status within BCAA	Proposed Biobank Sites	Credit Status Existing Conservation Measures
Koala	292	0	-292	133	-159

Table 23: Staging of development and retirement of ecosystem credits

Property	Stage	Indicative Time Frame	Grey Box - Forest Red Gum grassy woodland on flats (ha of impact)	Credits to be retired	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum (ha of impact)	Credits to be retired
Mt Gilead	1	0-2 years (2018-2020)	2.38	28	1.00	10
Dzwonniks	1	0-2 years (2018-2020)	0.21	2	2.14	20*
Mt Gilead	2	3-5 years 2021-2023	0.00	0	5.35	63
<b>Total</b>			<b>2.59</b>	<b>30</b>	<b>8.49</b>	<b>93</b>

\*Does not include the 16 credits generated for the 90% conservation measure

Table 24: Staging of development and retirement of species credits

Property	Stage	Indicative Time Frame	Koala habitat impacted	No. of Koala credits to be retired
Mt Gilead	1	0-2 years (2018-2020)	<b>3.38</b>	80
Dzwonniks	1	0-2 years (2018-2020)	<b>2.35</b>	53
Mt Gilead	2	3-5 years (2021-2023)	<b>5.35</b>	159
<b>Total</b>			<b>11.08</b>	<b>292</b>



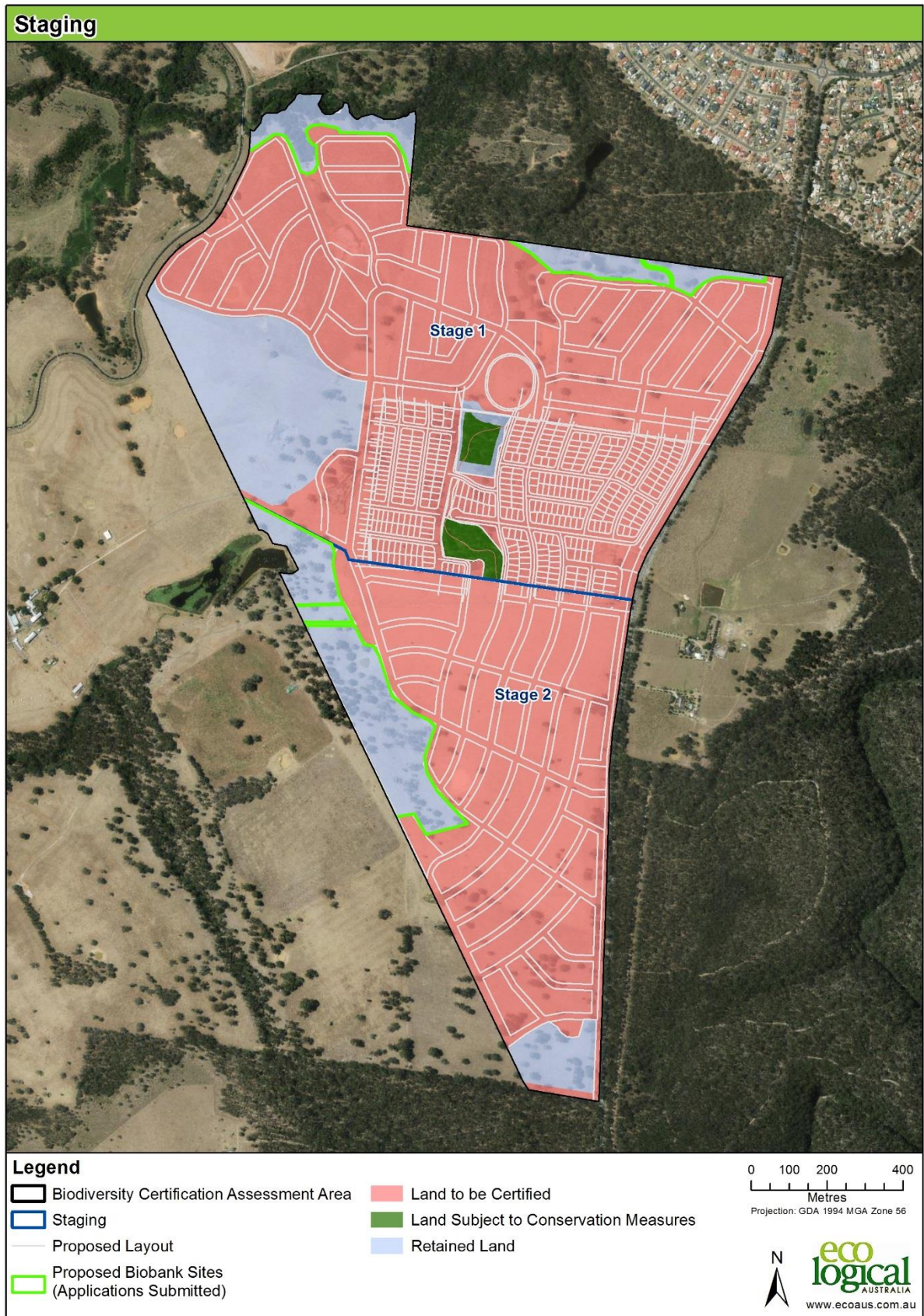


Figure 21: Development stages the certified land



## 6.6 Is an Improve or Maintain Outcome Achieved?

Subject to the Director-Generals consideration and approval of the red flag variation request (**Section 4**), an ‘*improve or maintain*’ outcome can be achieved by the purchase and retirement of credits from the proposed conservation lands, the existing BioBank sites within the BCAA and the purchase and retirement of **155** additional Koala credits from outside the BCAA.

## 6.7 Statement of commitments

The following is a summary of the commitments made throughout this biocertification assessment and application.

1. A Biocertification Agreement will be entered into between CCC, S&A Dzwonnik (the current land owners), Lendlease Communities (Mount Gilead) Pty Ltd and the Minister stating that the land proposed for conservation measures within the BCAA will be transferred by S&A Dzwonnik to Lendlease Communities (Mount Gilead) Pty Ltd and then to CCC, prior to 2025, classified as ‘Community Land – Natural Area’, and a plan of Management will be prepared and Adopted by 2025.
  - a. S&A Dzwonnik and subsequently Lendlease Communities (Mount Gilead) Pty Ltd, will be responsible for managing the land proposed as a Council Reserve for the first seven years, or until such time that CCC is satisfied that the ongoing management is at a maintenance level, expected to be by 2025.
  - b. The current land owners, Mr and Mrs Dzwonnik and subsequently Lendlease Communities (Mount Gilead) Pty Ltd, will be responsible for the initial temporary stock fencing of the conservation area, establishment of the walking path, initial weed and feral animal control, revegetation/supplementary planting and the bringing in of fallen timber from the adjacent development area. The boundary of the offset area will also be fenced following the subdivision of the adjacent land with post and chain markers prior to land transfer.
  - c. Campbelltown City Council will be responsible for adopting the Plan of Management in accordance with the Local Government Act prepared for the management of the land subject to conservation measures.
  - d. Campbelltown Council will be responsible for the on-going maintenance of these activities in perpetuity from the date that the land is transferred to Council and the land is gazetted as a natural area – bushland. Council will also install the Council Reserve signs.
2. Mt Gilead Pty Ltd has prepared and submitted the applications for registration of the two Biobank Agreements for Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites. These Biobank sites will be registered prior to this application for biodiversity certification being determined.
  - a. Active management of the proposed Noorumba-Mt Gilead and Macarthur-Onslow Mt Gilead Biobank Sites (i.e. meeting the Total Fund Deposit Amount), will commence prior to the commencement of Stage 1 construction (it is noted that conservation management of both biobank sites commenced in 2016 with the removal of grazing, fencing the boundary and initial weed control works underway).
  - b. Mt Gilead Pty has committed to making **93** ecosystem and **133** Koala credits available to meet the credit requirements of this Biocertification application as outlined in **Table 21, 22, 23 and 24**.
  - c. The subsequent implementation, monitoring, reporting and review of the terms of the BioBanking Agreements will be the responsibility of Mt Gilead and any future owners of the Biobank sites who would assume all responsibility for the implementation of the requirements of the Biobank Agreement.
  - d. A Biocertification Agreement will be entered into between Mt Gilead Pty Ltd, Lendlease Communities (Mount Gilead) Pty Ltd and the Minister stating that **30** of the **93** HN556,

**30** HN528 and **133** Koala credits will be purchased and retired prior to the commencement of Stage 1 with the remaining **63** HN556 credits and **159** Koala credits retired prior to the commencement of Stage 2 as outlined in **Tables 23** and **24**.

3. A Biocertification Agreement will be entered into between Lendlease Communities (Mount Gilead) Pty Ltd and the Minister stating that the additional **159** Koala credits required will be purchased and retired by the end of 2020 (or prior to the commencement of Stage 2).
4. Lendlease Communities (Mount Gilead) Pty Ltd will prepare and implement a Construction Environment Management Plan for vegetation clearing within the BCAA to guide the development outlined in this biocertification assessment and ensure that all direct and indirect impacts (e.g. APZs, utilities, access, stormwater run-off etc) are contained within the development footprint and appropriate mitigation measures are put in place to minimise indirect impacts to threatened fauna including Koala. Specifically, this will address the management of the land proposed for conservation measures and its buffer such that surrounding roads will be fully curbed and guttered with no stormwater being discharged into the conservation area.

In addition, the CEMP will include, but not be limited to:

- temporary and permanent protective fencing will be erected around all areas identified for conservation prior to clearing activities to minimise any inadvertent damage
- a fauna pre-clearance protocol
- retention of HBTs where possible and practical
- where trees are removed in the development area, these will be salvaged for fauna habitat values in the proposed Council Reserve and Biobank sites (i.e. meeting the additional management requirement if importing logs into the conservation area)
- a de-watering plan for any farm dams that are removed

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JBA Urban Planning Consultants (JBA) 2014. *Final Planning Proposal, Mt Gilead*. Report prepared on behalf of Mt Gilead Pty Ltd and S. and A. Dzwonnik and submitted to Campbelltown City Council.

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National Parks and Wildlife Service (NPWS) 2003b. *The Native vegetation of the Woronora, O'Hares and Metropolitan Catchments*. NSW National Parks and Wildlife Service, Sydney, August 2003.

Office of Environment and Heritage (OEH) 2014b. *BioBanking Assessment Methodology 2014a*. Office of Environment and Heritage for the NSW Government, September 2014, Sydney. Available online: <http://www.environment.nsw.gov.au/resources/biobanking/140661BBAM.pdf>

Office of Environment and Heritage (OEH) 2014b. *Sydney Growth Centres Strategic Assessment Commitment 7: Cumberland Plain Woodland HNV and PCLs review Outcomes Report*. Office of Environment and Heritage.

Office of Environment and Heritage (OEH) 2015a. *Atlas of NSW Wildlife database*. Office of Environment and Heritage.

Office of Environment and Heritage (OEH) 2015b. Biodiversity Certification Guide to Applicants. Office of Environment and Heritage, May 2015

Office of Environment and Heritage (OEH) 2015c. Biodiversity Certification Operational Manual. Office of Environment and Heritage, May 2015

Office of Environment and Heritage (OEH) 2015d. *Threatened Species Profiles*. Office of Environment and Heritage. Available online: <http://www.environment.nsw.gov.au/threatenedspecies/>

Worley parsons 2014 Mount Gilead Rezoning Stormwater Management and Flooding Assessment. Prepared for Mount Gilead Pty Ltd and S&A Dzwonnik, 4<sup>th</sup> November 2014



## Appendix A: Project Staff CVs

The following are brief curriculum vitae's for the key project staff. Please note that since this project commenced in 2013, there have been a number of staff movements, and some of the staff who undertook the field work and credit calculations are no longer with Eco Logical Australia, they have however been consulted in making revisions to this report.

### Robert Humphries – Project Manager



#### CURRICULUM VITAE

### Robert Humphries

**MANAGER, BIOBANKING AND BIOCERTIFICATION OFFSETS PROGRAMS**

#### QUALIFICATIONS

- Bachelor of Applied Science, Ballarat C.A.E 1983-85.
- Master of Applied Science (Research) University of Ballarat 1986-89.

Robert is an ecologist, environmental planner and project manager with over 25 years experience. Since graduating with Bachelors and Masters Degrees in wildlife management in 1985, Robert has worked mainly in the public sector with the Department of Environment and Conservation (Victoria) 1988-1996 and NSW National Parks and Wildlife Service, now NSW Office of the Environment & Heritage 1996-2006. Robert joined Eco Logical Australia in March 2008.

Robert was the Manager of the Threatened Species Section of the NSW Department of Conservation and Environment for over 10 years and has extensive experience of the NSW Threatened Species and Environmental Planning legislation, Government policy, the biodiversity of the Greater Sydney and Hunter Regions and the new biodiversity certification and biobanking provisions.

Robert was a member of the Biobanking Ministerial Reference Group from 2007-2012 and is the lead trainer in the BioBanking and Biodiversity Certification Accredited Assessor Training program.

#### RELEVANT PROJECT EXPERIENCE

##### BioCertification Assessments

Have completed or are currently undertaking formal Biodiversity Certification Assessments for:-

- Port Macquarie Airport Master Plan (Port Macquarie- Hastings Council)
- Tuncurry State Significant Site (Urban Growth NSW)
- Emerald Hills Urban Release Area (Camden City Council). Assessment completed and reviewed by OEH
- Warnervale Town Centre (Wyang Council)(Approved March 2014)
- Broulee and South Moruya Urban Release Areas (Eurobodalla Shire Council)(Approved September 2014)
- Mount Gilead Urban Release Area (Campbelltown City Council)

Have completed informal Biodiversity Certification Assessments for

- Ralston Avenue, Belrose for Metropolitan Local Aboriginal Land Council (August 2013)
- Greater Sancroix Area for Port Macquarie –Hastings Council (August 2013)
- Glenning Valley Urban Release Area (Travers Ecology and Glenning Valley Partnership 2011);
- Kings Hill Urban Release Area, Port Stephens LGA (Mondell Property Group and Hunter Land 2011);
- Ingleside Release Area, Pittwater/Warringah LGAs (Urban Growth NSW 2011)
- Darkinjung Local Aboriginal Land Council (North Wyong Structure Area)
- Yallah-Marshall Mount Urban Release Area (Wollongong City Council)
- Whitebridge Investigation Area (Urban Growth NSW 2011)
- Balmoral Urban Release Area, north west Sydney (Urban Growth NSW 2013)

### **Biodiversity Offset Strategies**

- North West & South West Growth Centres Biodiversity Offset Strategy for Sydney Water Infrastructure developments (May 2013)
- Biodiversity Offset Strategy for the proposed extension of the Pine Dale Mine (Enhance Place Pty Ltd, July 2013)
- Biodiversity Offset Strategy for proposed Stage 1 Modification, Moolarben Coal Mine (Yancoal, May 2013)
- Biodiversity Offset Strategy for Crudine Wind Farm (Wind Prospect CWP Pty Ltd – 2012)
- Biodiversity Offset Strategy for Sapphire Wind Farm (Wind Prospect CWP Pty Ltd – 2011)
- Biodiversity Offset Strategy for Boco Rock Wind Farm (Wind Prospect CWP Pty Ltd – 2011)
- Improve or Maintain Biodiversity Offset Strategy for Kings Hill Urban Release Area, Port Stephens LGA (Mondell Property Group, 2011)
- Biodiversity offset strategy for proposed Narrabri Coal mine (Narrabri Coal Operations Pty Ltd, 2011)
- Biodiversity offset strategy for proposed modification to Rocglen Coal Mine (Whitehaven Coal Pty Ltd, 2010)
- Biodiversity offset strategy for proposed Werris Creek LOM Coal Mine (Werris Creek Coal Pty Ltd, 2010)
- Biodiversity offset strategy for the South West Rail Link (Transport Construction Authority, 2010)
- Biodiversity offset strategy for the Richmond Rail Line duplication (Transport Construction Authority, 2011)
- Biodiversity offset strategy for the Camden Valley Way Upgrade (NSW RTA, 2011)
- Biodiversity Offset Strategy for the Oxley Highway Upgrade, Port Macquarie (NSW RTA, 2010)
- Preparation of Offset Strategy and package for the Kingsgrove to Revesby Quadruplication Project (2008/09 K2RQ/TIDC Alliance)

### **Biobank Site Assessments and Registrations**

- 80 ha site at Salamander for Port Stephens Shire Council (Assessment currently being assessed by OEH)
- Two Biobank sites (100 ha) in Western Sydney Parklands as an amendment to the existing Cecil Hills Biobank Site (Agreement No. 120 registered August 2014)
- 54 ha proposed Biobank at the Oaks on the Cumberland Plain (Private landholder) (Agreement No. 100, registered in September 2013)
- 69 ha proposed Biobank for Shoalhaven City Council at (Agreement No. 101, registered in June 2013)
- 45 ha proposed Biobank for Lake Macquarie City Council at Belmont (Agreement No. 103, registered in June 2013)
- 51 ha site west of Camden on the Cumberland Plain (Private landholder) (Agreement No. 88, registered in January 2013)
- 25 ha site west of Camden on the Cumberland Plain (Private landholder) (Agreement No. 3, registered in January 2011).
- 24 ha site in western Sydney (Western Sydney Parklands Trust). (Agreement No. 70, registered in February 2012).
- 10 ha site at Belrose (WSN Environmental Solutions) (Agreement No. 55, registered in March 2012)
- 1,500 ha site near Gunnedah to offset an approved Coal mine (Whitehaven Coal) (Agreement No. 43, registered in August 2012).

## Bruce Mullions – Senior Field Ecologist – Vegetation Mapping and threatened flora (moved to Eco Planning Pty Ltd, December 2016)



### CURRICULUM VITAE

## Bruce Mullins

ASSOCIATE - MANAGER, ECOLOGY AND ASSESSMENT - PRINCIPAL ECOLOGIST

### QUALIFICATIONS

- Master of Science, University of Technology, Sydney. Factors affecting the vegetation of mined and unmined areas in a montane forest.
- Bachelor of Science, University of Technology, Sydney
- Accredited Biobanking Assessor

Bruce is an ecologist with over twenty years post-graduate experience and is Eco Logical Australia's Senior Ecologist and Manager of the Ecology and Assessment team. Following the completion of a Master of Science thesis examining patch dynamics and plant ecophysiology at an abandoned mine site in the central tablelands of NSW, Bruce has been working as a researcher and environmental consultant. For seven years he managed the environmental consulting activities of Charles Sturt University, principally through the Johnstone Centre, after which time he joined Eco Logical Australia.

Bruce has highly developed skills in research and consulting. He is experienced in the design and execution of ecological surveys, environmental impact assessment, the development of management plans, literature reviews and all aspects of project management.

### RELEVANT PROJECT EXPERIENCE

- Parramatta Escarpment shared path and boardwalk, Options study, Parramatta City Council
- Jerrabomberra wetlands, vegetation mapping project.
- Plains-wanderer, survey and habitat assessment 2015, OEH
- Floristic Value Score advice, Riverina grasslands, OEH
- Mt Gilead Biocertification Assessment
- Bingara Gorge, Ecological surveys
- Western Sydney Dieback project, bird surveys and advice, Goodman.
- Metropolitan Colliery Vegetation Monitoring Program 2008 - present
- Ecological Assessment, Proposed Hume Highway Duplication, RTA
- Flora and Fauna Impact Assessment, Roadside Vegetation Maintenance, Old Princes Highway, Bulli Tops to Waterfall, Wollongong City Council
- Goodnight Island Ecological Assessment, Studio Internationale
- Research and Monitoring Program, DEFCOMMSTA Morundah, Dept of Defence
- Ecological Expert, Land and Environment Court, Booralie Rd, Warringah, Northern Beaches Council.
- Superb Parrot Surveys, selected sites in ACT 2014 and 2015
- Eastern Highlands Vegetation Surveys, (Kosciusko NP and ACT), DECCW and ACT government.
- West Dapto and Adjacent Growth Areas, Part 3A Assessment, Sydney Water Corporation
- Tharbogang Landfill Biodiversity Offset Strategy, Griffith City Council
- Ecological Equivalence Assessment, Carmichael Mine, central QLD.
- Rapid vegetation assessment, mid to lower Murrumbidgee (Griffith to below Balranald), OEH
- PAS expert advice (Plains-wanderer, *Brachyscome muelleroides* and *Leptorhynchos orientalis*), OEH

- Council Appointed Expert, terrestrial ecology, Proposed Subdivision Hampton Cres Blacktown
- Council Appointed Expert, terrestrial and aquatic ecology, Rooty Hill
- Box-Gum Woodland Mapping and Monitoring Plan for Kapooka Military Area, Dept of Defence
- Monitoring the Impacts of Kangaroo Grazing in the Kapooka Military Area, Dept of Defence
- Monitoring the Impacts of Kangaroo Grazing in Latchford Barracks, Dept of Defence
- North Bandiana Landscape Management Plan, Dept of Defence
- South Bandiana Landscape Management Plan, Dept of Defence
- Vegetation Condition Assessment, South West Slopes, DEWHA
- Flora and Fauna Assessment, Proposed Bayswater 2 Powerstation, Part 3A, AECOM
- Rapid weed assessments, Wilderness areas (Kosciusko, Deua, Monga, Mummel Gulf National Parks), OEH
- Hargraves to Windeyer Powerline Ecological Assessment, Barnson Pty Ltd
- Moolarben Coal Mine Preclearing Survey, Moolarben Coal Operations
- Vegetation Mapping, Mulwala Explosives Facility, Mulwala, Dept of Defence
- Native Grassland Condition Assessment, Tubbo Station, Tubbo Farming.
- Wagga Wagga Linepack Extension, Environmental Licencing Professionals
- Ecological Assessment, Cooktown, QLD, Aircservices Australia
- Assessment of Irongrass Natural Temperate Grassland, Taillem Bend, SA, Aircservices Australia
- Moorlaben Coal, Flora and Fauna Monitoring 2010-2011, Moolarben Coal Operations
- Tralee Station proposed rezoning, environmental assessment and constraints analysis, Queanbeyan, Urbis.
- Ecological Surveys, Nymagee, Triako mines with Charles Sturt University.
- Ecological Surveys, Cobar, Endeavour mine with Charles Sturt University.
- Ecological assessment, piping Llanillo Bore Drain, Lightning Ridge
- Ecological Assessment, proposed upgrade to Lake Brewster, near Hillston, State Water
- Ecological Assessment, Muggabah and Merrimajeel Creeks, Booligal, Dept Commerce
- Flora survey, Coleambally Irrigation Area, Australian Museum.
- Towra Point Artificial Bird Roosts REF, DECCW
- Southern Highlands Transfer, Identification of Flora and Fauna Constraints, Dept Commerce
- Shoalhaven Water Transfers, Terrestrial Ecology and Wetlands, Dept Commerce
- Wetland Vegetation Surveys for LiDAR comprising the Gwydir Wetlands, DECCW
- Wetland Characterisation and Management, Port Stephens Council
- EPBC Box Gum woodland survey and mapping, Molonglo region, ACT
- Tallawarra Local Environment Study, TRUenergy
- Shellharbour Hardrock Extraction Flora and Fauna Assessment, NSW Dept of Planning
- Campbelltown Biodiversity Study, Campbelltown City Council
- Native Vegetation Guide for the Riverina, Greening Australia
- Buckingbong State Forest Environmental Assessment, Dept of Defence
- Wagga Wagga Planning Studies, Willana Associates
- Historical distribution of Native Grasses through Parkes, Forbes and Lachlan Shires, Western Research Institute
- A review of the ecological health of the Murrumbidgee River, Living Murray
- Systematic Vegetation Surveys, Upper Hunter Valley
- Environmental investigations and vegetation mapping, DEFCommSTA properties, Dept of Defence
- Vegetation Condition Assessment, Woodlands Historic Park, Melbourne, Parks Victoria
- Flora survey, Riverine Plain (62 sites), DLWC
- Flora survey, Jingellic, Bogandyera and Clarkes Hill Nature Reserves, NPWS
- Flora survey, Wagga Wagga LGA, DEC
- Googong Environmental Investigations for Local Environment Study, Willana Associates
- Gum Swamp Management Plan and Operation and Maintenance Manual, Gum Swamp, DLWC
- Evaluation of 1750 mapping of vegetation by the Riverina Vegetation Committee, NPWS
- Edwin Land Parkway, Queanbeyan, GHD
- Vegetation validation - Narrandera, Ardlethan, Barmedman and Coolamon 1:100,000 Map Sheets, DECCW
- Scoping Report for the Development of a Biodiversity Strategy and Plan for the Rice Industry, Rice Growers Association



Dr Enhua Lee – Senior Field Ecologist – Biometric Plots and threatened flora (now with the Office of Environment and Heritage)



## CURRICULUM VITAE

### Dr Enhua Lee

#### SENIOR ECOLOGIST

#### QUALIFICATIONS

- PhD in Ecology and Wildlife Management. The Ecological Effects of Sealed Roads in Australia's Arid Zone. – 2006
- Bachelor of Advanced Science (First Class Honours). Mitochondrial Adjustments in the Muscles of the Fat-tailed Dunnart, *Sminthopsis crassicaudata*, During Cold Acclimation – 2000
- Accredited BioBanking Assessor (number 176)

Enhua is a Senior Ecologist in the Sutherland office of ELA with a Doctor of Philosophy in wildlife management and over 12 years of experience in environmental research and consulting.

Enhua has extensive practical experience in biodiversity survey and monitoring. As a senior ecologist, Enhua has been involved in planning, establishing and undertaking vegetation and fauna monitoring programs, and baseline flora and fauna surveys. Enhua also has well developed research and analytical skills, and time management and project management skills. She is an effective communicator, as demonstrated through her work in developing biodiversity education programs and her invitations to present her research findings at specialist conferences and to lay audiences. She has trained people in conducting flora and fauna surveys in Australia's rangelands and has published peer-reviewed book chapters and papers in international and national scientific journals.

Since joining Eco Logical Australia in 2007, Enhua has completed work for state and federal government agencies, local councils, as well as private businesses and property owners. She has a sound knowledge of environmental and planning legislation (NSW, VIC and WA State legislation and Commonwealth legislation) and has applied her knowledge to a range of projects. Her work has ranged from completing NSW biocertification, biobanking and ecological impact assessments (NSW and WA) to conducting complex statistical analyses to inform management plans. She has also been involved in numerous monitoring projects, strategic assessments, and has provided high level conservation advice to government agencies.

#### RELEVANT PROJECT EXPERIENCE

##### Biobanking/Biocertification Assessments

- Mt Gilead Biocertification Assessment (Mt Gilead and S. and A. Dzwonnik) (in progress)
- Macarthur-Onslow Mt Gilead Biobank Assessment (in progress)
- Noorumba-Mt Gilead Biobank Assessment (in progress)
- Hardwicke Stage 1 Biobank Assessment (submitted)
- Hardwicke Stage 2 Biobank Assessment (in progress)
- Port Macquarie Airport Biocertification Assessment (Port Macquarie Hastings Council) (in progress)
- Biobank Feasibility Assessments (Noorumba, Simmo's Beach, and Smiths Creek Reserve) (Campbelltown City Council)

**Ecological Constraints / Impact Assessment / Flora and Fauna Survey**

- Rossmore Ecological Constraints Assessment (Stephen Bowers Architects)
- Wilton Flora and Fauna Assessment (Sydney Water)
- Wilton Ecological Constraints Assessment for three sites in Wilton (Sydney Water)
- Gregory Hills Flora and Fauna Assessment of non-certified land (Dart West Developments)
- Denham Court Road Flora and Fauna Assessment (Rawson Communities)
- EPBC Act Strategic Assessment of Procedures and Guidelines (RMS)
- Narrabri Ecological Assessment (Santos)
- Lancelin Defence Training Area Flora and Fauna Survey (Defence) (WA)
- Marandoo East Drilling Flora and Fauna Survey for Native Vegetation Clearing Permit (RTIO) (WA)
- Homestead to Silvergrass Rare Flora Survey (RTIO) (WA)
- Brockman 2 Expansion Flora and Fauna Survey for Native Vegetation Clearing Permit (RTIO) (WA)
- McPhee Creek Environmental Approvals (Atlas Iron) (WA)
- Pilbara Expansion Cumulative Impact Assessment (BHPBIO) (WA)
- Kemerton Industrial Park Gap Analysis and Ecological Surveys (LandCorp) (WA)
- WestBank Ecological Survey and Assessment (LandCorp) (WA)
- Ninga Vertebrate Fauna Survey and Habitat Mapping (BHPBIO) (WA)
- Koodaideri Iron Ore and Infrastructure Project (Public Environmental Review) (Rio Tinto Iron Ore) (WA)
- Carnaby's Cockatoo habitat surveys throughout the south-west of WA (DSEWPac) (WA)
- Warwick Open Space Flora, Fauna and Fungi Survey (City of Joondalup) (WA)
- Edgewater Quarry Flora and Fauna Survey (City of Joondalup) (WA)
- Callawa Vertebrate Fauna Survey (WA Level 2 Fauna Survey) (BHPBIO) (WA)
- Menai Species Impact Statement (Landcom)
- Annangrove Light Industrial Area Flora and Fauna Constraints Assessment (Hills Shire Council)
- Crudine Ridge Wind Farm Ecological Assessment (Part 3A project) (Wind Prospect)
- Narrabri Gas Field Ecological Assessment (Part 3A project) (Eastern Star Gas)
- Beacon Hill Species Impact Statement (The Trustees of the Sisters of the Good Samaritan)
- Pittwater Road Upgrade Flora and Fauna Assessment (City of Ryde)
- Preliminary ecological assessment of Allenby Park (Stage 1) (AMPCI)
- Ecological Assessment of Allenby Park (Stage 2) (AMPCI)
- Ecological Assessment, Proposed Drainage Augmentation, Warringah Mall (AMPCI)
- Glenmore Park Flora and Fauna Assessment (AMPCI)
- Commonwealth BER Flora and Fauna Assessments (Hansen Yunckin)
- Wedderburn Hazard Reduction Flora and Fauna Assessment (Campbelltown Council)
- Stanwell Tops Conference Centre Ecological Assessment (Borst and Conacher Architects)
- Tubbo Farming Grassland Assessment (Tubbo Farming)
- Ecological Impact Assessments – various (Integral Energy)
- Sensitivity Mapping for NW and SW Growth Centre (Sydney Water)
- Western Parklands Ecological Constraints Assessment (DoP)
- Biobanking Pilot Assessments (DECC)
- El Caballo Blanco and Gledswood Rezoning Ecological and Bushfire Assessment (Landcom)
- South Randwick Feasibility Review: Environmental Issues and Constraints (Landcom)
- Whitebridge Constraints Assessment (Landcom)
- Ballanagamang Biobanking Assessment (Ecotrades)
- Fauna Report for the Gap Park Masterplan (Thompson Berril Landscape Design)
- Flora and Fauna Assessment: Compound Sites for Hume Highway Duplication (Leighton Contractors)

**Management Plans**

- Cloudbreak Life of Mine Revegetation Plan and Procedures (Fortescue Metals Group) (WA)
- Sunningdale Vegetation and Fauna Management Plan (Pacific Dunes)
- South Bandiana Landscape Management Plan (Defence)
- North Bandiana Landscape Management Plan (Defence)
- Kapooka Box-Gum Mapping and Monitoring Plan (Defence)
- Cooper Park Management Plan (Woollahra Council)

- SWC Carrier Flora and Fauna Assessment and Management Plan (Water Infrastructure Group)
- Sydney South West Property Environmental and Vegetation Management Plans (Sydney Water)
- Hawkesbury Roadside Vegetation Management Plan (Hawkesbury Council)
- Flying Fox Plan of Management – Parramatta Park (Parramatta Park Trust)
- *Acacia terminalis* Plan of Management – North Head Sewerage Treatment Plant (Sydney Water)
- North Head Sewage Treatment Plant Fire Management Plan (Sydney Water)

#### **Vegetation Community Mapping**

- Kapooka Box-Gum Mapping and Monitoring Plan (Defence)
- Wetland Vegetation Surveys for LiDAR, Lowbidgee and Gwydir wetlands (DECC)
- Molonglo River Vegetation and Habitat Survey and Mapping (ACT Planning)

#### **Ecological Monitoring**

- Drayton Coal Mine Monitoring (Anglo Coal (Drayton Management))
- Bindoon Defence Training Area Annual Monitoring (Defence) (WA)
- Mulgara Trapping, Translocation and Monitoring (Samsung/Roy Hill) (WA)
- Garden Island Weed Monitoring Survey and Assessment (Defence) (WA)
- Lancelin Defence Training Area Rapid Vegetation Monitoring (Defence) (WA)
- Tropicana Gold Mine Vegetation Monitoring (AngloGold Ashanti Australia) (WA)
- Bungaribee *Themeda australis* Relocation Monitoring (Landcom)
- Werris Creek Biodiversity Offset Area Annual Monitoring (Werris Creek Coal)
- Liddell Colliery Flora and Fauna Monitoring (Liddell Coal Operations)
- Kapooka Kangaroo Impact Monitoring (Defence)
- Latchford Barracks Kangaroo Impact Monitoring (Defence)
- Microbat Monitoring, Warringah Mall (AMPCI)
- Metropolitan Colliery Vegetation Monitoring (Metropolitan Colliery)

#### **Ecological Reviews**

- Review of Dunheved Rail Corridor Ecological Assessment and Advice (Lend Lease)
- EPBC Conservation Advice (DEWHA)
- Review of Threatened Species Recovery Plans (DECC)
- Review of DA documents (Ku-ring-gai Council)

#### **Statistical Analyses**

- Vegetation Community Assessment (PATN analysis), Neerabup Industrial Area (Landcorp) (WA)
- Historical Impacts of Linear Infrastructure on Sheetflow-dependent Vegetation Associations (API) (WA)
- Habitat Modelling for Flora and Fauna species in the Gold Coast region (Gold Coast Council)
- Rufous Scrub-bird Monitoring Assessment (DECC)
- Habitat Modelling Pilot for Flora and Fauna Species: Swan Coastal Plain and Jarrah Forest IBRAs (WA DEC)
- Far South Coast Fire Assessment: Effects of Fire on Vegetation Composition (DECC)

#### **Training/Education**

- Biodiversity Awareness Training Course (DECC)
- Part 5 Training Course (Rockdale Council)

#### **Other**

- Ecological Character Description for the Paroo River Wetlands Ramsar Site (DEWHA)
- Information sheet for the Menindee Lakes System (Australian Floodplain Association)
- Flora assessment at Pinaroo Lake in north-western New South Wales (DEWHA)

#### **Biodiversity Survey Experience**

Enhua has conducted surveys in a range of ecosystems, including semi-arid woodlands, shrublands and grasslands, temperate woodlands, forests, rainforests, and grasslands, and alpine woodlands across NSW, and

in parts of Victoria (North east region) and WA (Pilbara, Kimberley, and Goldfields-Esperance regions). This experience has exposed her to a diversity of fauna distributed across these ecosystems.

She is familiar with both active and passive survey techniques, including:

- Terrestrial and arboreal Elliott trapping
- Pitfall trapping
- Cage trapping
- Harp trapping
- Funnel trapping
- Active searches (herpetofauna)
- Bird point and transect census
- 'Distance' transect surveys (for population density estimation)
- Call playback
- Remote camera survey
- Anabat detection
- **Call detection**

### Scientific Publications

Lee, E., Croft, D. B., and Achiron-Frumkin, T. (2015). 'Roads in the Arid Lands: Issues, Challenges and Potential Solutions'. In: Handbook of Road Ecology. van der Ree, R., Smith, D.J. and Grilo, C (eds.). John Wiley & Sons, Oxford. 552 pp. ISBN: 978-1-118-56818-7.

Dawson, T. J., Webster, K. N., Lee, E. and Buttemer, W. A. (2013). 'High muscle mitochondrial volume and aerobic capacity in a small marsupial (*Sminthopsis crassicaudata*) reveals flexible links between energy-use levels in mammals.' *Journal of Experimental Biology*, 216: 1330-1337.

Lee, E., Ramp, D. and Croft, D. B. (2010). 'Flight response as a causative factor in kangaroo-vehicle collisions'. In: *Macropods* (Eds. G. Coulson and M. Eldridge). Surrey Beattie and Sons, Chipping Norton.

Lee, E. and Croft, D. B. (2009). 'The effects of an arid-zone road on vertebrates: Priorities for management?' In: *Too Close for Comfort: Contentious issues in human-wildlife encounters* (Eds. D. Lunney, A. Munn and W. Meikle). The Royal Zoological Society of New South Wales, Mosman.

Lee, E., Klöcker, U., Croft, D. B. and Ramp, D. (2004). 'Kangaroo-vehicle collisions in Australia's sheep rangelands, during and following drought periods'. *Australian Mammalogy*, 26: 215-226

Dawson, T. J., Webster, K. N., Mifsud, B., Raad, E., Lee, E. and Needham, A. D. (2003). 'Functional capacities of marsupial hearts: Size and mitochondrial parameters indicate higher aerobic capacities than generally seen in placental mammals'. *Journal of Comparative Physiology – B*, 173(7): 583-590



**Dr Rodney Armistead – Senior Field Ecologist – threatened fauna****CURRICULUM VITAE****Dr Rodney Armistead****ECOLOGIST****QUALIFICATIONS**

- PhD in Conservation Biology from Murdoch University, Perth Western Australia. The impact of Phytophthora Dieback on the Mardo or Yellow Footed Antechinus (*Antechinus flavipes leucogaster*).
- Bachelor of Advanced Science (Honours), Deakin University, Geelong. A phylo-genetic assessment of Swamp Antechinus (*Antechinus minimus*).

Rodney is an ecologist with a Doctor of Philosophy in Conservation Biology with 14 years' experience in environmental research and consulting. Rodney has considerable experience conducting flora, Phytophthora Dieback, terrestrial and aquatic fauna assessments across a variety of desert, alpine, coastal, woodland, tall forests, aquatic and urban habitats in Western Australia, Victoria, Tasmania and New South Wales. He has particular experience in establishing and conducting large broad scale mammals, reptile, frog as well as bird population, biodiversity and presence-absence surveys. He has had the pleasure of surveying such threatened and iconic native fauna species as the Green and Golden Bell Frog, Growling Grass Frog, Spotted Tree Frog, Striped Legless Lizard, Grassland Earless Dragon, Guthega Skink, Grey-headed Flying-foxes, Western and Northern Quoll, Pilliga Mouse, Southern Brown Bandicoots, Brush-tailed Phascogale, Brush-tailed Bettong, Platypus and the Mountain Pygmy Possum.

**RELEVANT PROJECT EXPERIENCE****Impact assessments and large scale flora and fauna surveys****New South Wales**

- Moxham Quarry, Flora and Fauna Assessment at Moxham Quarry, Northmeade, NSW.
- Bong Bong Road, Flora and Fauna Assessment, West Dapto, NSW
- The Crescent, Flora and Fauna Assessment Helensburgh,
- Bringelly Rd, Flora and Fauna Assessment, Bringelly
- Bingara Gorge, Flora and Fauna Assessment
- Shellharbour wetlands, Flora and Fauna Assessment
- Yennora, Ecological Constraints Assessment
- Calvary, Ecological Constraints Assessment, Victoria Road, Ryde

**Western Australia and Christmas Island**

- Busselton Flora and Fauna Assessment, Western Australia.
- Pinjarra urban growth Flora and Fauna Assessment, Western Australia.
- Flora and Fauna Assessment at Mount Gibson, Western Australia.
- Pilbara Fauna Assessment, Western Australia. (Fortescue Metals)
- Murchison Flora and Fauna Assessment, Western Australia.
- Great Victoria Desert Flora and Fauna Assessment, Western Australia.
- Spring vegetation surveys in rehabilitated bauxite mine pits.
- Seasonal hydrological changes in areas where bauxite mining and habitat rehabilitation has occurred. (Alcoa World Alumina)
- Stream monitoring in areas where bauxite mining and habitat rehabilitation has occurred. (Alcoa World Alumina)

- Habitat use by small mammals, reptiles and frogs in rehabilitated bauxite mine pits. (Alcoa World Alumina)
- Impact of fibrinol baiting for yellow-crazy ants on Christmas Island's native invertebrates and waterways. (Christmas Island National Parks).

#### Victoria

- Manor Lakes Flora and Fauna Assessment, Victoria. (Urban Growth Authority)
- Stella Property Flora and Fauna Assessment, Victoria. (Urban Growth Authority)
- Rye Flora and Fauna Assessment, Victoria. (Urban Growth Authority)
- Flinders St, Rye Flora and Fauna Assessment, Victoria. (Department of Education)
- Preliminary Flora, Fauna and geomorphic Assessment at Grantville, Victoria. (Melbourne Water)
- Rockbank Golden Grass Frog and Golden Sun Moth Surveys, Victoria. (Victorian Urban Growth Authority)
- Port Campbell gas pipeline alignment Flora and Fauna Assessment, Victoria.
- Melbourne/Geelong water pipeline Fauna Assessments, Victoria (Abigroup, Melbourne Water and Barwon Water).

#### Targeted Species Surveys and Ecological Monitoring

##### New South Wales

- Migratory shorebirds and Waders at Cronulla and Kurnell.
- Green and Golden Bell Frog Surveys at Cronulla, Kurnell, Enfield, Port Kembla and Sydney Olympic Park.
- Long-nosed Bandicoot, Inner Western Sydney threatened Population
- Guthega Skink Surveys. Perisher
- Pilliga Mouse surveys in the Pilliga State Forest
- Spot-tail Tiger Quoll surveys in Pilliga State Forest
- New Holland Mouse Surveys in the Pilliga State Forest
- Spot-tail Quoll, Eastern Pygmy Possum, Southern Brown Bandicoot, Giant Burrowing Frog and Broad Headed Snake surveys at Coalcliff
- Grey-headed Flying-fox camp static and fly-out population assessments at Kareela, Cannes, Parramatta River, Burnt Bridge Creek (Manly) and Wolli Creek Camps
- Grey-headed Flying-fox - preparation of management plans for Kareela, Cannes, Parramatta River, Burnt Bridge Creek (Manly) and Wolli Creek Camps
- Grey-headed Flying-fox – assistance and guidance with the preparation of the dispersal plan for the Kareela GHFF camp
- Grey-headed Flying-fox – Vegetation Management Plan for the Centennial Park Flying-fox Camp
- Microchiropteran bat harp-net live capture at Lake Keepit and a Kellyville culvert
- Microchiropteran bat anabat recording and data interpretation at Sydney, Wollongong, Lake Keepit, Mudgee and Newcastle

##### Western Australia

- Dibbler surveys on Boulanger and Whitlock Islands (University of Western Australia)
- Woylies or Brush-tail Bettong surveys in the southern Jarrah Forest and Dryandra Woodlands (Murdoch University)
- Southern Brown Bandicoot and Brush-tail Phascogale surveys in urban Busselton
- Northern Quoll, Pebble-Mound Mouse and Mulgara surveys in the central and southern parts of the Pilbara (Fortescue Metals and BHP)
- Mulgara, Sandhill Dunnart, Long-tailed Dunnart and Marsupial Mole surveys in the Great Victoria Desert (ecologia, Western Australia Museum and Department of Environment and Sustainability (DSE))

#### Victoria

- The distribution of Swamp Antechinus in the eastern Otway Ranges. (Deakin University)
- The distribution of Swamp Antechinus on Greater Glennie Island, Bass Strait (Deakin University)
- The distribution of New Holland Mouse at Anglesea and Wilson's Promontory
- The distribution and status of Mountain Pygmy-possums on Mount Buller, Mount Hotham and Bogong High Plains. (Parks Victoria).
- Spotted Tree Frog surveys in north-eastern Victoria (Parks Victoria).
- Platypus surveys in Melbourne's urban Melbourne's urban waterways (Melbourne Water)
- Modified gill net platypus surveys in the Wimmera region. (Project Platypus and Wimmera Catchment Management Authority)
- Platypus surveys in the Mackenzie River, Grampians National Park. (Wimmera Catchment Management Authority)
- Growling Grass Frog surveys in the urban growth areas of Werribee, Cranbourne and outer Melbourne.
- Plains Wanderer surveys in the urban growth areas of Werribee.
- Golden Sun Moth surveys in the urban growth areas of Werribee, Cranbourne and outer Melbourne.
- Micro-bat anabat recording surveys in the urban growth areas of Werribee, Cranbourne and outer Melbourne

- Striped Legless Lizard surveys in the urban growth areas of Melbourne.
- Grassland Earless Dragon surveys in the urban growth areas of Werribee
- Dwarf Galaxias surveys in urban waterways of the Mornington Peninsula, Melbourne.
- Dwarf Galaxias relocation surveys in urban waterways of the Mornington Peninsula, Melbourne.
- Broad Toothed Rat surveys in areas impacted by the Black Saturday Fires
- The distribution of Shearwater and Little Penguin nests and reproductive success on Phillip Island (Phillip Island National Park)

## Publications

### Western Australia

- Dunstan, W. A., Rudman, T. Shearer, B. L., Moore, N. A., Paap, T., Calver, M. C., Armistead, R. Dobrowolski, M. P., Morrison, B., Howard, K., O'Gara, E., Crane, C., Dell, B., O'Brien, P., McComb, J. A., and Hardy, G. E. St J. (2008) Research into natural and induced resistance in Australian native vegetation of *Phytophthora cinnamomi* and innovative methods to contain and/or eradicate within localised incursions in areas of high biodiversity in Australia. Eradication of *Phytophthora cinnamomi* from spot infections in native plant communities in Western Australia and Tasmania. Prepared by the Centre for Phytophthora Science and Management for the Australia Government Department of the Environment, Water, Heritage and the Arts.

### Victoria

- Cahill, D. M., Wilson, B. A., and Armistead, R. J. (2001). Dieback assessment at Fairhaven Ridge, Ganghook – Lorne State Park, Victoria. A report to Parks Victoria.
- Cahill, D. M., Wilson, B. A., and Armistead, R. J. (2001). Assessment of *Phytophthora cinnamomi* (cinnamon fungus) at Coalmine Road, Anglesea Alcoa lease, Victoria. As report for Alcoa World Alumina, Anglesea.
- Cahill, D. M., Wilson, B. A., and Armistead, R. J. (2001). Assessment of *Phytophthora* dieback, *Phytophthora cinnamomi* in the Otway National Park, Victoria. A report for Parks Victoria for the Great Ocean Walk.
- The distribution of platypus in waterways in greater Melbourne: spring 2008 and autumn 2009 survey results. A report prepared by Dr. R. Armistead and Dr. A Weeks for Melbourne Water (2009).
- The distribution of platypus in waterways in greater Melbourne: spring 2009 and autumn 2010 survey results. A report prepared by Dr. R. Armistead and Dr. A Weeks for Melbourne Water (2009).
- The distribution of platypus in waterways in the McKenzie River, Grampians National Park 2008 and 2009 survey results. A report prepared by Dr. R. Armistead and Dr. A Weeks for Wimmera Catchment Management Authority (2009).
- The Mount Hotham Mountain Pygmy Possum Recovery Plan (Biosis Research, Mount Buller and Mount Stirling Alpine Resort Management Board and Parks Victoria)

### New South Wales

- Eco Logical Australia (2012). Cannes Reserve, Avalon – Grey-headed Flying-fox camp Management and Species Impact Statement. A report to Pittwater Council
- Eco Logical Australia (2013). Kareela Grey-headed Flying-fox camp management plan. A report to Sutherland Shire City Council
- Eco Logical Australia (2013). Parramatta River Grey-headed Flying-fox camp management plan. A report to NPC Consultants
- Eco Logical Australia (2015). Wolli Creek - Grey-headed Flying-fox camp management plan. A report to Rockdale City Council
- Eco Logical Australia (2015). Burnt Bridge Creek - Grey-headed Flying-fox camp management plan. A report to Manly City Council

### Memberships

- Australasian Bat Society.
- Foundation for Australia's Most Endangered Species Ltd

**Belinda Failes – Field Ecologist – Vegetation mapping and biometric plots****CURRICULUM VITAE****Belinda Failes****ECOLOGIST****QUALIFICATIONS**

- Master of Wildlife Management (Macquarie University)
- Bachelor of Environmental Science, (University of Newcastle)
- Senior First Aid Certificate
- OHS Construction Induction Certificate – White Card
- Rail Industry Safety Induction (RISI) Card
- Working at heights
- Tree Rescue training
- Basic Tree Climbing training

Belinda has been working as an ecologist with Eco Logical Australia since 2011, and has been involved in the monitoring of, and preparation of reports for, threatened flora and endangered ecological communities, as well as the preparation of Vegetation Management Plans (VMP), Part 3A and Section 5A Assessments under the EP&A Act, Local Environment Studies, and Species Impact Statements (SIS).

Belinda has built on the skills she learned while studying a Master of Wildlife Management at Macquarie University through on-going professional development, and is skilled in both flora and fauna identification.

**RELEVANT PROJECT EXPERIENCE****Biobanking and BioCertification**

- Mount Gilead rezoning Biocertification
- Teralba Quarry Biobanking
- Ingleside rezoning Biocertification

**Flora and Fauna Impact Assessments**

- Bunya, Doonside, flora and fauna field work
- National Broadband Network ISEPP and DA approvals
- ITS for Sydney Water REF
- Water Infrastructure Group REF
- Jet Strike Fighters EIS - ecological impacts literature review
- Bunya, Doonside Themeda - relocation monitoring project (field work)
- South West Growth Centres - translocation of Cumberland Plain Land Snail
- North West Rail Link - ecological assessment (field work)
- Moxham Quarry, Northmead, impact assessment
- Schofield Road, Alex Avenue Precinct - impact assessment
- North Narrabeen Dunes, NSW - impact assessment
- Curl Curl Off-leash Dog Park Proposal - impact assessment
- Kilcare Rd, Blacktown - impact assessment
- Harbord Diggers - ecological constraints and impact assessment
- Metropolitan Colliery Vegetation Monitoring (field work)
- Hamlyn Terrace – ecological constraints and impact assessment

- Greta Freight Train Upgrade, Greta - pre-clearance surveys
- Withers Rd, Kellyville, impact assessment
- Schofields Defence Housing Association
- Wolgan Valley Road – Cranbrook School
- St Leonards Plaza
- Jemena gas pipeline
- Woolahra Biodiversity Management Plan – field work

#### **Vegetation Management Plans**

- Bunya, Doonside Landscaping DA
- Richmond Road Upgrade, Marsden Park, RMS
- The Hills Shire Council Weed Management Plan
- Hills M2 Corridor Weed Management Plan
- Edmondson Park Development
- Schofields Defence Housing Association
- Glenfield Stage 3
- Campbelltown Comprehensive Koala Plan of Management – field work

#### **Monitoring Field Work**

- Moolarben Mine Monitoring – flora and fauna monitoring
- Wivenhoe Bird Monitoring

#### **Relocation**

- Bunya Cumberland Plain Land Snail
- South West Growth Centres - translocation of Cumberland Plain Land Snail

#### **Pre-clearance Surveys**

- Hamlyn Terrace
- Greta Freight Train Upgrade, Greta
- Tomago industrial development
- M5 surreys

#### **Constraints Assessment**

- Menangle Park Wastewater
- Harbord Diggers
- Wolgan Valley Road – Cranbrook School



## Joanne Daly - Mapping and area calculations (on secondment to Illawarra Local Land Services)



## CURRICULUM VITAE

**Joanne Daly****GIS OFFICER AND ENVIRONMENTAL SCIENTIST****QUALIFICATIONS**

- Bachelor of Environmental Science (Honours)
- Attended the BioBanking Assessor Accreditation training Course, TAFE NSW and DECCW

Joanne joined the Eco Logical Australia team full-time in September 2008 after completing a Bachelor of Environmental Science (Honours) at the University of Wollongong. Jo has worked on mapping wetlands in the Namoi catchment, refining the Mitchell Landscapes data layer and other projects that have required GIS for analysis and mapping.

Jo has a multidisciplinary background with focuses in GIS and geomorphology. She has a range of GIS skills including: map production; vectorisation; and digitizing. She is also able to utilize GIS to determine the inputs for the BioBanking Credit Calculator for a BioBanking Assessment.

**RELEVANT PROJECT EXPERIENCE**

## GIS Editing and Analysis:

- Natural Asset Management for Urban Waterways Baulkham Hills Shire Council
- Namoi CMA Wetland mapping Namoi Catchment Management Authority
- Liverpool Plains Biodiversity Strategy
- Mainland Islands Conservation Status Prioritisation
- Hunter Councils API Vectorisation
- Regionally Significant Riparian Corridors Assessment
- Species Habitat Modelling for Gold Coast City Council
- Strathfield Local Environmental Plan and Zoning Update
- Sydney Metro CMA Land Use Mapping
- Whitehaven Regional Biodiversity Offset

## BioBanking Assessments and Biodiversity Offset Calculations:

- Strategic Biodiversity Offsets Overview for Cockatoo Coal Ltd
- Brownlow Hill Biobank Site
- Darkinjung Land Council Biobank Agreement Assessment
- Liddell Colliery Expansion

## Plans of Management and Masterplans:

- Queanbeyan River Corridor Plan of Management
- Wongawallan Management Plan
- Bonogin Conservation Reserves Management Plan
- Bidjigal Reserve Plan of Management
- Middle Creek Management Plan
- Dunbar Park Plan of Management

## Dr Deanne Hickey - Mapping and area calculations



## CURRICULUM VITAE

**Deanne Hickey****GIS ANALYST****QUALIFICATIONS**

- Bachelor Science (Marine Science Honours 1) University of Sydney
- Master of Science (Research) Inundation modelling of coastal wetland communities to identify coastal wetland communities vulnerable to predicted sea level rise
- PhD Candidate (current) Benefits of a Bayesian approach to land use modelling

Deanne is a GIS Analyst with experience in landscape mapping, spatial modelling, multi-criteria analysis, high quality map production, spatial data collection and quantitative analysis. Deanne is experienced using big data for spatial analysis and is competent across various platforms.

Deanne is based in the Sutherland Office and works on a variety of projects from Biobanking, restoration ecology, bushfire, planning and ecology disciplines. Previously she has worked in an academic environment, most recently at the University of Sydney on a Rural Industry Research and Development Corporation (RIRDC) funded project. This research project investigated spatial trends emerging from the aggregation and subdivision of rural land holdings across Australia.

**RELEVANT PROJECT EXPERIENCE****Aboriginal and Cultural Heritage**

Boundary Road Aboriginal Archaeological Due Diligence Assessment  
 Camden Lakeside and Gledswood Aboriginal Archaeological Assessment  
 Raby Road Leppington Heritage Impact Statement

**Arborist Assessment**

West Connex Arborist Assessment  
 Heathcote Station Arborist Assessment  
 Penrith Station Arborist Assessment

**Biobanking and Biocertification Assessment**

Sapphire Windfarm Biodiversity Offset Strategy  
 Windermere Biobank Assessment  
 Rockview South Biobank Assessment  
 White Rock Wind Farm Offset Package and Biobank Assessment  
 Mt Gilead Stage 1 Biocertification Assessment  
 Governors Hill Biocertification Assessment

**Bushfire**

FNAP Bushfire Attack Level (BAL) Identification (Newcastle to Nowra)  
 Jordon Springs Stage 1 BAL certificates  
 Box Hill Stage 1, 2 & 3 BAL mapping and BAL certificates  
 Willowdale Bushfire Emergency and Evacuation Plan  
 ANSTO Preliminary Design Advice – Bushfire Constraints

Oran Park Bushfire Prone Land Mapping Update  
Catherine Park Bushfire Prone Land Mapping Update  
Woorong Park Bushfire Protection Assessment

**Ecological Assessment**

Boundary Road Review of Environmental Factors  
Blacktown Workers Club Flora and Fauna Assessment  
West Belconnen Project – Heath Goanna Habitat Assessment  
Parramatta North Urban Transformation – Ecological Assessment  
Scarborough Ponds Review of Environmental Factors  
West Dapto Flora and Fauna Assessment

**Planning and Assessment**

Sutherland to Cronulla Active Transport Link  
Sydney Drinking Water Catchment Audit  
Eurobodalla Flying-fox Management Plan  
Wolli Creek GHFF Management Plan

**Restoration Ecology**

Riley's Creek Riparian Corridor Vegetation Management Plan  
Environmental Management, Avon Road, Pymble  
Alex Ave, Schofields Vegetation Management Plan  
M2 Vegetation Management Plan Update  
El Caballo Golf Course Vegetation Management Plan Implementation  
Little Bay Wetland Regeneration and Weed Control

## Appendix B: Planning proposal application

Provided as a separate document

# Appendix C: Threatened species likelihood tables and assessment of candidate species

The table below lists the threatened species known or considered likely to occur within the BCAA based on previous surveys, Atlas, EPBC Act Protected Matters Search, Biodiversity certification credit calculator tool and/or expert opinion. Those species categorised as ‘species credit’ species (all threatened flora species and approximately half of all threatened fauna species) that were filtered into the BCAA by the biocertification credit calculator version 1.9 and validated as species credit species against the threatened species profile ecological data from the BioNet Atlas of NSW Wildlife (Step 1 of section 4.3 of the BCAM) are indicated. At this stage of the candidate species assessment, additional species are added to the list if they have been recently listed in the TSC Act, there are records on the Atlas or have been recorded in past ecological surveys/reports (Step 2 of section 4.3 of the BCAM). A Wildlife Atlas search was undertaken by ELA on 23<sup>rd</sup> April 2015 to identify any additional species to be added to the table.

The ‘Likelihood’ and ‘Justification’ columns justifies the culled list of candidate species for further assessment and the ‘Additional survey required’ indicates whether additional survey is required to complete a formal Biocertification assessment (Step 3 of section 4.3 of the BCAM).

Five categories for likelihood of occurrence of species are used in this report and are defined below. Assessment of likelihood was based on species’ locality records, presence or absence of suitable habitat features within the BCAA, results of previous studies, on site field surveys and professional judgement.

- **known/yes** - the species is known to occur within suitable habitat within the BCAA.
- **likely** - a medium to high probability that a species occupies or uses habitat within the BCAA.
- **potential** - suitable habitat for a species occurs within the BCAA, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur.
- **unlikely** - a very low to low probability that a species occupies or uses habitat within the BCAA.
- **no** - habitat within the BCAA and in the immediate vicinity is unsuitable for the species, or, in the case of plants, the species was not located during searches of the BCAA.

TSC/EPBC Act Status

- CE = Critically Endangered species, population or ecological community.
- E = Endangered species, population (E2) or ecological community (E3).
- V = Vulnerable species, population or ecological community.



## Threatened flora

Scientific name	Common name	TSC Act	EPBC Act	Data source	Habitat association	Recorded on site	Likelihood	Justification	Additional survey required
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	BCAM, Atlas, PMST	<i>Acacia bynoeana</i> is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains, and has recently been found in the Colymea and Parma Creek areas west of Nowra. It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (OEH 2015d).	No	No	No suitable habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Acacia pubescens</i>	Downy Wattle	V	V	BCAM	<i>Acacia pubescens</i> occurs on the NSW Central Coast in Western Sydney, mainly in the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. It is associated with Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest growing on clay soils, often with ironstone gravel (OEH 2015d).	No	No	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Allocasuarina glareicola</i>		-	E	PMST	<i>Allocasuarina glareicola</i> is primarily restricted to the Richmond district on the north-west Cumberland Plain, with an outlier population found at Voyager Point. It grows in Castlereagh woodland on lateritic soil (OEH 2015d).	No	No	No habitat present and outside known range.	No
<i>Asterolasia elegans</i>		E	E	PMST	<i>Asterolasia elegans</i> is restricted to a few localities on the NSW Central Coast north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs. It is found in sheltered forests on mid- to lower slopes and valleys, in or adjacent to gullies (OEH 2015d).	No	No	No habitat present and outside known range.	No
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E	V	PMST	<i>Caladenia tessellata</i> occurs in grassy sclerophyll woodland, often growing in well-structured clay loams or sandy soils south from Swansea, usually in sheltered moist places and in areas of increased sunlight. It flowers from September to November (OEH 2015d).	No	No	Outside known range	No
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	PMST	<i>Cryptostylis hunteriana</i> is known from a range of vegetation communities including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum ( <i>Eucalyptus sclerophylla</i> ), Silvertop Ash ( <i>E. sieberi</i> ), Red Bloodwood ( <i>Corymbia gummifera</i> ) and Black Sheoak ( <i>Allocasuarina littoralis</i> ); where it appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid ( <i>C. subulata</i> ) and the Tartan Tongue Orchid ( <i>C. erecta</i> ). Coastal Plains Scribbly Gum Woodland and Coastal Plains Smoothed-barked Apple Woodland is potential habitat on the Central Coast. Flowers between November and	No	No	No suitable habitat present.	No

Scientific name	Common name	TSC Act	EPBC Act	Data source	Habitat association	Recorded on site	Likelihood	Justification	Additional survey required
					February, although may not flower regularly (OEH 2015d).				
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	BCAM, PMST	<i>Cynanchum elegans</i> is a climber or twiner with a variable form, and flowers between August and May, peaking in November. It occurs in dry rainforest gullies, scrub and scree slopes, and prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest. The species has also been found in littoral rainforest; <i>Leptospermum laevigatum</i> – <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; <i>Eucalyptus tereticornis</i> open forest/ woodland; <i>Corymbia maculata</i> open forest/woodland; and <i>Melaleuca armillaris</i> scrub to open scrub (OEH 2015d).	No	No	No suitable habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Dillwynia tenuifolia</i>		V		BCAM	The core distribution is the Cumberland Plain from Windsor and Penrith east to Dean Park near Colebee. Other populations in western Sydney are recorded from Voyager Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. In western Sydney, may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays (OEH 2015d).	No	No	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Epacris purpurascens</i> var. <i>purpurascens</i>		V		BCAM	Found in a range of habitat types, most of which have a strong shale soil influence (OEH 2015d).	No	No	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V	BCAM	<i>Eucalyptus benthamii</i> occurs in wet open forest on well drained sandy alluvial soils along stream channels, small terraces and alluvial flats on valley floors (OEH 2015d).	No	No	No suitable habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	V	-	PMST	Known from coastal areas from northern Sydney south to the Nowra district. Previous records from the Hunter Valley and Nelson Bay are now thought to be erroneous. Grows in shrubby woodland in open forest on shallow sandy soils (OEH 2015d).	No	No	No suitable habitat present.	No
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaf Grevillea	V		BCAM	Endemic to Western Sydney. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels. Recorded from Cumberland Plain	No	No	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016

Scientific name	Common name	TSC Act	EPBC Act	Data source	Habitat association	Recorded on site	Likelihood	Justification	Additional survey required
					Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest (OEH 2015d).				undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	BCAM, Atlas, PMST	<i>Grevillea parviflora</i> subsp. <i>parviflora</i> is sporadically distributed throughout the Sydney Basin mainly around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie and Cessnock and Kurri Kurri. It grows in sandy or light clay soils over thin shales, often with lateritic ironstone gravels. It often occurs in open, slightly disturbed sites such as tracks (OEH 2015d).	No	No	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b).  Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Grevillea parviflora</i> subsp. <i>supplicans</i>		E		BCAM	Has a very restricted known distribution (approximately 8 by 10 km) and is confined to the north-west of Sydney near Arcadia and the Maroota–Marramarra Creek area, in Hornsby and Baulkham Hills LGAs. Occurs in heathy woodland associations on skeletal sandy soils over massive sandstones (OEH 2015d).	No	No	Outside range and no suitable habitat present.	No. Already surveyed for by ELA (2014 2015a and b).  Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Gyrostemon thesioides</i>		E		BCAM	Within NSW, has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers. Grows on hillsides and riverbanks and may be restricted to fine sandy soils (OEH 2015d).	No	No	Outside range and no suitable habitat present.	No. Already surveyed for by ELA (2014 2015a and b).  Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Wingless Raspwort	V	V	PMST	Square Raspwort occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. It appears to require protected and shaded damp situations in riparian habitats (OEH 2015d).	No	No	No suitable habitat present.	No
<i>Hibbertia</i> sp. <i>Bankstown</i>		CE	CE	BCAM	This species is endemic to New South Wales and is currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs, in the Bankstown LGA (OEH 2015d).	No	No	Outside of range.	No
<i>Hibbertia superans</i>		E		BCAM	Occurs from Baulkham Hills to South Maroota in the northern outskirts of Sydney, where there are currently 16 known sites. The species occurs on sandstone ridgetops often near the shale/sandstone boundary (OEH 2015d).	No	No	Outside of range and marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b).  Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Hypsela sessiliflora</i>		E	Ex	BCAM	Currently known from only two adjacent sites on a single private property at Erskine Park in the Penrith LGA. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial	No	No	Outside of range.	No

Scientific name	Common name	TSC Act	EPBC Act	Data source	Habitat association	Recorded on site	Likelihood	Justification	Additional survey required
					woodland and an alluvial woodland/shale plains woodland ecotone (OEH 2015d).				
<i>Leucopogon exolasius</i>	Woronora Beard-heath	V	V	Atlas, PMST	<i>Leucopogon exolasius</i> is found along the upper Georges River area and in Heathcote National Park. It is associated with Sydney Sandstone Gully Forest on rocky hillsides and creek banks (OEH 2015d).	No	No	No suitable habitat present.	No
<i>Leucopogon fletcheri</i> subsp. <i>fletcheri</i>		E		BCAM	Restricted to north-western Sydney between St Albans in the north and Annangrove in the south, within the local government areas of Hawkesbury, Baulkham Hills and Blue Mountains. Occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs (OEH 2015d).	No	No	Outside range and marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	BCAM, Atlas, PMST	Found in heath on sandstone, and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soils (OEH 2015d).	No	No	No suitable habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Pelargonium</i> sp. <i>striatellum</i>	Omeo's Stork's Bill	E	E	PMST	The species is known to occur in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. It is not known if the species' rhizomes and/or soil seedbank persist through prolonged inundation or drought (OEH 2015d).	No	No	No suitable habitat present.	No
<i>Persicaria elatior</i>	Knotweed	V	V	BCAM	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance (OEH 2015d).	No	No	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Persoonia bargoensis</i>	Bargo Geebung	E	V	BCAM, PMST	Associated with woodland to dry sclerophyll forest, on sandstone and clayey laterite on heavier, well-drained, loamy, gravelly soils of the Hawkesbury Sandstone and Wianamatta Shale in the catchments of the Cataract, Cordeaux and Bargo Rivers (OEH 2015d).	No	Unlikely	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	BCAM, Atlas, PMST	<i>Persoonia hirsuta</i> occurs from Singleton in the north, south to Bargo and the Blue Mountains to the west. It grows in dry sclerophyll eucalypt woodland and forest on sandstone (OEH 2015d).	No	No	No suitable habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).

Scientific name	Common name	TSC Act	EPBC Act	Data source	Habitat association	Recorded on site	Likelihood	Justification	Additional survey required
<i>Persoonia nutans</i>	Nodding Geebung	E	E	BCAM	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained. Endemic to the Western Sydney (OEH 2015d).	No	No	No suitable habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	BCAM, PMST	<i>Pimelea curviflora</i> var. <i>curviflora</i> is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. It grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (OEH 2015d).	No	Unlikely	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	BCAM, PMST	In western Sydney, <i>Pimelea spicata</i> occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale. It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines. Has been located in disturbed areas that would have previously supported CPW (OEH 2015d).	No	Unlikely	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Pomaderris brunnea</i>	Rufous Pomaderris	V	V	Atlas, PMST	<i>Pomaderris brunnea</i> occurs in a limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. It also occurs near Walcha on the New England tablelands and in far eastern Gippsland in Victoria It grows in moist woodland or forest on clay or alluvial soils of floodplains and creek lines (OEH 2015d).	No, although found to the west in Stage 2 Mt Gilead along creek	No	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E	E	BCAM, PMST	Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where <i>Pterostylis saxicola</i> occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated (OEH 2015d).	No	No	No suitable habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Pultenaea pedunculata</i>	Matted Bush-pea	E	-	BCAM, Atlas	In NSW, <i>Pultenaea pedunculata</i> is known from three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn. It grows in woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area (OEH 2015d).	No	No	Marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b). Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).



Scientific name	Common name	TSC Act	EPBC Act	Data source	Habitat association	Recorded on site	Likelihood	Justification	Additional survey required
<i>Streblus pendulinus</i>	Siah's backbone	-	E	PMST	On the Australian mainland, Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest (OEH 2015d).	No	No	No suitable habitat present.	No
<i>Tetralthea glandulosa</i>		V		BCAM	Restricted to Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong LGAs. Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone (OEH 2015d).	No	No	Outside known range and marginal habitat present.	No. Already surveyed for by ELA (2014 2015a and b).  Also not recorded during additional survey in 2015 and 2016 undertaken for this biocertification assessment ( <b>Figure 8</b> ).
<i>Thesium australe</i>	Austral Toadflax	V	V	PMST	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast (OEH 2015d).	No	No	Outside known range.	No
<i>Thelymitra</i> sp. Kangaloon	Kangaloon Sun-orchid	CE	CE	PMST	<i>Thelymitra</i> sp. <i>Kangaloon</i> is only known to occur on the southern tablelands of NSW in the Robertson / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is thought to be a short-lived perennial, flowering in late October and early November. It is found in swamps in sedgeland over grey silty grey loam soils. It is known to occur at three swamps that are above the Kangaloon Aquifer, and that are a part of the ecological community "Temperate Highland Peat Swamps on Sandstone" which is listed under the EPBC Act.	No	No	Outside known range.	No

## Threatened fauna

Group	Scientific name	Common name	TSC Act	EPBC Act	Data Source	BCAM credit	Habitat association	Likelihood	Justification	Additional survey required
Invertebrate	<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	-	BCAM, Atlas	Species	Associated with open eucalypt forests, particularly Cumberland Plain Woodland. Found under fallen logs, debris and in bark and leaf litter around the trunk of gum trees or burrowing in loose soil around clumps of grass. Urban waste may also form suitable habitat (OEH 2015d).	Unlikely	Despite records across Appin Road and in Noorumba Reserve, no leaf litter accumulation present	No. Habitat assessed by ELA (2014) as unsuitable
Amphibian	<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Atlas, PMST	Species	Forages in woodlands, wet heath, dry and wet sclerophyll forest. Associated with semi-permanent to ephemeral sand or rock based streams, where the soil is soft and sandy so that burrows can be constructed (OEH 2015d).	No	No suitable habitat present	No
Amphibian	<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	BCAM, PMST	Species	This species has been observed utilising a variety of natural and man-made waterbodies such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water. Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading. Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–Typha sp. and spikerushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable. Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish ( <i>Gambusia holbrooki</i> ) (OEH 2015d).  Recorded at Birwiri Creek, 7km to north of BCAA, in 2015	Unlikely	No suitable habitat present	No. All potential habitat surveyed and species not recorded ( <b>Appendix H</b> ).
Amphibian	<i>Litoria littlejohnii</i>	Littlejohn's Tree Frog	V	V	PMST	Species	Littlejohn's Tree Frog occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. It appears to be restricted to sandstone woodland and heath communities at mid to high altitude (OEH 2015d).	No	No suitable habitat present	No
Amphibian	<i>Litoria raniformis</i>	Southern Bell Frog	E	V	PMST	Not listed in Bionet	Relatively still or slow-flowing sites such as billabongs, ponds, lakes or farm dams, especially where Typha sp., Eleocharis sp. and Phragmites sp. (Bulrushes) are present. This species is common in lignum shrublands, black box and River Red Gum woodlands, irrigation channels and at the periphery of rivers in the southern parts of NSW. This species occurs in vegetation types such as open grassland, open forest and ephemeral and permanent non-saline marshes and swamps. Open grassland and ephemeral permanent non-saline marshes and swamps have also been associated with this species (OEH 2015d).	No	No suitable habitat present	No
Amphibian	<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		Atlas	Species	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings (OEH 2015d).	No	No suitable habitat present	No

Group	Scientific name	Common name	TSC Act	EPBC Act	Data Source	BCAM credit	Habitat association	Likelihood	Justification	Additional survey required
Reptile	<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Atlas, PMST	Species	Typical sites consist of exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin. They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (OEH 2015d).	No	No suitable habitat present	No
Reptile	<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V	-	BCAM, Atlas	Species	Associated with Sydney sandstone woodland and heath land. Rocks, hollow logs and burrows are utilised for shelter (OEH 2015d).	No	No suitable habitat present	No. Already surveyed for by ELA (2014)
Birds	<i>Anthochaera phrygia</i>	Regent Honeyeater	E	E & M	BCAM, PMST	Species	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak ( <i>Casuarina cunninghamiana</i> ). Areas containing Swamp Mahogany ( <i>Eucalyptus robusta</i> ) in coastal areas have been observed to be utilised. The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes. As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (OEH 2015d).	Unlikely	Marginal habitat present	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Botaurus poiciloptilus</i>	Australasian Bittern	V	-	PMST	Species	Terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats. Reedbeds, swamps, streams, estuaries (OEH 2015d).	No	No suitable habitat present	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	BCAM	Ecosystem	Associated with dry open woodland with grassy areas, dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland. Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy. Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed in lightly disturbed (OEH 2015d).	No	No suitable habitat present	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	BCAM, Atlas	Ecosystem	During summer in dense, tall, wet forests of mountains and gullies, alpine woodlands. In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages. They sometimes inhabit woodland, farms and suburbs in autumn/winter (OEH 2015d).	No	No suitable habitat present	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V	-	Atlas	Ecosystem	Associated with a variety of forest types containing Allocasuarina species, usually reflecting the poor nutrient status of underlying soils. Intact drier forest types with less rugged landscapes are preferred. Nests in large trees with large hollows (OEH 2015d).	No	No suitable habitat present	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	BCAM, Atlas	Ecosystem	Distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. The Brown Treecreeper occupies eucalypt woodlands, particularly open woodland lacking a dense understorey. It is sedentary and nests in tree hollows within permanent territories (OEH 2015d).	Unlikely	Marginal habitat present	No. Bird surveys already undertaken by ELA (2014)

Group	Scientific name	Common name	TSC Act	EPBC Act	Data Source	BCAM credit	Habitat association	Likelihood	Justification	Additional survey required
Birds	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	BCAM, Atlas	Ecosystem	Distribution includes most of mainland Australia except deserts and open grasslands. Prefers eucalypt forests and woodlands with rough-barked species, or mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods from bark, dead branches, or small branches and twigs (OEH 2015d).	Unlikely	Marginal habitat present	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	PMST	Species	Habitat is characterised by dense, low vegetation and includes sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest, as well as open woodland with a heathy understorey. In northern NSW occurs in open forest with tussocky grass understorey. All of these vegetation types are fire prone, aside from the rainforest habitats utilised by the northern population as fire refuge. Age of habitat since fires (fire-age) is of paramount importance to this species; Illawarra and southern populations reach maximum densities in habitat that has not been burnt for at least 15 years; however, in the northern NSW population a lack of fire in grassy forest may be detrimental as grassy tussock nesting habitat becomes unsuitable after long periods without fire; northern NSW birds are usually found in habitats burnt five to 10 years previously (OEH 2015d).	No	No suitable habitat present	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	Atlas	Species	Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands floodplains. Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains (OEH 2015d).	No	No suitable habitat present	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	BCAM, Atlas	Ecosystem	In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes (OEH 2015d).	Recorded	Recorded by ELA (2014)	No as already recorded and an ecosystem species
Birds	<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	BCAM, Atlas	Ecosystem	Utilises open eucalypt, sheoak and acacia forest, woodland or open woodland. Uses tall trees for nesting, with a large stick nest being built. Lays eggs in spring, and young fledge in early summer. Preys on birds, reptiles and mammals, and occasionally feeds on large insects or carrion (OEH 2015d).	Potential	Suitable habitat present	No. Bird surveys already undertaken by ELA (2014) and species is an ecosystem species
Birds	<i>Lathamus discolor</i>	Swift Parrot	E	E	BCAM, Atlas, PMST	Ecosystem	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts. Hence, in this region, autumn and winter flowering eucalypts are	Potential	Suitable habitat present	No. Bird surveys already undertaken by ELA (2014) and

Group	Scientific name	Common name	TSC Act	EPBC Act	Data Source	BCAM credit	Habitat association	Likelihood	Justification	Additional survey required
							important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany ( <i>Eucalyptus robusta</i> ), Spotted Gum ( <i>Corymbia maculata</i> ), Red Bloodwood ( <i>C. gummifera</i> ), Mugga Ironbark ( <i>E. sideroxylon</i> ), and White Box ( <i>E. albens</i> ) (OEH 2015d).			species is an ecosystem species
Birds	<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	BCAM, Atlas	Ecosystem	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses (OEH 2015d).	Potential	Suitable habitat present	No. Bird surveys already undertaken by ELA (2014) and species is an ecosystem species
Birds	<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	BCAM	Ecosystem	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas (OEH 2015d)	Potential	Suitable habitat present	No. Bird surveys already undertaken by ELA (2014) and species is an ecosystem species
Birds	<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	-	BCAM	Ecosystem	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark ( <i>Eucalyptus sideroxylon</i> ), White Box ( <i>E. albens</i> ), Inland Grey Box ( <i>E. microcarpa</i> ), Yellow Box ( <i>E. melliodora</i> ), Blakely's Red Gum ( <i>E. blakelyi</i> ) and Forest Red Gum ( <i>E. tereticornis</i> ) (OEH 2015d).	Unlikely	Prefers other habitats	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Neophema pulchella</i>	Turquoise Parrot	V	-	BCAM	Ecosystem	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland (OEH 2015d).	Unlikely	Prefers other habitats	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Ninox connivens</i>	Barking Owl	V	-	BCAM	Ecosystem	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas (OEH 2015d).	Potential	Suitable habitat present	No. Species is an ecosystem species
Birds	<i>Ninox strenua</i>	Powerful Owl	V	-	BCAM, Atlas	Ecosystem	The Powerful Owl is associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes. Large trees with hollows at least 0.5m deep are required for shelter and breeding (OEH 2015d).	Potential	Suitable habitat present	No. Species is an ecosystem species
Birds	<i>Petroica boodang</i>	Scarlet Robin	V	-	BCAM, Atlas	Ecosystem	Occurs from the coast to the inland slopes in NSW. After breeding (July-Jan), some disperse to the lower valleys and plains of the tablelands and slopes. Primarily resides in dry eucalypt forests and woodlands, with usually open and grassy understorey, with scattered shrubs. Abundant logs and fallen timber are important habitat components. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees, and may join mixed flocks of other small insectivorous birds (OEH 2015d).	Unlikely	Prefers other habitats	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Rostratula australis</i>	Painted Snipe (Australian subspecies)	E	V	PMST	Ecosystem	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. Breeding is often in response to local conditions; generally occurs from September to December. Forages nocturnally on mud-flats and in	No	No suitable habitat present	No. Bird surveys already undertaken by ELA (2014)




Group	Scientific name	Common name	TSC Act	EPBC Act	Data Source	BCAM credit	Habitat association	Likelihood	Justification	Additional survey required
							shallow water. Feeds on worms, molluscs, insects and some plant-matter (OEH 2015d).			
Birds	<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	BCAM, Atlas	Ecosystem	Typically found in grassy eucalypt woodlands, but also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. It is often found in riparian areas and sometimes in lightly wooded farmland. Appears to be sedentary, though some populations move locally, especially those in the south (OEH 2015d).	Unlikely	Prefers other habitats	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Stictonetta naevosa</i>	Freckled Duck	V	-	Atlas	Ecosystem	Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters (OEH 2015d).	Unlikely	Marginal habitat present	No. Bird surveys already undertaken by ELA (2014)
Birds	<i>Tyto novaehollandiae</i>	Masked Owl	V	-	BCAM, Atlas	Ecosystem	Lives in dry eucalypt forests and woodlands from sea level to 1100 m (OEH 2015d).	Potential	Suitable habitat present	No as ecosystem species
Mammal	<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	Atlas	Species	Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath. Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit. Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old birds nests and in the branch forks of tea-trees (OEH 2015d).	No	No suitable habitat present	No
Mammal	<i>Dasyurus maculatus</i> <i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll Spotted-tailed Quoll (SE mainland population)	V -	- E	BCAM, Atlas, PMST	Ecosystem	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests, more frequently recorded near the ecotones of closed and open forest. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (OEH 2015d).	No	Marginal habitat present	No. Already surveyed for by ELA (2014)
Mammal	<i>Isoodon obesulus</i>	Southern Brown Bandicoot	E	E	PMST	Species	This species is associated with heath, coastal scrub, heathy forests, shrubland and woodland on well drained soils. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire (OEH 2015d).	No	No suitable habitat present	No
Mammal	<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Atlas	Species	Associated with dry hardwood forest and woodlands. Habitats typically include gum barked and high nectar producing species, including winter flower species. The presence of hollow bearing eucalypts is a critical habitat value (OEH 2015d).	No	No suitable habitat present	No
Mammal	<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	PMST	Species	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (OEH 2015d).	No	No suitable habitat present	No
Mammal	<i>Phascolarctos cinereus</i>	Koala	V	V	BCAM, Atlas, PMST	Species	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70%, with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: <i>Eucalyptus tereticornis</i> , <i>E. punctata</i> , <i>E. cypellocarpa</i> , <i>E. viminalis</i> (OEH 2015d)	Potential	Marginal habitat present	No. Presence assumed

Group	Scientific name	Common name	TSC Act	EPBC Act	Data Source	BCAM credit	Habitat association	Likelihood	Justification	Additional survey required
Mammal	<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	PMST	Ecosystem	A small burrowing native rodent with a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. A social animal, living predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha and the species peaks in abundance during early to mid stages of vegetation succession typically induced by fire (OEH 2015d).	No	No suitable habitat present	No
Mammal-bat	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	BCAM, Atlas, PMST	Species credit (Breeding habitat)	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests. This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces. Found in well-timbered areas containing gullies (OEH 2015d).	Recorded	Marginal habitat present	No breeding habitat present within BCAA
Mammal-bat	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	BCAM, Atlas	Ecosystem	Prefers moist habitats with trees taller than 20m. Roosts in tree hollows but has also been found roosting in buildings or under loose bark (OEH 2015d).	Recorded	Recorded by ELA (2014)	No as already recorded and species is an ecosystem species
Mammal-bat	<i>Miniopterus australis</i>	Little Bentwing Bat	V	-	BCAM, Atlas	Ecosystem and Species (breeding)	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub (OEH 2015d).	Potential	Suitable habitat present	No as ecosystem species and no suitable breeding habitat
Mammal-bat	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	V	-	BCAM, Atlas	Ecosystem and Species (breeding)	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland. It forages above and below the tree canopy on small insects. Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (OEH 2015d).	Recorded	Recorded by ELA (2014)	No as already recorded and species is an ecosystem species. There is no suitable breeding habitat present
Mammal-bat	<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat	V	-	BCAM, Atlas	Ecosystem	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range. Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges. Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (OEH 2015d).	Recorded	Recorded by ELA (2014)	No as already recorded and species is an ecosystem species
Mammal-bat	<i>Myotis macropus</i>	Southern Myotis	V	-	BCAM, Atlas	Ecosystem and Species (breeding)	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, close to water. While roosting (in groups of 10-15) is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater	Recorded	Recorded by ELA (2014)	Potential breeding habitat (hollow bearing trees within 200m of permanent water) searched during breeding season (Appendix H).


Group	Scientific name	Common name	TSC Act	EPBC Act	Data Source	BCAM credit	Habitat association	Likelihood	Justification	Additional survey required
							drains, however with specific roost requirements. Forages over streams and pools catching insects and small fish. In NSW females have one young each year usually in November or December (OEH 2015d)			
Mammal-bat	<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox	V		BCAM, Atlas, PMST	Ecosystem and Species (breeding)	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (OEH 2015d).	Potential	Suitable habitat present	No as ecosystem species and no suitable breeding habitat
Mammal-bat	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	V		Atlas	Ecosystem	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland, open country, mallee, rainforests, heathland and waterbodies. Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock and in abandoned sugar glider nests. The Yellow-bellied Sheath-tail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (OEH 2015d).	Recorded	Recorded by ELA (2014)	No as already recorded and species is an ecosystem species
Mammal-bat	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		BCAM, Atlas	Ecosystem	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range, tending to be more frequently located in more productive forests. Within denser vegetation types use is made of natural and man-made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (OEH 2015d).	Recorded	Recorded by ELA (2014)	No as already recorded and species is an ecosystem species
Migratory	<i>Apus pacificus</i>	Fork-tailed Swift		M	PMST	Ecosystem	Sometimes travels with Needletails. Varied habitat with a possible tendency to more arid areas but also over coasts and urban areas.	Potential	Species may use site on occasion	No as ecosystem species
Migratory	<i>Ardea alba</i>	Great Egret		M	PMST	Ecosystem	The Great Egret is common and widespread in Australia. It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats.	Potential	Suitable wetland areas present	No as ecosystem species
Migratory	<i>Ardea ibis</i>	Cattle Egret		M	PMST	Ecosystem	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments. Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leave the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range.	Recorded	Recorded by ELA (2014)	No as already recorded and species is an ecosystem species
Migratory	<i>Gallinago hardwickii</i>	Latham's Snipe		M	PMST	Ecosystem	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover. Occupies a variety of vegetation around wetlands including wetland grasses and open wooded swamps.	No	No suitable habitat present	No
Migratory	<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle		M	PMST	Ecosystem	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas. Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away.	No	No suitable habitat present	No


Group	Scientific name	Common name	TSC Act	EPBC Act	Data Source	BCAM credit	Habitat association	Likelihood	Justification	Additional survey required
Migratory	<i>Hirundapus caudacutus</i>	White throated Needletail		M	PMST	Ecosystem	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas. Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather.	Potential	Species may use site on occasion	No as this is an ecosystem species
Migratory	<i>Merops ornatus</i>	Rainbow Bee-eater		M	PMST	Ecosystem	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May. Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs. Nest is a chamber at the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting.	Likely	Suitable open and wetland habitats available	No as this is an ecosystem species
Migratory	<i>Monarcha melanopsis</i>	Black-faced Monarch		M	PMST	Ecosystem	Rainforest and eucalypt forests, feeding in tangled understorey.	No	No suitable habitat present	No
Migratory	<i>Myiagra cyanoleuca</i>	Satin Flycatcher		M	PMST	Ecosystem	Wetter dense forest.	No	No suitable habitat present	No
Migratory	<i>Pandion cristatus</i>	Eastern Osprey	V	M	PMST	Ecosystem	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes.	No	No suitable habitat present	No
Migratory	<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	PMST	Ecosystem	The Rufous Fantail is a summer breeding migrant to southeastern Australia. The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation. Open country may be used by the Rufous Fantail during migration.	No	No suitable habitat present	No

## Appendix D: Vegetation type profiles

Biometric Vegetation Type	HN526 -Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
	
<b>Description</b>	This community mostly had a woodland structure. The mid stratum was uniformly present within this vegetation type and was quite dense. The ground stratum was extremely sparse and there was a fair amount of leaf litter build up and fallen logs present.
<b>Location and habitat</b>	This community occurred in the north of the BCAA along a second/ third order stream, which is an intermittent tributary that flows into Menangle Creek. The creek banks varied from steep banks with active erosion to areas of gentle slope.
<b>Ancillary codes</b>	One ancillary codes was identified for this vegetation type: sparse..
<b>Sampling locations</b>	Sparse – A01
<b>Upper stratum</b>	The canopy of this vegetation type was comprised of <i>Eucalyptus moluccana</i> (Grey Box) and <i>E. tereticornis</i> (Forest Red Gum).
<b>Midstorey</b>	This was dominated by exotic species, mostly <i>Ligustrum lucidum</i> (Large-leaved Privet), <i>Ligustrum sinense</i> (Small-leaved Privet), and <i>Olea europaea</i> var. <i>cuspidata</i> (African Olive).
<b>Groundcovers</b>	The under-storey was extremely sparse having been shaded by the shrub layer, and species richness was low. It included a mix of native and introduced species: <i>Oplismenus aemulus</i> (Australian Basket Grass) and <i>Einadia hastata</i> (Berry Saltbush), and <i>Rubus fruticosus</i> sp. aggregate (Blackberry), <i>Cirsium vulgare</i> (Spear Thistle), and <i>Conyza bonariensis</i> (Fleabane).
<b>Corresponding vegetation type</b>	River-Flat Eucalypt Forest
<b>Threatened Species</b>	No threatened flora or fauna were recorded within this BVT, although it is likely that threatened bat species use the community.



<b>Biometric Vegetation Type</b>	<b>HN528 - Grey Box - Forest Red Gum grassy woodland on flats of the southern Cumberland Plain, Sydney Basin Bioregion</b>
	
<b>Description</b>	This community had a woodland structure. The mid stratum was present in some areas and absent in others. The ground stratum included a combination of grasses and herbs. The community has been subject to a long history of disturbance; it was degraded in areas, with erosion and compaction of soils evident.
<b>Location and habitat</b>	The community occurred in the northern half of the BCAA and was contiguous with native vegetation of the same type as well as other vegetation types (River-Flat Eucalypt Forest). The patches occurred on gentle slopes at low topography on clay soils.
<b>Ancillary codes</b>	<p>Three different ancillary codes were identified for this vegetation types as follows:</p> <ul style="list-style-type: none"> <li>• Olive – applied to the north western patch which was in moderate to good condition due to the presence of fallen logs and trees with hollows, and had a mid-storey dominated by <i>Olea europaea</i> var. <i>cuspidata</i>.</li> <li>• Native - applied to the north eastern patch which lacked a mid-storey layer and had a ground layer dominated by native grasses.</li> <li>• Scattered Paddock Trees – applied to remaining areas where the community occurred. These areas were comprised of canopy species with an exotic groundcover. No mid-storey was present in these areas.</li> </ul>
<b>Sampling locations</b>	<p>Olive – B01, B02  Native – D01, D02  Scattered Paddock Trees – B1_2013, C2_2013 (undertaken by ELA 2014)</p>
<b>Upper stratum</b>	The canopy of this vegetation type was dominated by <i>Eucalyptus tereticornis</i> (Forest Red Gum), although <i>E. creber</i> (Narrow-leaved Ironbark) and <i>E. moluccana</i> were also present.
<b>Midstorey</b>	A shrub layer was absent through most of the BCAA. Where present, it was largely composed of the introduced species <i>Olea europaea</i> var. <i>cuspidata</i> (African Olive), with a small amount of native <i>Bursaria spinosa</i> (Blackthorn) present.
<b>Groundcovers</b>	The ground cover diversity was generally very poor. It was composed of native and exotic grasses: <i>Austrostipa elegantissima</i> (Feather Speargrass), <i>Aristida ramosa</i> (Purple Wiregrass), <i>Microlaena stipoides</i> (Weeping Grass), <i>Bothriochloa macra</i> (Redleg Grass), <i>Rytidosperma</i> sp., <i>Eragrostis brownii</i> (Brown's Lovegrass), <i>Ehrharta erecta</i> (Panic Veldtgrass), <i>Pennisetum clandestinum</i> (Kikuyu), <i>Paspalum dilatatum</i> (Paspalum), with common native sedges, herbs and scramblers, including <i>Cyperus gracilis</i> (Slender Flat-sedge), <i>Glycine clandestina</i> , <i>Dichondra repens</i> (Kidney Weed), <i>Einadia</i> spp., and <i>Oxalis perennans</i> , also present.
<b>Corresponding vegetation type</b>	Cumberland Plain Woodland
<b>Threatened Species</b>	No threatened flora or fauna were recorded within this BVT but a number of threatened bat species were recorded.

<b>Biometric Vegetation Type</b>	<b>Hn556 - Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion</b>
	
<b>Description</b>	<p>This community had a woodland structure. The mid stratum was absent across much of the community, but was present within Dzwonniks land, which contains land proposed for conservation. The ground stratum included a combination of grasses and herbs. The community has been subject to a long history of disturbance, through clearing, prolonged grazing, and fertilizer application, although Dzwonniks land, which contains land proposed for conservation, has been subject to lower levels of disturbance.</p>
<b>Location and habitat</b>	<p>The community occurred in the southern portions of the BCAA and was contiguous with native vegetation of the same type in some areas, or occurred as scattered patches. The community occurred on gentle slopes at low topography on transitional soils. Sandstone outcrops were evident in the community.</p>
<b>Ancillary codes</b>	<p>Eight different ancillary codes were identified for this vegetation types as follows:</p> <ul style="list-style-type: none"> <li>• Good North – applied to approximately three quarters of the northern patch (eastern side) within Dzwonniks land. This was in moderate to good condition and had a native mid-storey and low incidence of weeds. It also contained trees with hollows, and had all canopy species regenerating.</li> <li>• Thinned South - applied to a small portion of the southern patch (western side) within Dzwonniks land. This was in moderate to good condition but had a thinned canopy and mid-storey and a moderate incidence of weeds.</li> <li>• Thinned North - applied to approximately one quarter of the northern patch (western side) within Dzwonniks land. This was in moderate to good condition but had a thinned canopy and mid-storey and a higher incidence of weeds.</li> <li>• Good South – applied to the majority of the southern patch (eastern side) within Dzwonniks land. This was in low condition and had a sparse native mid-storey and moderate incidence of weeds.</li> <li>• Native – applied to a small patch along the western boundary of the BCAA, and a strip along the eastern boundary of the BCAA. This patch was in low condition, had a native dominated ground layer and was less subject to disturbance through grazing.</li> <li>• Exotic - applied to a larger patch along the western boundary of the BCAA which was in low condition and had a ground layer dominated by exotic species, although some native species were nevertheless present.</li> <li>• Scattered Paddock Trees – applied to remaining areas where the community occurred. These areas were in low condition and comprised of canopy species with an exotic groundcover.</li> <li>• Cleared – applied to areas around the northern and southern patches within Dzwonniks land that will be revegetated. These areas were in low condition, lacked a canopy and mid-storey, and had a high incidence of weeds.</li> </ul>
<b>Sampling locations</b>	<p>Good North – D1_2013 (undertaken by ELA 2014)  Thinned South – F3_2013 (undertaken by ELA 2014)  Thinned North – F2_2013 (undertaken by ELA 2014)  Good South – F1_2013 (undertaken by ELA 2014)  Native – G01, H01, H02  Exotic – E01, E02, E03  Scattered Paddock Trees – A1_2013 (undertaken by ELA 2014), A5 2016, A6 2016</p>

	Cleared – D2_2013 (undertaken by ELA 2014)
<b>Upper stratum</b>	The canopy of this vegetation type was dominated by <i>Eucalyptus creber</i> (Narrow-leaved Ironbark), <i>E. tereticornis</i> (Forest Red Gum), <i>E. punctata</i> (Grey Gum), and <i>E. moluccana</i> (Grey Box).
<b>Midstorey</b>	A shrub layer was absent due to the grazing across the BCAA.
<b>Groundcovers</b>	The ground cover diversity was generally very poor. It was composed of native and exotic grasses: <i>Microlaena stipoides</i> (Weeping Grass), <i>Eragrostis brownii</i> (Brown's Lovegrass), <i>Cynodon dactylon</i> (Couch), <i>Sporobolus creber</i> (Western Rat-tail Grass), <i>Pennisetum clandestinum</i> (Kikuyu), <i>Setaria parviflora</i> , and <i>Paspalum dilatatum</i> (Paspalum), although the majority was composed of the exotic grass, <i>Pennisetum clandestinum</i> . Besides grasses, there were a few herbs/low shrubs present, including <i>Dichondra repens</i> (Kidney Weed) and the introduced <i>Sida rhombifolia</i> (Paddy's Lucerne).
<b>Corresponding vegetation type (Biolink 2013)</b>	Shale Sandstone Transition Forest
<b>Threatened Species</b>	No threatened flora or fauna were recorded within this BVT but a number of threatened bat species were recorded.

## Appendix E: Flora species recorded in Biometric plots

Provided as a separate xls file.

## Appendix F: Fauna species recorded in BCAA

Fauna group	Scientific name	Common name
Frogs	<i>Crinia signifera</i>	Clicking Froglet
Frogs	<i>Litoria dentata</i>	Bleating Frog
Frogs	<i>Litoria fallax</i>	Eastern Sedge Frog
Frogs	<i>Litoria peronii</i>	Peron's Tree Frog
Frogs	<i>Uperoleia laevigata</i>	Smooth Toadlet
Reptiles	<i>Eulamprus quoyii</i>	Eastern Water Skink
Fish	<i>Cyprinus carpio</i> *	Common Carp
Fish	<i>Gambusia holbrooki</i> *	Eastern Gambusia
Birds	<i>Alisterus scapularis</i>	King Parrot
Birds	<i>Anas gracilis</i>	Grey Teal
Birds	<i>Anas superciliosa</i>	Pacific Black Duck
Birds	<i>Anthochaera carunculata</i>	Red Wattlebird
Birds	<i>Anthus novaeseelandiae</i>	Australasian Pipit
Birds	<i>Ardea ibis</i> ^	Cattle Egret
Birds	<i>Ardea pacifica</i>	White-necked Heron
Birds	<i>Aythya australis</i>	Hardhead
Birds	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo
Birds	<i>Cacatua sanguinea</i>	Little Corella
Birds	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black Cockatoos
Birds	<i>Carduelis carduelis</i> *	European Goldfinch
Birds	<i>Chenonetta jubata</i>	Australian Wood Duck
Birds	<i>Cisticola exilis</i>	Golden-headed Cisticola
Birds	<i>Colluricincla harmonica</i>	Grey Shrike-thrush
Birds	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike
Birds	<i>Corcorax melanorhamphos</i>	White-winged Chough
Birds	<i>Corvus coronoides</i>	Australian Raven
Birds	<i>Cracticus tibicen</i>	Australian Magpie
Birds	<i>Cracticus torquatus</i>	Grey Butcherbird
Birds	<i>Cygnus atratus</i>	Black Swan
Birds	<i>Egretta novaehollandiae</i>	White-faced Heron
Birds	<i>Elseoyornis melanops</i>	Black-fronted Dotterel



Fauna group	Scientific name	Common name
Birds	<i>Eolophus roseicapillus</i>	Galah
Birds	<i>Falco cenchroides</i>	Nankeen Kestrel
Birds	<i>Fulica atra</i>	Eurasian Coot
Birds	<i>Geopelia humeralis</i>	Bar-shouldered Dove
Birds	<i>Glossopsitta concinna</i>	Musk Lorikeet
Birds	<i>Glossopsitta pusilla</i>	Little Lorikeet
Birds	<i>Grallina cyanoleuca</i>	Magpie-lark
Birds	<i>Hirundo neoxena</i>	Welcome Swallow
Birds	<i>Leucosarcia picata</i>	Wonga Pigeon
Birds	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater
Birds	<i>Malurus cyaneus</i>	Superb Fairy-wren
Birds	<i>Manorina melanocephala</i>	Noisy Miner
Birds	<i>Manorina melanophrys</i>	Bell Miner
Birds	<i>Meliphaga lewinii</i>	Lewin's Honeyeater
Birds	<i>Myiagra inquieta</i>	Restless Flycatcher
Birds	<i>Neochmia temporalis</i>	Red-browed Finch
Birds	<i>Ocyphaps lophotes</i>	Crested Pigeon
Birds	<i>Pardalotus punctatus</i>	Spotted Pardalote
Birds	<i>Pardalotus striatus</i>	Striated Pardalote
Birds	<i>Philemon corniculatus</i>	Noisy Friarbird
Birds	<i>Platycercus elegans</i>	Crimson Rosella
Birds	<i>Platycercus eximius</i>	Eastern Rosella
Birds	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe
Birds	<i>Porphyrio porphyrio</i>	Purple Swamphen
Birds	<i>Psephotus haematonotus</i>	Red-rumped Parrot
Birds	<i>Psophodes olivaceus</i>	Eastern Whipbird
Birds	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird
Birds	<i>Rhipidura albiscapa</i>	Grey Fantail
Birds	<i>Rhipidura leucophrys</i>	Willie Wagtail
Birds	<i>Strepera graculina</i>	Pied Currawong
Birds	<i>Sturnus tristis</i> *	Common Myna
Birds	<i>Sturnus vulgaris</i> *	Common Starling
Birds	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe

Fauna group	Scientific name	Common name
Birds	<i>Threskiornis molucca</i>	Australian White Ibis
Birds	<i>Threskiornis spinicollis</i>	Straw-necked Ibis
Birds	<i>Todiramphus sanctus</i>	Sacred Kingfisher
Birds	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet
Birds	<i>Vanellus miles</i>	Masked Lapwing
Mammals (excluding bats)	<i>Bos taurus</i> *	Domestic Cattle
Mammals (excluding bats)	<i>Equus ferus caballus</i> *	Domestic Horse
Mammals (excluding bats)	<i>Oryctolagus cuniculus</i> *	European Rabbit
Mammals (excluding bats)	<i>Vulpes vulpes</i> *	European Red Fox
Mammals (excluding bats)	<i>Wallabia bicolor</i>	Swamp Wallaby
Mammals - bats	<i>Chalinolobus dwyeri</i> #	Large-eared Pied Bat
Mammals - bats	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat
Mammals - bats	<i>Chalinolobus morio</i>	Chocolate Wattled Bat
Mammals - bats	<i>Falsistrellus tasmaniensis</i> #	Eastern False Pipistrelle
Mammals - bats	<i>Miniopterus schreibersii oceanensis</i> #	Eastern Bentwing Bat
Mammals - bats	<i>Mormopterus norfolkensis</i> #	East-coast Freetail Bat
Mammals - bats	<i>Mormopterus sp2</i>	Eastern Freetail Bat
Mammals - bats	<i>Myotis macropus</i> #	Large-footed Myotis
Mammals - bats	<i>Nyctophilus spp.</i>	Long-eared Bat
Mammals - bats	<i>Saccolaimus flaviventris</i> #	Yellow-bellied Sheath-tail Bat
Mammals - bats	<i>Scoteanax orion</i>	Eastern Broad-nosed Bat
Mammals - bats	<i>Scoteanax rueppellii</i> #	Greater Broad-nosed Bat
Mammals - bats	<i>Tadarida australis</i>	White-striped Freetail Bat
Mammals - bats	<i>Vespadelus regulus</i>	Eastern forest Bat
Mammals - bats	<i>Vespadelus vulturnus</i>	Little Forest Bat

\* Denotes introduced species, # Denotes threatened species, ^ Denotes migratory species.

## Appendix G: 2013 Anabat results

Mt Gilead.

4 Anabat nights 10-11 April 2013.

Bat calls were analysed using the program AnalookW (Version 3.8 25 October 2012, written by Chris Corben, [www.hoarybat.com](http://www.hoarybat.com)). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al. 2004); and south-east Queensland and north-east New South Wales (Reinhold et al. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW. Available: (<http://www.forest.nsw.gov.au/research/bats/default.asp>).

Bat calls are analysed using species-specific parameters of the call profile such as call shape, characteristic frequency, initial slope and time between calls (Reinhold et al. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et al. 2006) were followed:

- Search phase calls were used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al. 2002)
- Recordings containing less than three pulses were not analysed and these sequences were labeled as short (Law et al. 1999)
- Four categories of confidence in species identification were used (Mills et al. 1996):
  - definite – identity not in doubt
  - probable – low probability of confusion with species of similar calls
  - possible – medium to high probability of confusion with species with similar calls
  - unidentifiable – calls made by bats which cannot be identified to even a species group.
- *Nyctophilus* spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay et al. 2004)
- Sequences not attributed to microbat echolocation calls were labeled as junk or non-bat calls and don't represent microbat activity at the site
- Sequences labelled as low were of poor quality and therefore not able to be identified to any microbat species, they can however be used as an indicator of microbat activity at the site

Over 320 sequences were recorded from Anabat detectors placed at four separate locations on 10 and 11 April 2013 within the study area at Mt Gilead. Approximately 64% of sequences submitted were able to be identified to species with the remainder being too short or of low quality preventing positive identification of species. General microbat activity was moderate with calls recorded more often than every ten minutes but less often than every two minutes. Feeding buzzes and foraging activity were occasionally recorded.

There were a minimum of 13 species identified including **six vulnerable** species listed under the NSW TSC Act 1987 (Tables 1 - 4). The most commonly recorded species were the threatened ***Mormopterus norfolkensis* (East-coast Freetail Bat)** and ***Chalinolobus gouldii*** (Goulds Wattled Bat), accounting for over 66% of positively identified sequences. Only ***M. norfolkensis*** was found at every Anabat location surveyed. In addition ***M. norfolkensis*** was commonly one of the first species to be recorded at each Anabat location and on three out of four evenings, also the last species to be recorded. These results are indicative of a nearby roost for ***M. norfolkensis***.

Calls of the threatened ***Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)** overlap in frequency with those of *Vespadelus darlingtoni* (Large forest bat) and *V. regulus* (Southern Forest Bat) in the Sydney region. Calls were identified as ***M.s.oceanensis*** when there was a down-sweeping tail, drop of more than 2kHz in the pre-characteristic section, and the pulse shape and time between calls was variable.

The calls of *C. gouldii*, *Mormopterus sp 2* (Eastern Freetail Bat) and ***M. norfolkensis*** can be difficult to separate if *C. gouldii* and ***M. norfolkensis*** are not alternating. Calls were identified as *M. sp 2* when the call shape was flat and the frequency was between 28.5 – 30 kHz. *C. gouldii* and ***M. norfolkensis*** were distinguished by alternation in call frequency between pulses and differences in their characteristic frequencies.

Calls of the threatened ***Myotis macropus* (Large-footed Myotis)** are very similar to all *Nyctophilus* species and it is often difficult to separate these species. Calls were identified as *Nyctophilus* spp. when the time between calls (TBC) was higher than 95ms and the initial slope (OPS) was lower than 300. Calls were identified as ***M. macropus*** when the TBC was lower than 75ms and the OPS was greater than 400.

Calls of the threatened **Eastern falsistrelle (*Falsistrellus tasmaniensis*)**, are very similar to those of the threatened **Greater broad-nosed bat (*Scoteanax rueppellii*)** and Eastern broad-nosed bat (*Scotorepens orion*). Calls were identified as ***F. tasmaniensis*** when characteristics of the call sequence eliminated the other two species and /or based upon the down sweeping tail of the calls and on the length of the pre-characteristic section.

**Table 1: Species recorded within the study area at Mt Gilead, Anabat 1 on 10 March 2013.**

Scientific name	Common name	Number of calls	Definite	Probable	Possible
<i>Chalinolobus gouldii</i> / <i>Mormopterus spp.</i>	Gould's Wattled Bat / a Freetail Bat	1			
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	10	8	2	
<i>Miniopterus schreibersii oceanensis</i> *	Eastern Bentwing Bat	4	1	2	1
<i>Mormopterus norfolkensis</i> *	East-coast Freetail Bat	37	35	2	
<i>Mormopterus species 2</i> / <i>norfolkensis</i> *	Eastern Freetail Bat / East-coast Freetail Bat	2			
<i>Mormopterus species 2</i>	Eastern Freetail Bat	3	3		
<i>Myotis macropus</i> * / <i>Nyctophilus spp.</i>	Large-footed Myotis / A long eared bat	4			
<i>Myotis macropus</i> *	Large-footed Myotis	7	6		1

Scientific name	Common name	Number of calls	Definite	Probable	Possible
<i>Scoteanax rueppellii</i> *	Greater Broad-nosed Bat	1	1		
<i>Tadarida australis</i>	White-striped Freetail Bat	1	1		
<i>Vespadelus regulus</i>	Eastern Forest Bat	2		1	1
<i>Vespadelus regulus</i> / <i>Miniopterus schreibersii oceanensis</i> *	Eastern Forest Bat / Eastern Bentwing Bat	2			
Low		4			
Short		56			
Total sequences		134			

\*Threatened species

**Table 2: Species recorded within the study area at Mt Gilead, Anabat 1 on 11 March 2013.**

Scientific name	Common name	Number of calls	Definite	Probable	Possible
<i>Miniopterus schreibersii oceanensis</i> *	Eastern Bentwing Bat	4	3	1	
<i>Mormopterus norfolkensis</i> *	East-coast Freetail Bat	17	17		
<i>Mormopterus</i> spp.	a Freetail bat	1			
<i>Vespadelus regulus</i> / <i>Miniopterus schreibersii oceanensis</i> *	Eastern Forest Bat / Eastern Bentwing Bat	1			
<i>Myotis macropus</i> * / <i>Nyctophilus</i> spp.	Large-footed Myotis / A long eared bat	8			
<i>Myotis macropus</i> *	Large-footed Myotis	1	1		
<i>Vespadelus vulturnus</i>	Little Forest Bat	2	2		
Low		8			
Short		29			
Total sequences		71			

\*Threatened species

**Table 3: List of species recorded within the study area at Mt Gilead, Anabat 2 on 10 March 2013.**



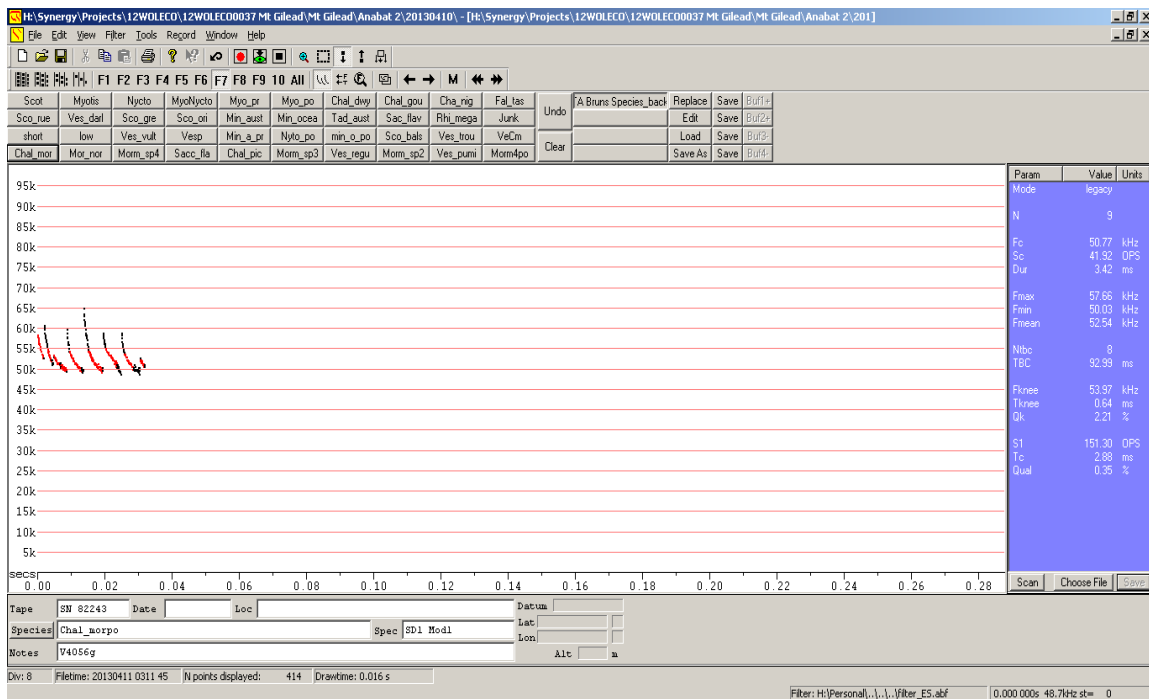
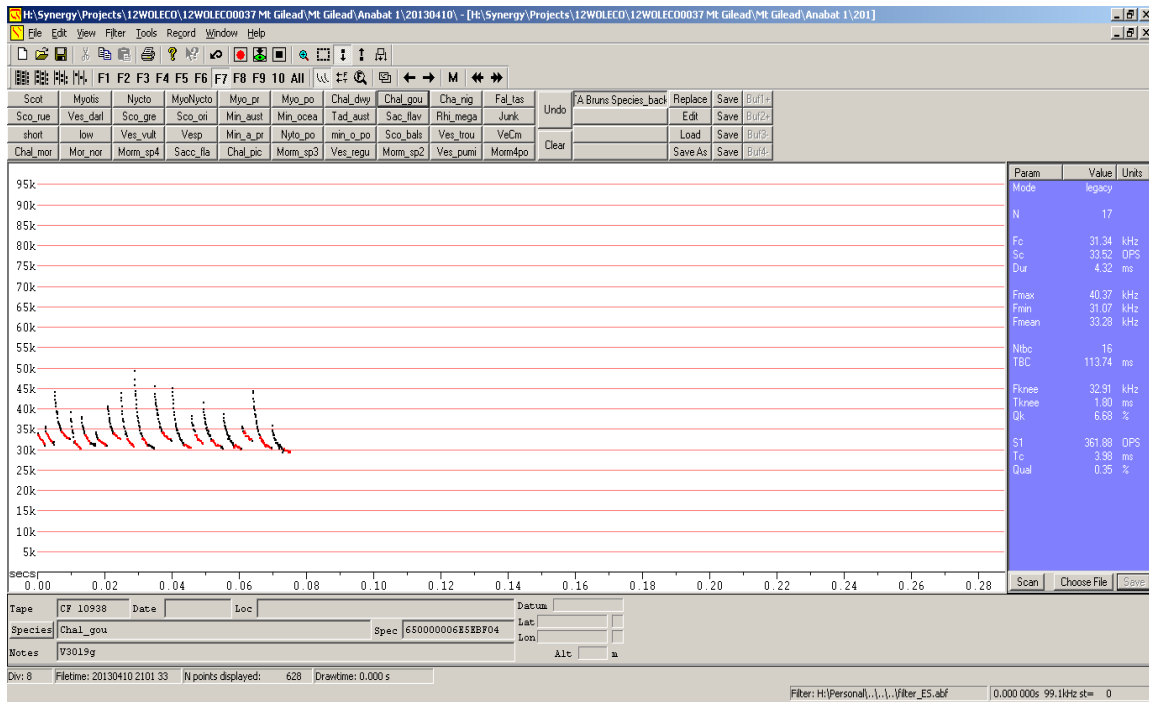
Scientific name	Common name	Number of calls	Definite	Probable	Possible
<i>Chalinolobus gouldii</i> / <i>Mormopterus spp.</i>	Gould's Wattled Bat /a Freetail Bat	3			
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	31	31	1	2
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	1	1		
<i>Falsistrellus tasmaniensis</i> *	Eastern falsistrelle	1	1		
<i>Falsistrellus tasmaniensis</i> * / <i>Scoteanax rueppellii</i> * / <i>Scotorepens orion</i>	Eastern falsistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat	1			
<i>Mormopterus norfolkensis</i> *	East-coast Freetail Bat	5	3		2
<i>Mormopterus species 2</i>	Eastern Freetail Bat	1	1		
<i>Myotis macropus</i> *	Large-footed Myotis	3	2		1
<i>Saccolaimus flaviventrus</i> *	Yellow-bellied Sheath-tail Bat	2	2		
<i>Vespadelus vulturnus</i>	Little Forest Bat	1	1		
Low		1			
Short		37			
Total sequences		87			

\*Threatened species

**Table 4: List of species recorded within the study area at Mt Gilead, Anabat 2 on 11 March 2013.**

Scientific name	Common name	Number of calls	Definite	Probable	Possible
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	25	25		
<i>Mormopterus norfolkensis</i> *	East-coast Freetail Bat	17	14	1	2
<i>Mormopterus spp.</i>	a Freetail bat	7			
<i>Myotis macropus</i> * / <i>Nyctophilus spp.</i>	Large-footed Myotis / A long eared bat	5			
<i>Nyctophilus spp.</i>	A long eared bat	1	1		
<i>Scoteanax rueppellii</i> *	Greater Broad-nosed Bat	1	1		
<i>Tadarida australis</i>	White-striped Freetail Bat	2	2		
<i>Vespadelus regulus</i> / <i>Miniopterus schreibersii oceanensis</i> *	Eastern Forest Bat / Eastern Bentwing Bat	1			
Low		11			
Short		37			
Total sequences		107			

\*Threatened species



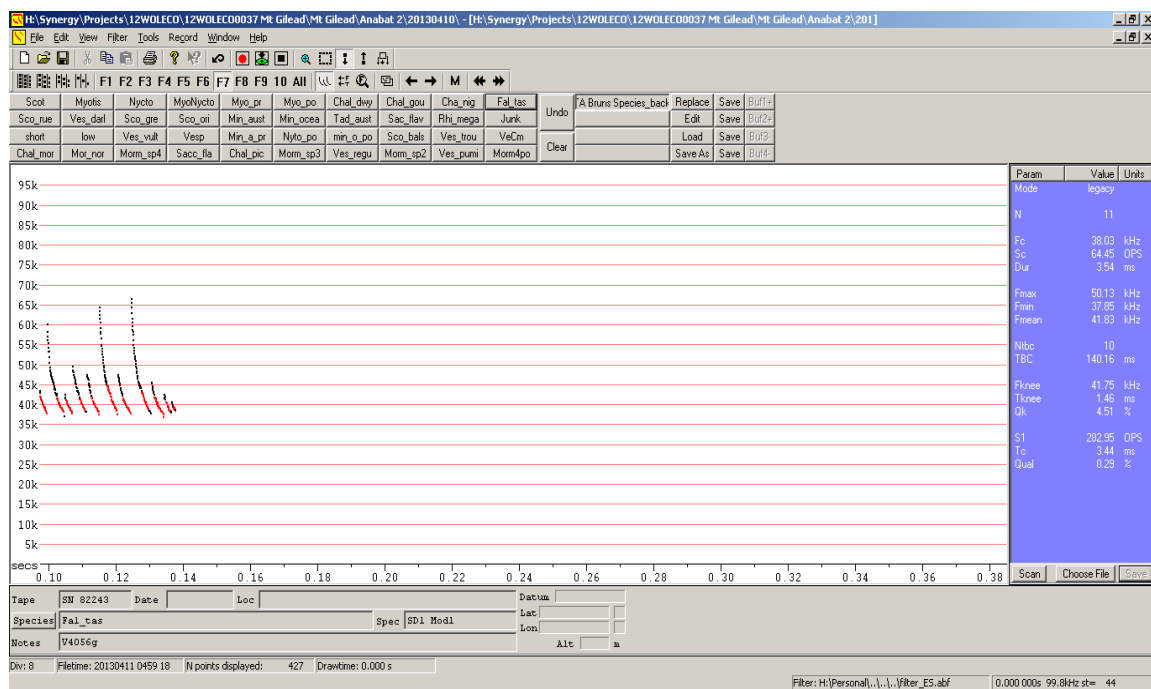


Figure 3: Possible call profile for *Falsistrellus tasmaniensis* recorded at Mt Gilead at 04:59 on 11 April 2013.

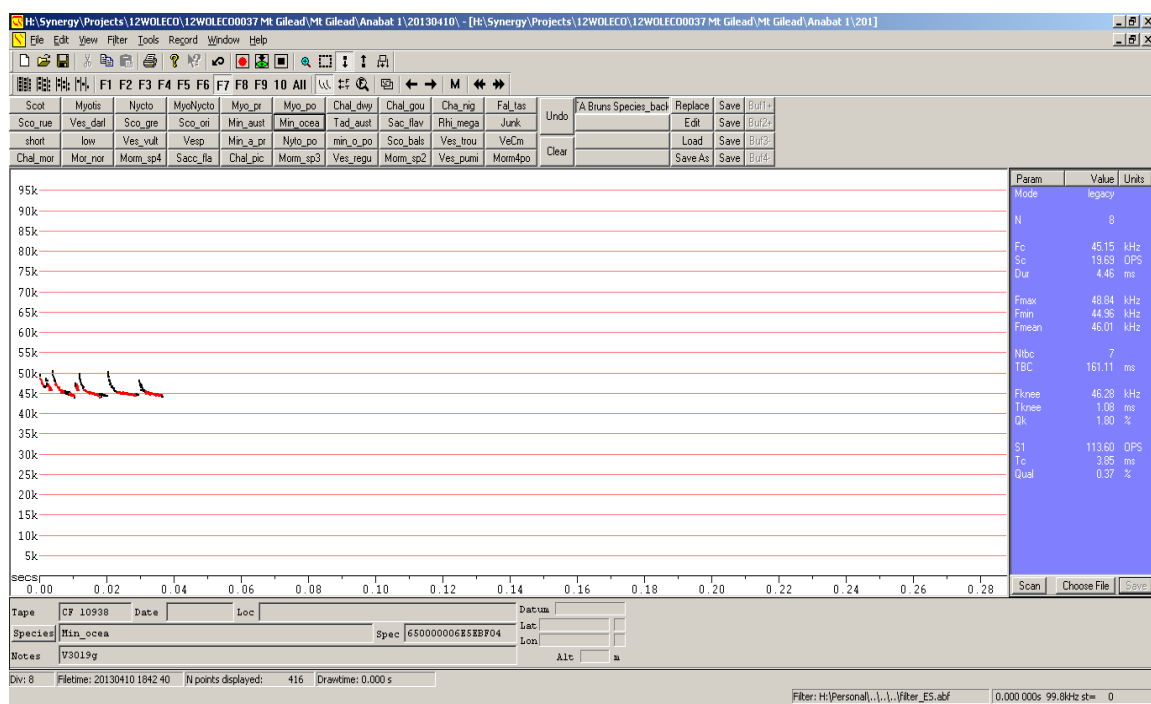


Figure 4: Possible call profile for *Miniopterus schreibersii oceanensis* recorded at Mt Gilead at 18:42 on 10 April 2013.

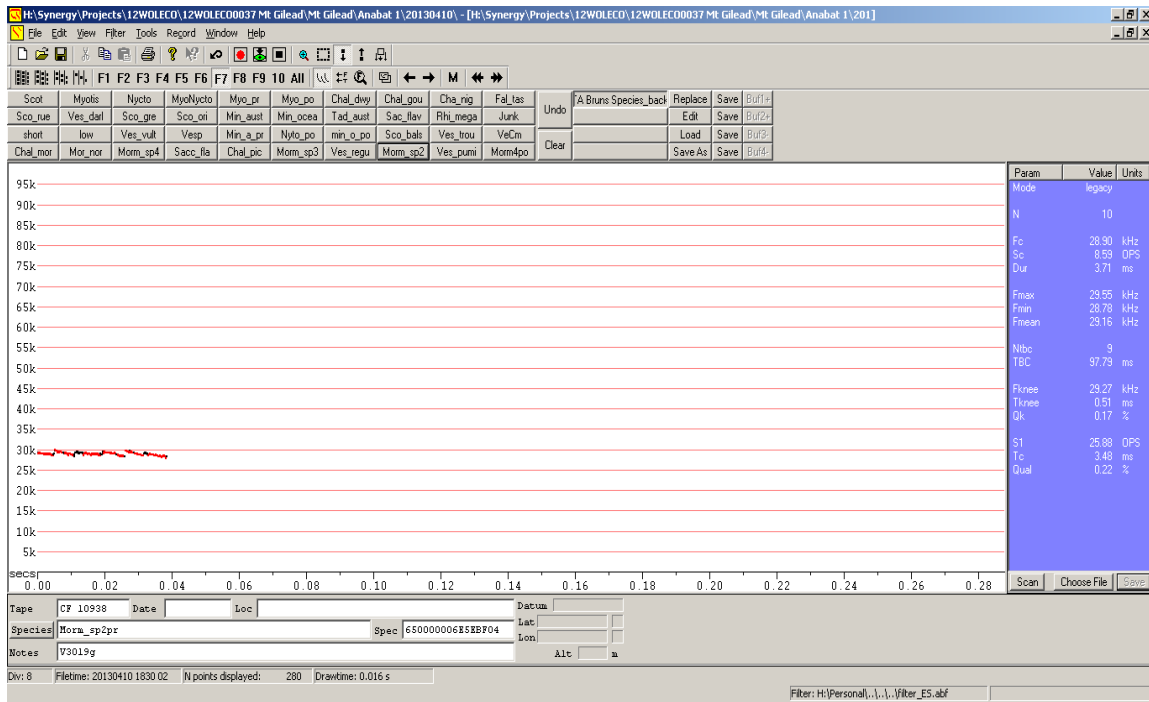


Figure 5: Probable call profile for *Mormopterus species 2* recorded at Mt Gilead at 18:30 on 10 April 2013.

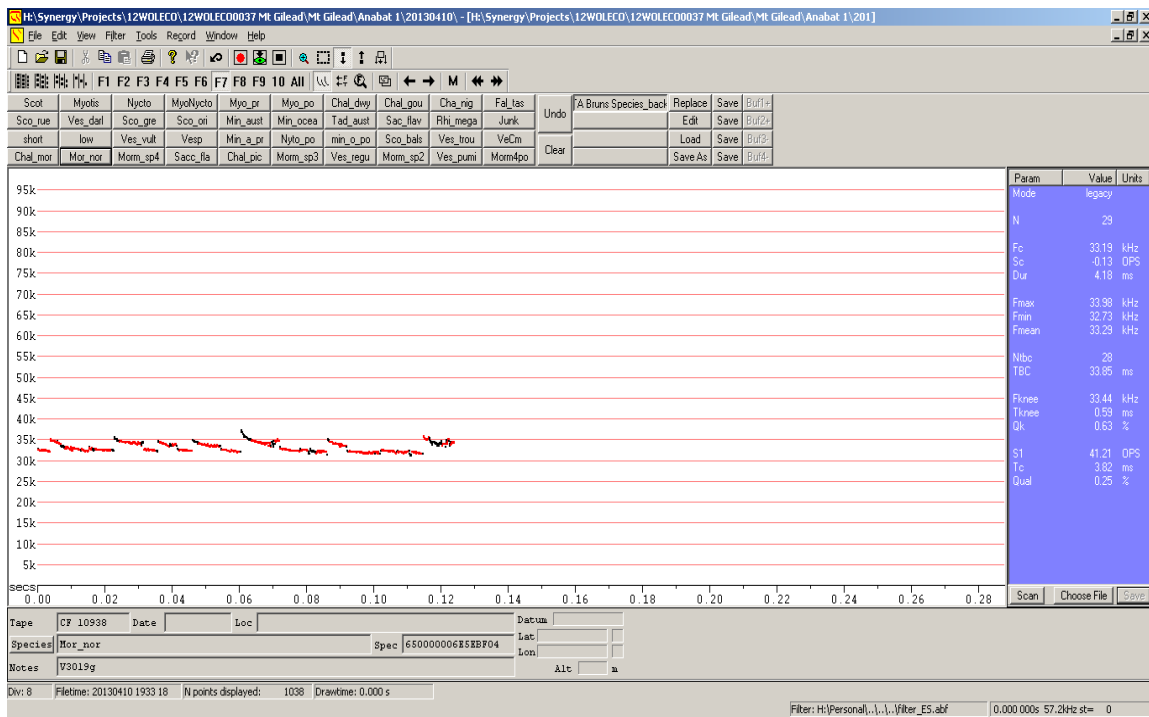


Figure 6: Call profile for *Mormopterus norfolkensis* recorded at Mt Gilead at 19:33 on 10 April 2013.



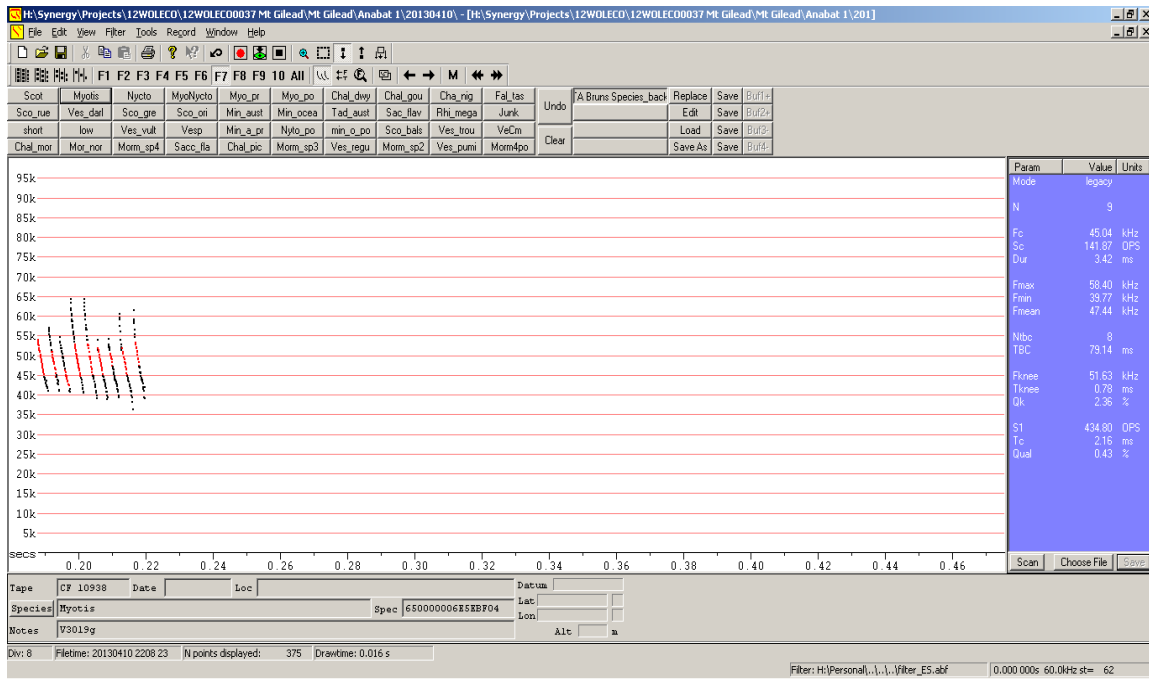


Figure 7: Call profile for *Myotis macropus* recorded at Mt Gilead at 22:08 on 10 April 2013.

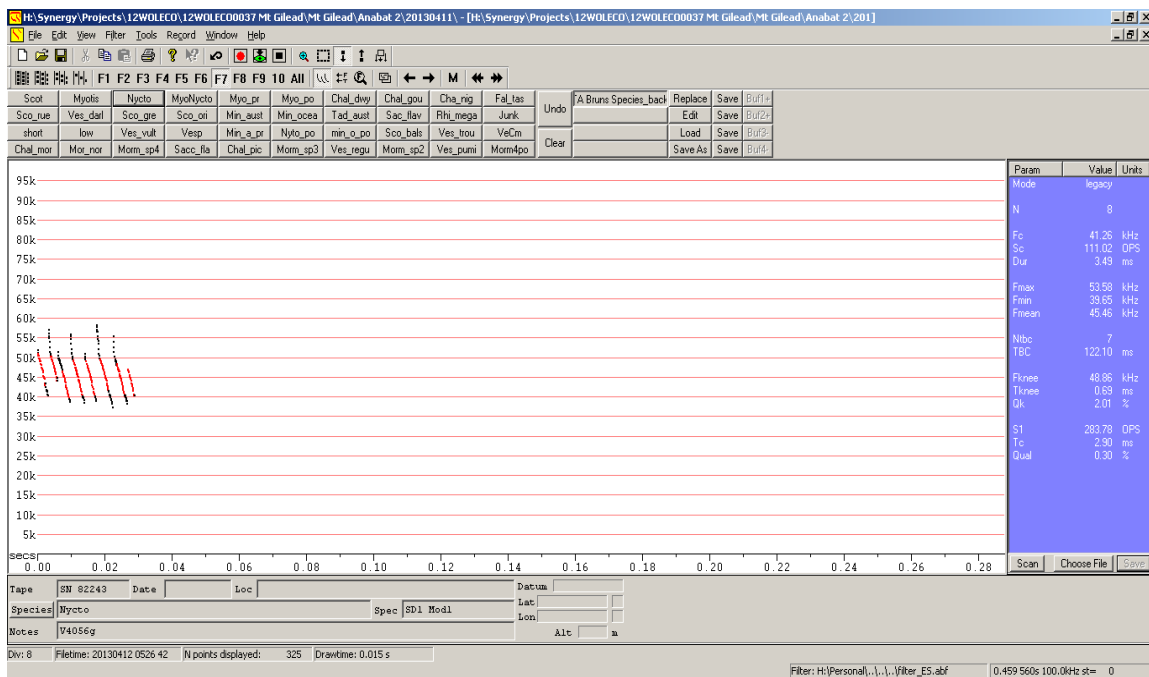


Figure 8: Call profile for *Nyctophilus* spp. recorded at Mt Gilead at 05:26 on 12 April 2013.

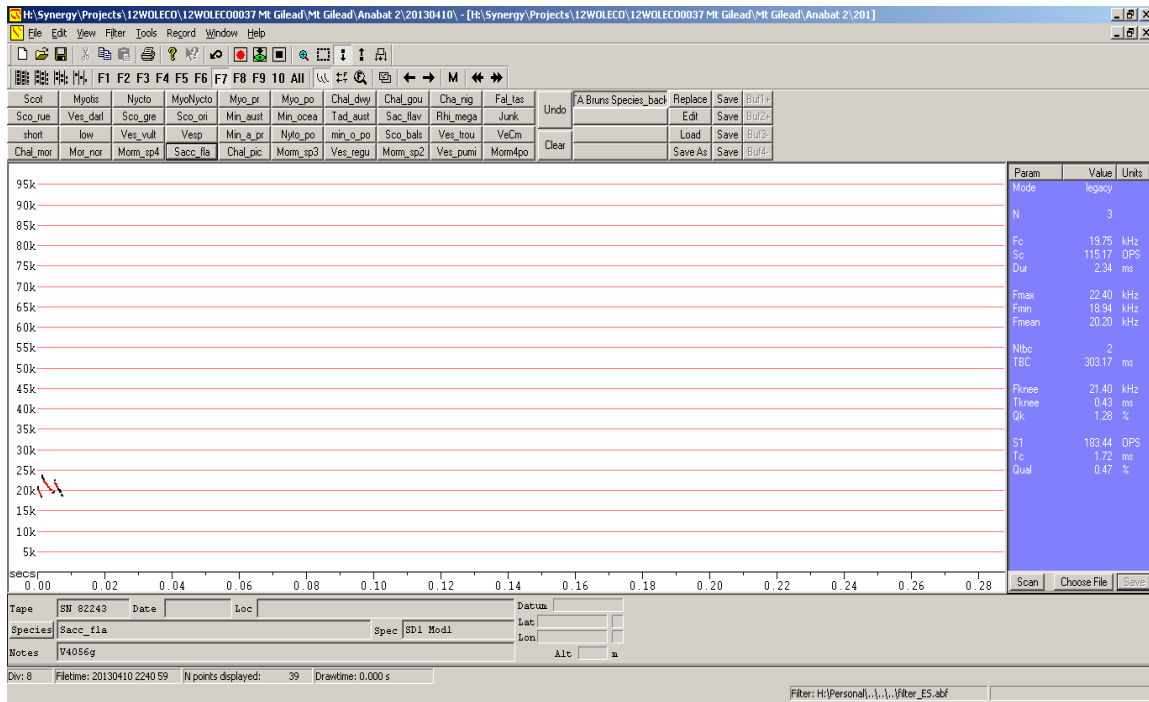


Figure 9: Call profile for *Saccolaimus flaviventris* recorded at Mt Gilead at 22:40 on 10 April 2013.

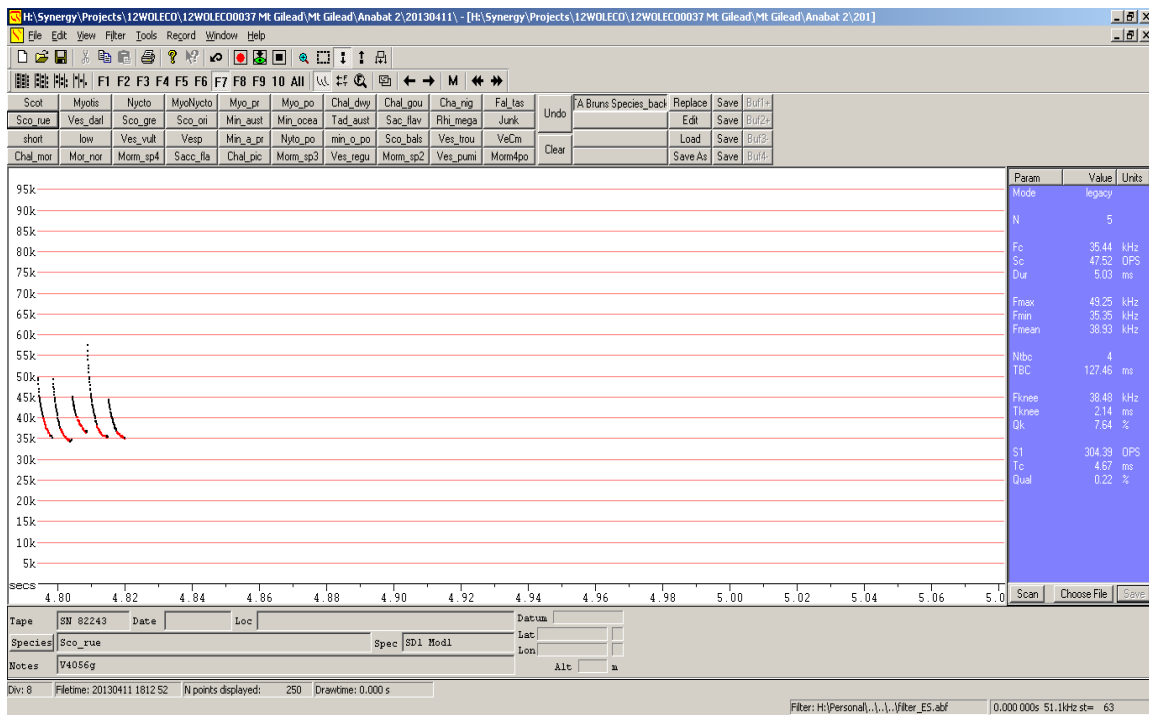


Figure 10: Call profile for *Scoteanax rueppellii* recorded at Mt Gilead at 18:12 on 11 April 2013.

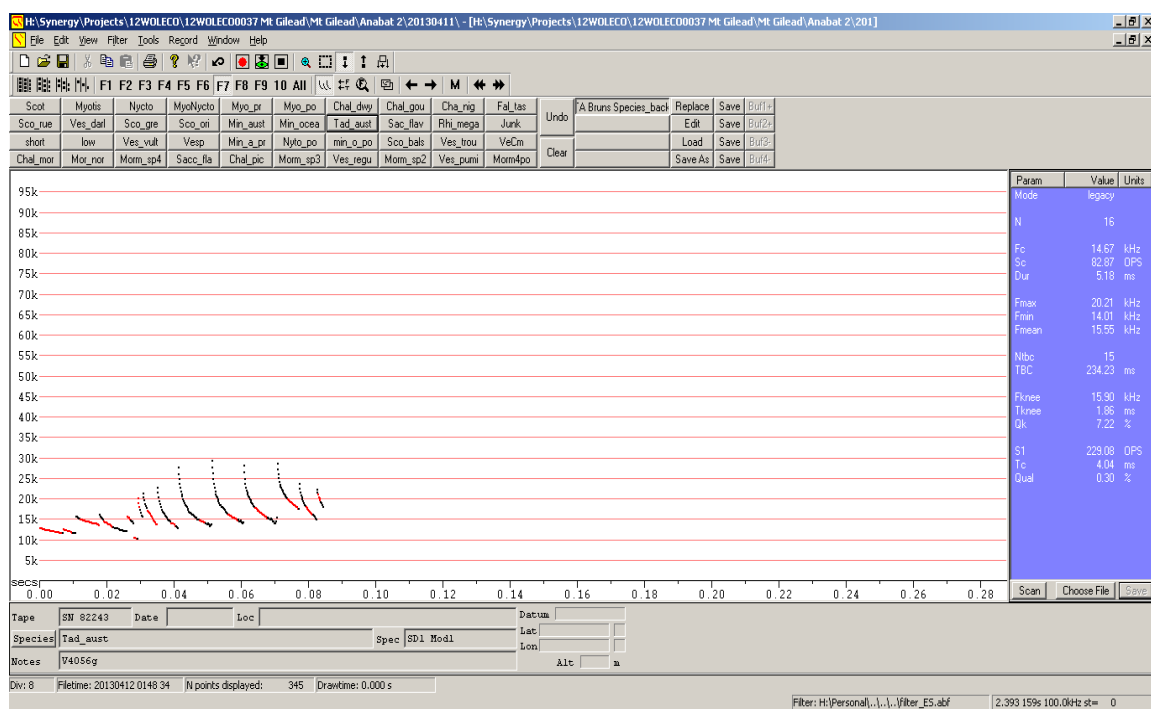


Figure 11: Call profile for *Tadarida australis* recorded at Mt Gilead at 01:48 on 12 April 2013.

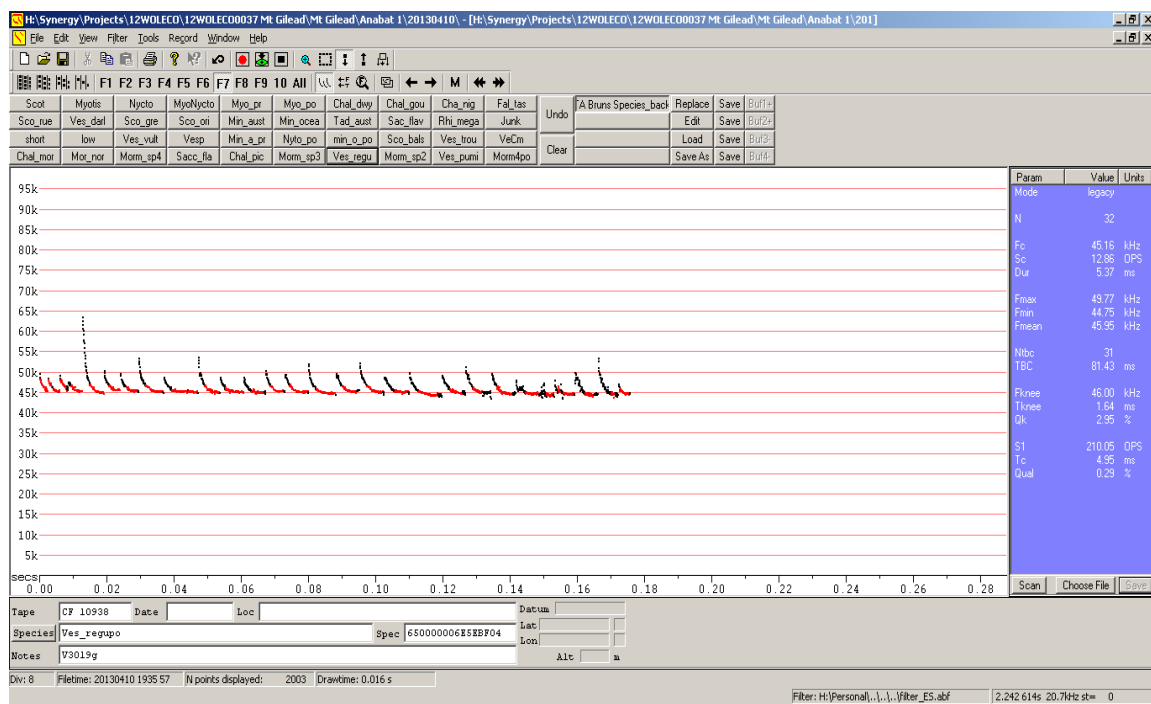


Figure 12: Call profile for *Vespadelus regulus* recorded at Mt Gilead at 19:35 on 10 April 2013.

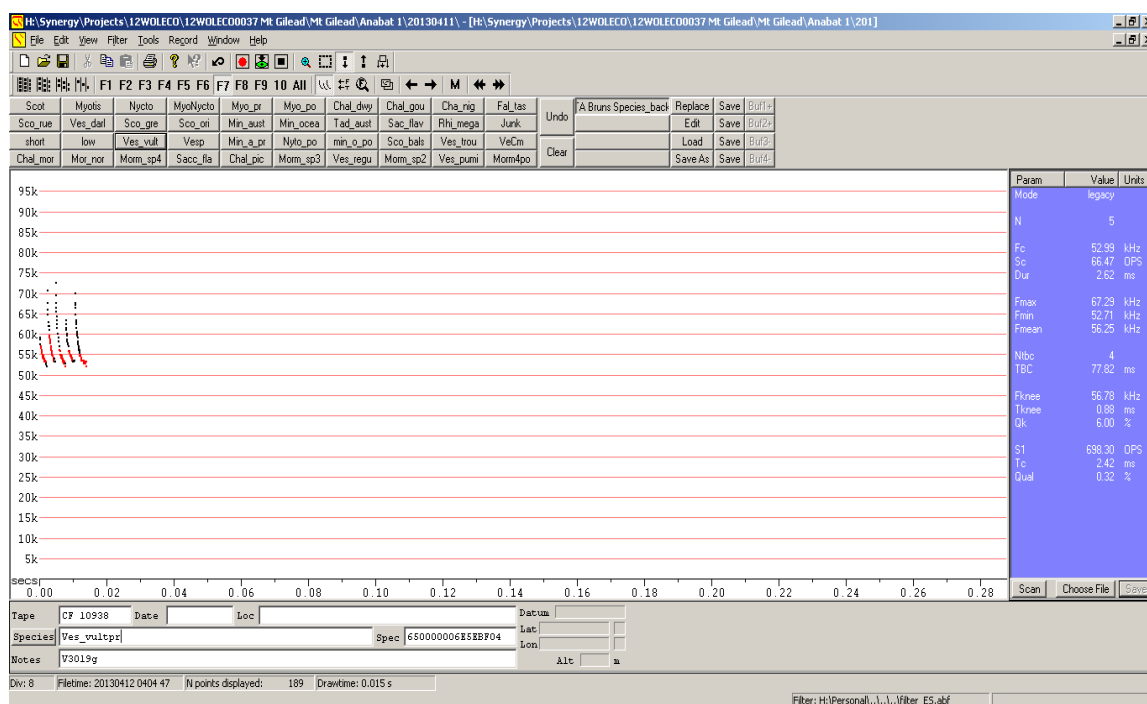


Figure 13: Call profile for *Vespadelus vulturnus* recorded at Mt Gilead at 04:04 on 12 April 2013.

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## Appendix H: Supplementary Green and Golden Bell Frog and Myotis breeding habitat surveys

Provided as a separate Pdf report.



## Appendix I: Transect/plot data

**Vegetation Zone 1: Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion - Low (Sparse)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
A01	5	2	0	2	0	0	60	0	0	61	295459	6222898	56

**Vegetation Zone 2: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion – Moderate to good (Olive)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
B01	18	9.5	0	16	0	14	55.5	1	0	25	295526	6222778	56
B02	17	5.5	0	26	0	12	62.5	1	0	35	295646	6222853	56

**Vegetation Zone 3: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion - Low (Native)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
D01	18	8	0	74	0	2	4	0	0.67	4	296243	6222510	56
D02	15	7	0	50	0	12	8	0	0.67	0	296373	6222494	56

**Vegetation Zone 4: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion - Low (Scattered paddock trees)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
B1_2013	10	9	0	2	0	2	100	1	0	1	295607	6222033	56
C2_2013	4	0	0	22	0	2	98	1	0	8	296265	6222382	56

**Vegetation Zone 5: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion – Moderate to good (Good North)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
D1_2013	27	20.5	7	89	14	40	4	4	1	5	295999	6221958	56

**Vegetation Zone 6: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion - Moderate to good (Thinned South)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
F3_2013	37	6.6	0.7	84	0	4	18	0	0.5	9	295888	6222040	56

**Vegetation Zone 7: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion - Moderate to good (Thinned North)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
F2_2013	32	10.4	8.9	84	4	12	40	0	0.67	1	295863	6221847	56

**Vegetation Zone 8: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion - Low (Good South)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
F1_2013	29	20.2	1	74	0	12	28	0	0	3	295988	6221720	56

**Vegetation Zone 9: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin**  
**Bioregion - Low (Native)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
G01	17	6	0	46	0	6	24	0	1	0	295495	6221652	56
H01 2016	21	0.3	0	32	0	6	64	0	1	0	296294	6200532	56
H02 2016	25	9.7	0	46	0	10	32	0	1	0	296309	6221057	56

**Vegetation Zone 10: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin**  
**Bioregion - Low (Exotic)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
E01	14	19	0.5	0	0	2	66	1	0	32	295824	6221042	56
E02	17	7	0	10	0	0	68	1	0	25	295767	6221229	56
E03	13	4	0	42	0	0	44	0	0	6	295604	6221477	56

**Vegetation Zone 11: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin**  
**Bioregion - Low (Scattered paddock trees)**

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
A1_2013	5	13	0	0	0	2	100	1	0	0	296126	6220624	56
A5 2016	4	17.5	0	0	0	6	68	1	0	0	296220	6220382	56
A6 2016	5	0.1	0	4	0	8	88	0	0	0	296183	6222165	56

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