Old Cooma Road Cemetery – Planning Proposal

Flora and fauna study

Prepared for
Queanbeyan-Palerang Regional Council

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Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Methodology
BC Act	*Biodiversity Conservation Act 2016*
CEEC	Critically Endangered Ecological Community
cm	Centimetres
DBH	Diameter at breast height
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ha	hectares
HBT	Hollow-bearing Tree
KFH	Key Fish Habitat
LEP	Local Environment Plan
m	metres
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
QPRC	Queanbeyan-Palerang Regional Council
TEC	Threatened Ecological Community
WM Act	*Water Management Act 2000*

1 Introduction

Eco Logical Australia Pty Ltd (ELA) was engaged by Queanbeyan-Palerang Regional Council (QPRC) to undertake a Flora and Fauna Study to inform and support a planning proposal for a new cemetery site at Lot 2 DP 112382 and Lot 126 DP754881, Old Cooma Road, Burra (hereon referred to as the "study area").

ELA understands that QPRC are proceeding with a planning proposal to amend schedule 1 of the Queanbeyan Local Environment Plan 2012 to allow for the additional permitted uses of "cemetery" within the study area, which is zoned E4 - Environmental Living.

A Gateway Determination was issued for the planning proposal by NSW Department of Planning and Environment, with the condition that a detailed flora and fauna study be undertaken for the study area. A biodiversity study was undertaken for the study site in 2008, which informed the zonings contained in the Queanbeyan Local Environment Plan 2012. However, a detailed study is required to support the current planning proposal.

This study has been undertaken to identify the ecological values and constraints present within the study area. This report presents the results of the FFA, identifies areas of low, medium and high ecological constraint, and presents recommendations for mitigating impacts associated with the proposal.

1.1 Study area

The study area is located within the Queanbeyan-Palerang Local Government Area, and has a total area of 36.4 hectares (ha) (**Figure 1**). It is currently zoned E4 – Environmental Living under the Queanbeyan Local Environment Plan 2012 (LEP), and is covered by the Terrestrial Biodiversity layer associated with the LEP, identifying areas of high conservation value.

The study is area wholly located within the South Eastern Highlands IBRA region (Monaro sub-region), in the Murrumbidgee catchment.

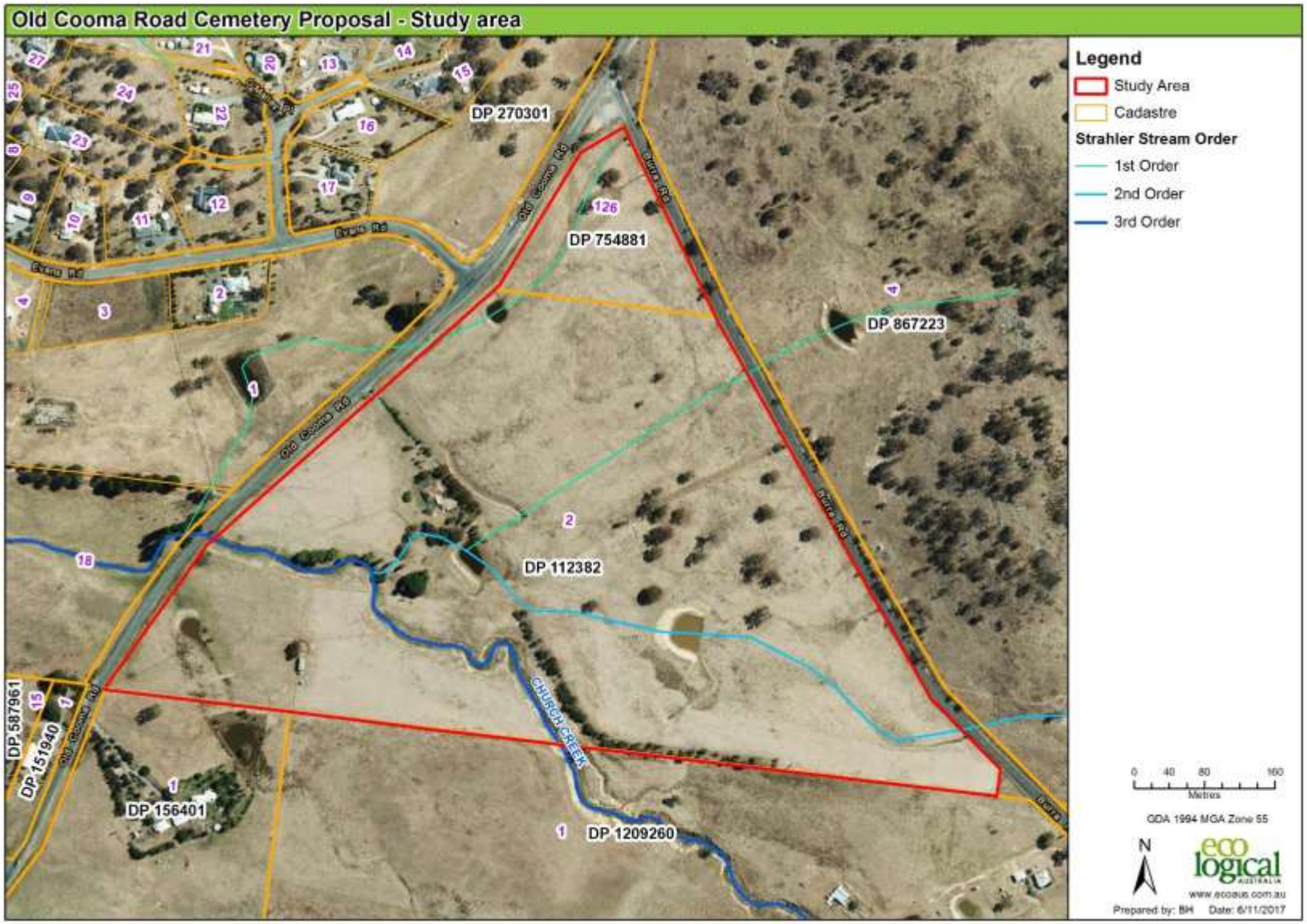

Figure 1: Study area

2 Methods

2.1 Data audit

The following databases and data sources were reviewed prior to conducting the field surveys:

- BioNet / Atlas of NSW Wildlife Search (OEH, 2017a) covering an area from latitude -35.35 to -35.55 and longitude 149.10 to 149.30 (Datum GDA94).
- EPBC Act Protected Matters Search Tool (DotEEa, 2017) using a radius of 10 km around the coordinates -35.45, 129.21 (Datum GDA94).
- BioNet Vegetation Classification (OEH, 2017b).
- *Basic Vegetation Assessment for the Preliminary Environmental Review of 1187 Old Cooma Road, Googong* (QPRC 2017).
- *Planning Proposal for Cemetery and Crematorium, Lot 2 DP112382 and Lot 126 DP754881* (QPRC undated).
- Queanbeyan Local Environment Plan 2012.
- Aerial photography.

2.2 Field survey

A field survey was undertaken by ELA ecologists Jennie Powell and Sarah Dickson-Hoyle on November 2 and 3, 2017. Vegetation surveys were undertaken in accordance with the NSW Biodiversity Assessment Method (BAM) (OEH 2017c).

2.2.1 Plant Community Type identification and mapping

The field survey involved traversing the full extent of the study area in order to identify and map vegetation community type and condition. Boundaries between vegetation communities were logged with a handheld GPS. Each vegetation community encountered was described in the field in terms of structure, condition and composition, corresponded to a Plant Community Type (PCT) as defined in the BioNet Vegetation Classification database, and qualitatively assigned to a condition class.

Descriptions were based on (often multiple) rapid survey assessments conducted within each vegetation community. Rapid assessments involved describing the vegetation structure (dominant species and cover within each vegetation strata), as well as topographic position, soils and any other relevant abiotic factors.

Where vegetation communities were highly degraded and lacking in native species richness, quantitative assessments to identify the corresponding PCT were not deemed possible. In these instances, PCTs were determined qualitatively based on an assessment of remnant native species (in particular, dominant canopy species), surrounding vegetation in the broader locality, and biotic factors such as landform and soils.

2.2.2 Vegetation integrity survey plots

Two vegetation integrity survey plots were undertaken in the single vegetation zone. The minimum required number of plots was calculated in accordance with Table 4 of the BAM, reproduced as **Table 1** below. An additional plot undertaken to ensure a representative sample was taken for the vegetation.

Table 1: Minimum number of transects/plots required per zone area

Vegetation zone area (ha)	Minimum number of transects/plots
<2	1 plot/transect
>2-5	2 plots/transects
>5-20	3 plots/transects
>20-50	4 plots/transects
>50-100	5 plots/transects
>100-250	6 plots/transects
>250-1000	7 plots/transects; more maybe needed if the condition of the vegetation is variable across the site
>1000	8 plots/transects; more maybe needed if the condition of the vegetation is variable across the site

Survey methods followed those outlined in Section 5.3.4 of the BAM. Within each plot, the following data relating to vegetation composition, structure and function was collected:

- Native and exotic species richness, cover and abundance, and growth form within 20 m x 20 m plot
- Identification of High Threat Exotic species
- The number of large trees (defined as greater than the large tree benchmark for each PCT) and trees with hollows within 20 m x 50 m plot
- Length of fallen logs greater than 10 cm diameter, and presence of tree regeneration and trees within defined tree stem size classes within 20 m x 50 m plot
- Litter cover, assessed within five 1 m x 1 m quadrats within 20 m x 50 m plot.

Data from vegetation integrity plot assessment were used to calculate the vegetation integrity score for the relevant vegetation zone, utilising the BAM Credit Calculator.

2.2.3 Paddock tree assessment

Paddock trees were identified, mapped and assessed in accordance with the definition and methodology outlined in Appendix 1 of the BAM.

Each paddock tree was assigned into one of the following classes:

- Class 1: paddock trees that are ≤20 cm DBH, or trees that meet the definition of trees with negligible biodiversity value as defined in Appendix 1 of the BAM
- Class 2: paddock trees that are ≥20 cm DBH and less than the large tree benchmark for the most likely plant community type
- Class 3: paddock trees that are greater than or equal to the large tree benchmark for the most likely plant community type

For all Class 2 and Class 3 paddock trees, the following data were collected:

- Presence of hollows or other important habitat features (e.g. mistletoe)
- Habitat suitability for threatened species
- Species

2.2.4 Threatened flora and fauna

Habitat suitability for threatened fauna and flora species that cannot be predicted by habitat surrogates (species credit species) was assessed in accordance with Section 6.1 of the BAM. Targeted surveys were conducted in areas of suitable habitat for the threatened flora species *Leucochrysum albicans* var. *tricolor* (Hoary Sunray), *Swainsona sericea* (Silky Swainson-pea) *Swainsona recta* (Small Purple-pea) and *Rutidosis leptorrhynchoides* (Button Wrinklewort).

2.3 BAM Calculator

Biodiversity credits required to offset the clearance of native vegetation or threatened species habitat on the site were calculated using the BAM calculator as a Part 4 Developments (Small Area) assessment type. The plot data were entered into the calculator to derive the current vegetation integrity score. The future integrity score was "0" because complete clearance of native vegetation was assumed.

The number of ecosystem credits required to offset impacts on native vegetation is calculated in an equation using the loss in the vegetation integrity score, vegetation zone area and the biodiversity risk weighting of a threatened ecological community or threatened species predicted to have habitat in the vegetation zone. The number of species credits required to offset impacts on threatened fauna and flora species, which cannot be predicted by habitat surrogates, is calculated in an equation using the biodiversity risk weighting of a threatened species, area of habitat, and for all fauna species and some flora species the condition of the habitat.

The calculator also provides a price per credit estimated by the biodiversity offset payment calculator should a proponent choose to purchase their offset requirement from the Biodiversity Conservation Fund. The price includes an estimate for market value with an added administrative and risk loading component.

3 Results and discussion

3.1 Data audit

3.2 Vegetation zones and additional vegetation

One vegetation zone, and two additional planted and/or non-native vegetation communities were identified and mapped within the study area.

These were:

- Vegetation zone: PCT 1330 Yellow Box – Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion
- Additional vegetation communities:
    - Native vegetation (planted, no PCT)
    - Exotic Vegetation

The distribution of this zone and these additional vegetation communities within the study area is shown in **Figure 2**. These are described in greater detail below.

Vegetation zone 1: PCT1330 Yellow Box – Blakely's Reg Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (poor condition)

PCT1330 was present as three discrete patches of vegetation within the study area. This vegetation zone was present as a highly modified form of PCT1330, with a partially cleared canopy consisting of *Eucalyptus melliodora* (Yellow Box), *E. blakelyi* (Blakely's Red Gum) and *E. bridgesiana* (Apple Box) over an exotic ground cover dominated by the exotic pasture grasses *Hordeum leporinum* (Barley Grass), *Lolium perenne* (Perennial Ryegrass) and *Phalaris aquatica* (Phalaris), and exotic forbs including *Hypochaeris radicata* (Catsear) and *Acetosella vulgaris* (Sheep Sorrell). The native perennial grasses *Austrostipa scabra* (Spear Grass) and *A. bigeniculata* were present as scattered individuals, predominantly on low rocky rises with shallower soils.

Equivalent vegetation communities are presented in **Table 2** below.

Table 2: PCT1330 and corresponding vegetation

PCT	BC Act listing	EPBC Act listing	Total area (ha)
PCT 1330 Yellow Box – Blakely's Reg Gum grassywoodland on the tablelands, South Eastern Highlands Bioregion	White Box – Yellow Box – Blakely's Red Gum Woodland	None – too degraded	1.65

Any direct impacts to PCT 1330 require offsets above an impact threshold which relates to the vegetation integrity score of the vegetation zone. Section 10.3 of the BAM states that an offset is required for a vegetation zone that has a vegetation integrity score of ≥ 15 where the PCT is representative of an endangered or critically endangered community. The vegetation zone has been assessed as a highly degraded form of an endangered ecological community (EEC) (see below). The estimated offsets calculated by the BAM calculator for impacts to 1.65 ha of this vegetation zone was 12 credits, with an estimated cost of $20,180.65 (ex. GST). However, the vegetation integrity score for the vegetation zone was 14.2, therefore offsets for the impacts to the vegetation zone are not required under BAM.

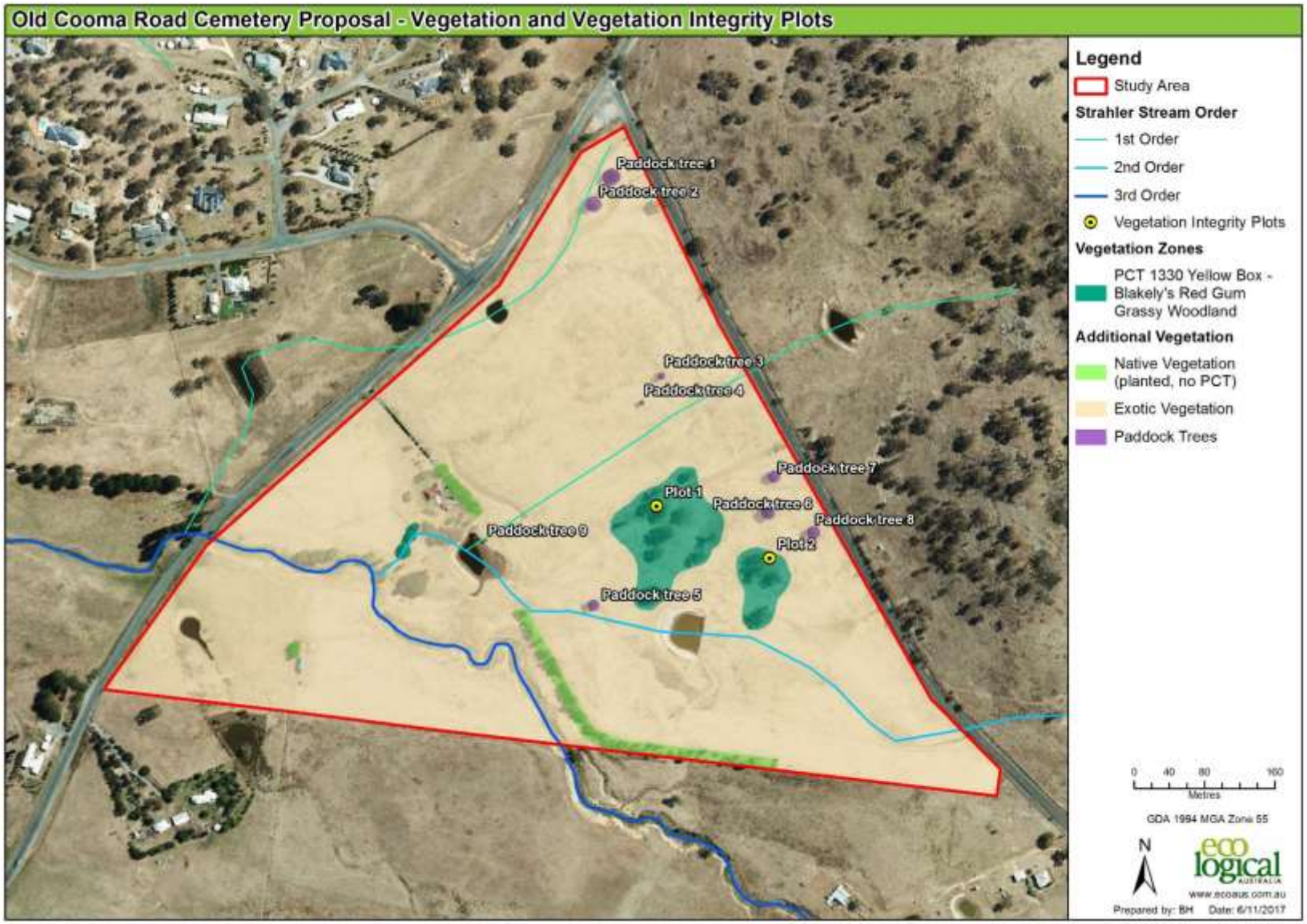

Figure 2: Vegetation zones and additional vegetation within the study area

Vegetation Zone 1 was too degraded to meet the condition requirements for listing as the EPBC Act Critically Endangered Ecological Community (CEEC) *White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grassland* (DotEE) due to the predominantly exotic perennial ground cover.

Assessment against the NSW Scientific Committee determination for the TSC Act listed EEC *White Box Yellow Box Blakely's Red Gum woodland* (NSW Scientific Committee 2002) indicates that Vegetation Zone 1 is a highly degraded form of this EEC: the relatively small size of the patches, the isolated and fragmented occurrence surrounded by exotic pasture, and the heavily degraded ground cover means that this patch is not considered to be a viable remnant of the above EEC in the long term without restoration intervention as natural ecological processes are likely disrupted.

Native vegetation (planted, no PCT)

Native vegetation plantings were present throughout the study area, predominantly as a long linear fenced planting towards the southern boundary, as well as linear plantings along the driveway and a small stand of planted trees near a farm shed (**Figure 2**). This vegetation community comprised a native canopy and shrub layer, consisting of locally native species such as *E. viminalis* (Ribbon Gum), *E. mannifera* (Brittle Gum), *E. albens* (White Box), *Acacia decurrens, A. dealbata* (Silver Wattle) and *A. baileyana* (Cootamundra Wattle), over a tall grassy ground cover dominated by exotic pasture species, primarily *P. aquatica.*

A total of 0.65 ha of Native Vegetation (planted) was mapped within the study area. While this vegetation community has biodiversity values, including supporting habitat for smaller woodland birds (as indicated by the higher bird species diversity and abundance compared to other vegetation zones), it was not considered as being equivalent to a PCT or native vegetation community due to it being a mixed native planting.

Exotic vegetation

Exotic Vegetation dominated across the study area. This vegetation is predominantly exotic pasture dominated by *H. leporinum* in association with the exotic pasture grasses *L. perenne, P. aquatica*, *H. lanatus* (Yorkshire Fog) and *Dactylis glomerate* (Cocksfoot), and the exotic forbs *Trifoliunm subterraneum* (Subterranean Clover), *H. radicata* and *Plantago lanceolata* (Plantain). In lower lying drainage lines there are small patches of native sedges and rushes including *Carex appressa* (Tall Sedge) and *Juncus filicaulis*. Native grasses and forbs including *A. bigeniculata, Cotula australis* (Common Cotula), and *Leptorhynchos squamatus* were recorded at various locations throughout, however never in high covers or abundances.

The area mapped as Exotic Vegetation also includes exotic woody species such as *Salix* sp. (Willow) and *Populus* spp. (Poplars) - predominantly found along creeklines - and planted ornamental vegetation surrounding the existing house.

A total of 32.6 ha of Exotic Vegetation was mapped within the study area. There are no equivalent PCTs or TECs for this vegetation.

3.2.1 Paddock Trees

A total of nine paddock trees were identified and assessed within the study area (**Figure 2**). A summary of these is presented in **Table 3** below.

Table 3: Summary of paddock trees

Paddock Tree No.	Species	Class	Habitat features	Potential threatened species
1	*E. melliodora*	3	None	None
2	*E. bridgesiana*	3	Hollows, mistletoe	*Callocephalon fimbriatum* (Gang-gang Cockatoo) *Calytorhynchos lathamii* (Glossy-black Cockatoo) *Polytelis swainsonii* (Superb Parrot) *Myotis macropus* (Southern Myotis)
3	*E. rubida*	3	Decorticating bark, exposed hollow	*Myotis macropus* (Southern Myotis)
4	*E. rubida*	3	Decorticating bark, exposed hollow	*Myotis macropus* (Southern Myotis)
5	*E. rubida*	3	Decorticating bark	*Myotis macropus* (Southern Myotis)
6	*E. melliodora*	3	None	None
7	*E. blakelyi*	3	None	None
8	*E. melliodora*	3	None	None
9	*E. blakelyi*	1	None	N/A

3.2.2 Vegetation integrity survey plots

The site attribute results from the vegetation integrity survey plot assessment are presented in **Table 4**. A full list of all flora species recorded within each plot is included in **Appendix A**. Photographs of each plot and transect are included below.

Table 4: Vegetation integrity plot data

Plot No.	No. native species	No. high threat weeds	Litter cover (%)	Stem size classes (DBH)	No. trees with hollows	No. large trees	Regen.	Total length fallen logs (m)
1	2	1	49	80cm+	1	1	N	9
2	6	1	35	80cm+	2	1	N	37

The BAM calculator determined the current vegetation integrity score for zone 1 as 14.2.

Photograph 1: Vegetation integrity survey plot 1 (view from start of transect)

Photograph 2: Vegetation integrity survey plot 2 (view from start of transect)

3.3 Flora

A total of 52 flora species were recorded within the study area (including species recorded within vegetation integrity survey plots), 24 of which were exotic.

Suitable habitat was not identified for the threatened flora species identified in **Section 2.2.4**, and targeted surveys within Vegetation Zone 1 did not identify these species. As the surveys were conducted during known flowering time, these species, nor other threatened flora species listed under the BC Act and/or the EPBC Act, are considered unlikely to occur within the study area.

3.4 Aquatic ecology

The riparian corridor categories within the study area were assessed in relation to the *Water Management Act 2000* (WM Act). The watercourses within the subject land are identified, under the Strahler stream order classification, as first, second, third and fourth order streams (**Figure 1**).

The required vegetated buffer zones for these stream classifications is shown in **Table 5**.

Table 5: NSW DPI Water recommended riparian corridor widths

Watercourse Type (Strahler)	Vegetated Riparian Zone Width (each side of watercourse from TOB)	Total width
1st Order	10 m	20 m
2nd Order	20 m	40 m
3rd Order	30 m	60 m
4th Order or greater	40 m	80 m

While the 1st and 2nd order drainage lines within the study area are ephemeral and did not contain water at the time of survey, the 3rd order Church Creek contained a number of permanent pools. These were fringed with and/or had dense in-stream vegetation consisting of dense stands of the native sedges and rushes *Typha* sp., *Eleochaeris* sp., *C. appressa* and *Juncus* spp. (**Photo 3**) and in moderate to good condition. In addition, there were four farm dams, which were observed as providing habitat for a range of common waterbirds associated with agricultural environments, such as *Chenonetta jubata* (Australian Wood Duck). The common native frog species *Crinia signifera* (Common Eastern Froglet) and *Limnodynastes tasmaniensis* (Spotted Marsh Frog) were heard calling from the small dam in the far south-western corner of the study area.

Church Creek is classed as Key Fish Habitat (KFH) by DPI Fisheries (**Figure 3**). Church Creek is a third order stream, which is classed as key fish habitat (KFH) by DPI Fisheries. There is approximately 3.5 km of KFH upstream of the study area. The classification begins when Church Creek becomes a third order stream (joining an unnamed second order stream). The waterway is rated as **Class 2** (moderate key fish habitat) with a sensitivity rating of **Type 2** (moderately sensitive key fish habitat) (Fairfull 2013). These ratings are perceived from field observations.

Photograph 3: Aquatic habitat within Church Creek

Freshwater fish community status is unmapped by DPI. The downstream receiving waterway, Jerrabomberra Creek, has been mapped as 'Poor'. No threatened freshwater fish communities have been found, or modelled within Church Creek. Although the creek is, at times, hydrologically connected to Lake Burley Griffin, where Eel Tailed Catfish (*Tandanas tandanas*) are modelled to occur the habitats are vastly different. It is unlikely that catfish would travel upstream (approximately 25 km) to the site because of the significant barriers posed by dense in-stream vegetation and large reaches of dry streambed. There are also no deep pools at the site to create suitable catfish habitat. *Euastacus armatus* (Murray Crayfish), *Macquaria australasica* (Macquarie Perch), *Maccullochella macquariensis* (Trout Cod) occur in the Murrumbidgee River, downstream of Lake Burley Griffin, but would be unable to migrate upstream beyond Scrivener Dam.

An unpublished study by ELA (Ian Dixon 2016 – 2017) used a backpack electrofisher near Googong in creeks of similar size and recorded *Anguilla australis* (Shortfinned Eel), *Anguilla reinhardtii* (Longfinned Eel) and small bodied fish including *Galaxias olidus* (Mountain Galaxias) and *Gobimorphus coxii* (Cox's Gudgeon. These species and other hardy small bodied fish are most likely to use this creek when flows are suitable. No other threatened aquatic invertebrates have expected distributions in the region (DPI Primefact publications).

No threatened fish are likely to occur near the study area, therefore, the proposal is not likely to directly impact threatened fish or their habitats.

Direct impacts to aquatic habitat would arise if works are proposed instream or on waterfront land (Waterfront land includes bed and bank of any river, lake or estuary and all land within 40 m of the highest bank - *Water Management Act 2000*). Indirect impacts to downstream habitats may occur if mitigation

measures are not put in place during works. Indirect impacts include turbid water, sediment deposition and oil/pollutant spills. Both direct and indirect impacts can reduce water quality, decrease light penetration through the water column and fill pools with sediment. This may alter the plant and animal production that supports the aquatic food web. If works occur when the creek is dry, or exists as a series of isolated pools, impacts would be limited to the immediate area.

3.5 Fauna and fauna habitats

Key fauna habitat features identified within the study area are shown on **Figure 3**. These consisted of hollow-bearing trees, active wombat burrows, mistletoe, small patches of outcropping (embedded) rock, and active bird nests, as well as aquatic habitats associated with farm dams and Church Creek (for aquatic ecology please see **Section 3.5** below). The farm dams and Church Creek may support potential foraging habitat for the threatened microchiropteran bat species *Myotis macropus* (Southern Myotis).

The outcropping rock habitat may provide refuge habitat for a range of small reptile species. However, the rock habitat within the study area was not considered to be the partially embedded rock habitat that constitutes potential habitat for the threatened *Aprasia parapulchella* (Pink-tailed Worm Lizard).

One bird nest was observed in an outer fork of a *E. blakelyi* (**Figure 3**). This was likely a nest of *Cracticus tibicens* (Australian Magpie).

The hollow-bearing trees (including stags) supported a range of small (< 5 cm diameter), medium (5-20 cm diameter) and large (>20 cm diameter) hollows. These hollows may provide potential denning, roosting or nesting habitat for a range of bird, arboreal mammal and microchiropteran bat species that are known from the locality and that utilise agriculturally modified habitats.

The *E. blakelyi* and *E. melliodora* hollow-bearing trees containing large hollows may support nesting habitat for the threatened bird species *Polytelis swainsonii* (Superb Parrot). One *E. bridgesiana* (Paddock Tree 1) had dense infestations of mistletoe (greater than five individual mistletoe plants), providing potential nesting and foraging habitat for the threatened bird species *Grantiella picta* (Painted Honeyeater) (note: this species was not identified as a candidate species in the BAM calculator). Threatened species requiring further assessment in accordance with the BAM are detailed in **Section 3.4.1** below. One individual *Cacatua galerita* (Sulphur-crested Cockatoo) was observed emerging from a large hollow in an *E. bridgesiana*. An active nest of the introduced pest species *Sturnus vulgaris* (Starling) was present in a hollow-bearing stag.

Twenty-three fauna species were opportunistically recorded during field surveys. This consisted of 19 native and one exotic bird species, two native frog species and one native mammal species. The majority of the bird species recorded were either larger common bird species such as *Platycercus elegans* (Crimson Rosella), *Cracticus tibicens* and *Eolophus roseicapilla* (Galah), or smaller bird species commonly associated with open grasslands and modified habitats, such as *Anthus nocaeseelandiaea* (Australasian Pipet) and *Rhipidura leucophrys* (Willie Wagtail).

Evidence of cattle was observed within the study area. QPRC confirmed that the tenants occupying the study area were still grazing cattle at the time of survey.

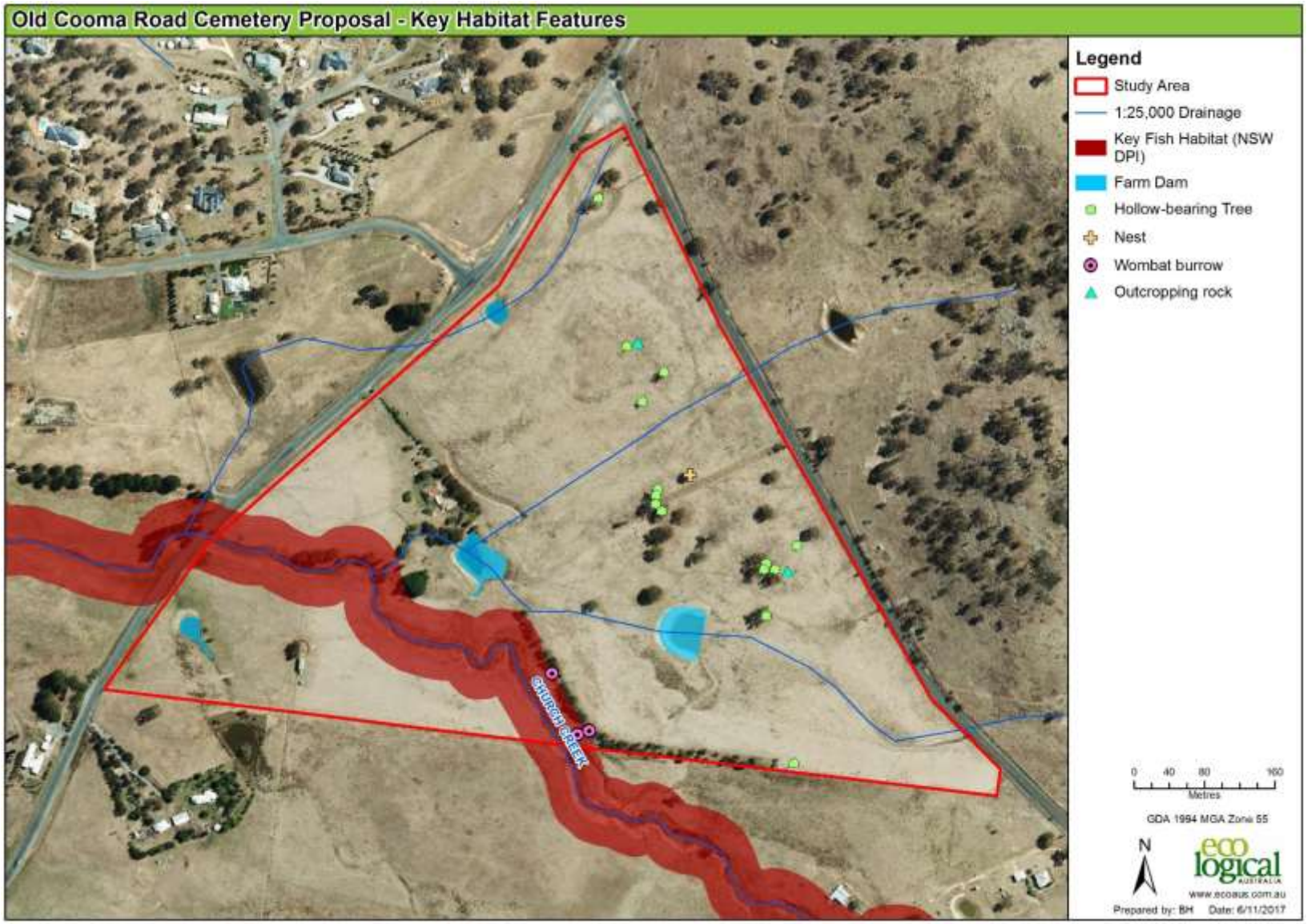

Figure 3: Key habitat features

3.5.1 Predicted fauna species

The following fauna species listed in **Table 6** are listed as Ecosystem Credit Species, and are predicted to be associated with PCT 1330. No additional surveys are required for these species. Ecosystem Credits (offsets) would apply to these species if impacts were to occur to PCT 1330.

Table 6: Fauna species reliably predicted to occur in PCT 1330

Scientific name	Common name
Anthochaera phrygia	Regent Honeyeater
Artamus cyanopterus cyanopterus	Dusky Woodswallow
Chthonicola sagittata	Speckled Warbler
Climacteris piculmus victoriae	Brown Tree-creeper
Glossopsitta pusilla	Little Lorikeet
Lathamus discolour	Swift Parrot (note: does not breed on mainland)
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat
Petroica boodang	Scarlet Robin
Petroica phoenicea	Flame Robin (note: does not breed inland)
Polytelis swainsonii	Superb Parrot
Stagonopleura guttata	Diamond Firetail

Note: three Ecosystem Credit Species predicted to be associated with PCT 1330 have been excluded from the **Table 6**, due to a confirmed lack of key habitat constraints within the study area or the species is considered a vagrant in the Monaro IBRA subregion. These are *Haliaeetus leucogaster* (White-bellied Sea Eagle); *Dasyurus maculatus* (Spotted-tailed Quoll); *Phascolarctos cinereus* (Koala) and *Pteropus poliocephalus* (Grey-headed Flying Fox).

Table 7 lists Species Credit fauna species for which breeding habitat potentially exists within the study area. These species all breed in hollow-bearing trees. Targeted surveys for these species in the appropriate survey months would be required to confirm the absence of these species within the study area. Otherwise, Species Credits (offsets) would apply, should the proposal impact upon hollow-bearing trees.

Table 7: Fauna species requiring targeted survey

Scientific name	Common name
Callocephalon fimbriatum	Gang-gang Cockatoo
Calyptorhynchos lathami	Glossy Black Cockatoo
Myotis macropus	Southern Myotis
Ninox strenua	Powerful Owl
Polytelis swainsonii	Superb Parrot

Note: the Species Credit species *Hieraaetus morphnoides* (Little Eagle) was excluded by ELA from **Table 7** due to no nest trees being recorded in the study area, and *Cercartetus nanus* (Eastern Pygmy Possum) was excluded due to the lack of required vegetation structural diversity. Furthermore, while the Powerful Owl has been listed in the table above, it is considered unlikely to be reliant on habitats within the study area, due to its lack of reliance on paddock trees. However, targeted surveys would be required to confirm this absence.

3.6 Summary of ecological constraints

A summary of the key ecological constraints present within the study area is shown in **Figure 4**.

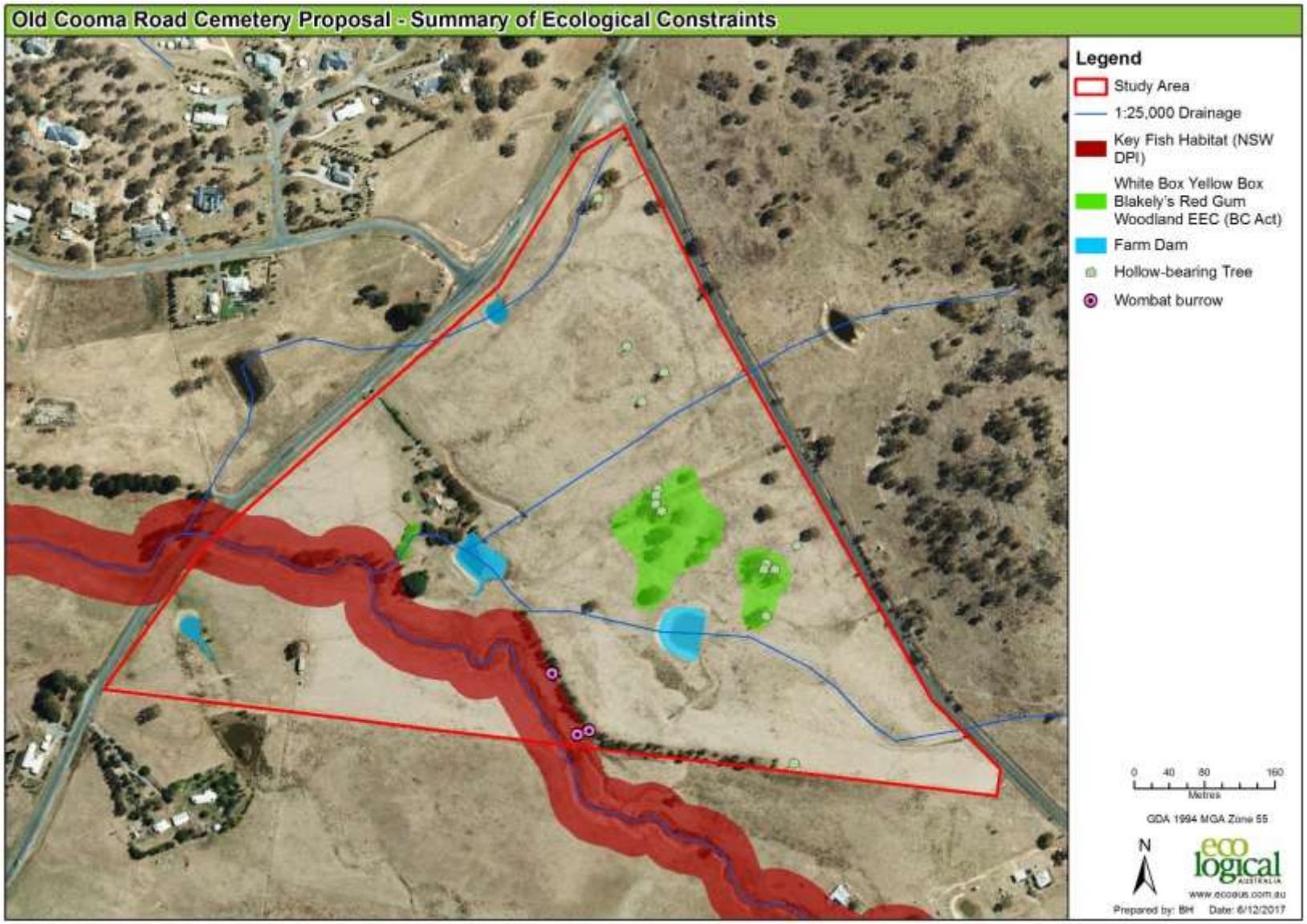

Figure 4: Summary of ecological constraints

4 Recommendations and conclusion

The majority of the study area poses a low ecological constraint to the proposal, due to the highly modified and disturbed vegetation and lack of important habitat features. However, the key habitat features shown in **Figure 4**, in particular the hollow-bearing trees, provide potential breeding habitat for a range of threatened fauna species. Furthermore, despite being highly modified, Vegetation Zone 1 is considered equivalent to the TEC White Box Yellow Box Blakely's Red Gum Woodland, an endangered ecological community listed under the NSW BC Act. There is the potential for the proposal to incorporate measures to effectively manage and enhance this vegetation for biodiversity outcomes.

A series of measures to minimise or mitigate the impacts associated with the proposal are recommended as follows:

- Design the proposal to avoid direct impacts to any hollow-bearing trees, paddock trees, or the area of TEC White Box Yellow Box Blakely's Red Gum Grassy Woodland
- Consider developing a Vegetation Management Plan for the site, with a particular emphasis on managing and restoring aquatic habitats and the TEC
- Retain the planted native vegetation. Additional plantings should utilise native species of local provenance to the greatest extent possible
- Any waterway crossings should be designed and constructed in accordance with the national guidelines entitled 'Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings' (Fairfull and Witheridge 2003). Crossings are to be designed to allow adequate fish passage during operation. The crossings are on Class 2 – Moderate key fish habitat
    - Bridge, arch structure, culvert or fords are the preferred crossing type (in that order) for Class 2 waterways
- Develop a Construction Environmental Management Plan (CEMP) to address potential pollution and contamination issues, such as silt control and oil/fuel/chemical storage/spill management, which could arise during construction
- The timing of works should coincide with low flow periods
- If dewatering of pools or farm dams is required, engage a qualified aquatic ecologist to relocate fish and other aquatic fauna upstream

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Appendix A Flora and fauna species recorded

Flora species

Scientific name	Common name	Native/Exotic
Acacia baileyana	Cootamundra Wattle	Native
Acacia dealbata	Silver Wattle	Native
Acacia decurrens	Black Wattle	Native
Acacia sp.	Wattle	Native
Acetocella vulgaris	Sheep Sorrell	Exotic
Aristida sp.	-	Native
Austrostipa bigeniculata	-	Native
Austrostipa scabra	Spear Grass	Native
Avena barbata	Bearded Oats	Exotic
Bromus catharticus	Prairie Grass	Exotic
Bromus sp.	-	Exotic
Carex appressa	Tall Sedge	Native
Cirsium vulgare	Spear Thistle	Exotic
Cotula australis	Common Cotula	Native
Dactylus glomeratus	Cocksfoot	Exotic
Einadia nutans	Climbing Saltbush	Native
Eleochaeris sp.	-	Native
Eleusine tristachya	Goose Grass	Exotic
Erodium cicutarium	Common Storksbill	Exotic
Eucalyptus albens	White Box	Native
Eucalyptus blakelyi	Blakely's Red Gum	Native
Eucalyptus bridgesiana	Apple Box	Native
Eucalyptus mannifera	Brittle Gum	Native
Eucalyptus melliodora	Yellow Box	Native
Eucalyptus ovata	Swamp Gum	Native
Eucalyptus rubida	Candlebark	Native
Eucalyptus stellulata	Black Sallee	Native
Eucalyptus viminalis	Ribbon Gum	Native
Geranium solanderi	Native Geranium	Native

Scientific name	Common name	Native/Exotic
Holcus lanatus	Yorkshire Fog	Exotic
Hordeum leporinum	Barley Grass	Exotic
Hypochaeris radicata	Catsear	Exotic
Juncus filicaulis	-	Native
Juncus sp.	-	Native
Lactuca serriola	Prickly Lettuce	Exotic
Leptorhynchos squamatus	-	Native
Lolium perenne	Perennial Rye Grass	Exotic
Malva sp..	-	Exotic
Onopordum acanthium	Scotch Thistle	Exotic
Phalaris aquatica	Phalaris	Exotic
Plantago debilis	-	Native
Plantago lanceolata	Plantain	Exotic
Poa annua	Winter Grass	Exotic
Poa labillardierei	River Tussock	Native
Populus sp.	Poplar	Exotic
Rumex brownii	Swamp Dock	Native
Rumex crispus	Curly Dock	Exotic
Rytidosperma sp.	A Wallaby Grass	Native
Salix sp.	Willow	Exotic
Trifolium dubium	Yellow Suckling Clover	Exotic
Trifolium subterraneum	Subterranean Clover	Exotic
Vulpia sp.	-	Exotic

Fauna species

Scientific name	Common name	Native/Introduced
Birds		
Anas superciliosa	Pacific Black Duck	Native
Anthochaera carunculata	Red Wattlebird	Native
Anthus novaeseelandiaea	Australasian Pipet	Native
Cacatua galerita	Sulphur-crested Cockatoo	Native
Cacomantis pallidus	Pallid Cuckoo	Native

Scientific name	Common name	Native/Introduced
Chenonetta jubata	Australia Wood Duck	Native
Coracina novaehollandiae	Black-faced Cuckoo-shrike	Native
Cracticus tibicen	Australian Magpie	Native
Eolophus roseicapilla	Galah	Native
Gerygone albogularis	White-throated Gerygone	Native
Malurus cyaneus	Superb Fairy-wren	Native
Manorina melanocephala	Noisy Miner	Native
Pachycephala rufiventris	Rufous Whistler	Native
Pardalotus striatus	Striated Pardalote	Native
Platycercus elegans	Crimson Rosella	Native
Platycercus eximius	Eastern Rosella	Native
Psephotus haematonotus	Red-rumped Parrot	Native
Rhipidura albiscapa	Grey Fantail	Native
Rhipidura leucophrys	Willie Wagtail	Native
Sturnus vulgaris	Common starling	Introduced
Frogs		
Crinia signifera	Common Eastern Froglet	Native
Limnodynastes tasmaniensis	Spotted Marsh Frog	Native
Mammals		
Vombatus ursinus	Common Wombat (active burrows)	Native

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