Glen Artney Area 3

Lot 2 DP 816346 and Lot 426 DP 1178998

Flora and Fauna Assessment



prepared by

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for

Tamworth Regional Council

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1 INTRODUCTION

This assessment has been prepared by The Envirofactor Pty Ltd as an extension of the original assessment '*Lands Adjacent to Glen Artney Industrial Area - Flora and Fauna Assessment*' submitted by GHD (2015), which looked at four parcels of land west of Tamworth comprising 902.4 ha. A review of this assessment for one of these parcels (Area 3) by The Envirofactor (2016) highlighted a number of short comings of the original assessment as it pertained to the Commonwealth listed critically endangered community, *White Box Yellow Box Blakely's Red Gum grassy woodland and derived native grassland.* Area 3 (comprising Lot 2 DP 816346 and Lot 426 DP 1178998) covers approximately 246 ha. The purpose of this additional assessment is to complete an appropriate assessment of this parcel in accordance with both Federal and State legislation.

2 PROJECT LOCATION

The project area lies on the North West Slopes of NSW within the Tamworth LGA. It is located approximately 5 kilometres (km) west of the Tamworth CBD. Area 3 is bounded to the northeast by Wallamore Road to the southwest by the Oxley Highway. Goddard's Lane forms the north-western boundary, while the south-eastern boundary abuts residential/rural residential development.

3 BIOPHYSICAL DESCRIPTION OF THE PROJECT AREA

3.1 Topography and soils

The project area lies towards the southern edge of the Nandewar Bioregion (Thackway and Cresswell 1995) within the Peel sub-region of the Naomi River catchment area. The topography is undulating, dissected northwest to southeast by Murroon Creek an ephemeral drainage line. Geology of the area is of tertiary basalts with red-brown loamy clay soils (Morgan and Terrey 1992).

3.2 Landscape setting

Area 3 lies within a region that has been extensively cleared (66%) for grazing and cropping (Morgan and Terrey 1992). As a consequence, native vegetation remnants are generally confined to; steeper hillslopes, small patches and scattered paddock trees within grazing and cropping paddocks, areas of crown land and linear strips along rivers, roadsides and Travelling Stock Reserves.

Located on the western edge of the Tamworth urban area, Area 3 is surrounded by existing residential/rural residential and industrial development that includes Tamworth Regional Airport to the southwest and Westdale Wastewater Treatment Plant to the northeast.

3.3 Landuse

Historically, Area 3 has been extensively cleared for grazing and/or cultivation leaving only scattered paddock trees and small clumps of trees. Infrastructure on the area includes; contour banks, constructed waterway, fencing, 2 farm dams and 2 houses and associated sheds. At the time of the survey the majority of Area 3 had been had been recently cultivated or was fallow, only the ground layer within Murroon Creek remains uncultivated.

4 ASSESSMENT METHODS

4.1 Field survey

As per suggested guidelines for optimal capture of native flora and fauna, this survey was undertaken during mid-spring on the 19th and 20th of October 2016. The survey comprised;

1. The placement of appropriately sized flora survey plots within the highest quality 'patch' for the assessment of the federally listed critically endangered *White Box – Yellow Box - Blakely's Red Gum grassy woodland and derived native grassland* [20 x 50 m dimension]
2. Assessment of native and introduced vegetation cover using standard biometric methods
3. Collection of allometric data on remnant trees, this included tree identity, diameter and presence and number of tree hollows.
4. Collection of habitat information as per the field sheets (appendix A) for a general assessment of habitat type and quality
5. Random meanders across the study area
6. Opportunistic fauna sightings and signs of fauna occupation (scats, claw marks).

A total of 12 full vascular plant floristic sites of a 20 x 50 m dimension were placed within Area 3. These were selectively placed within areas likely to contain the potential for higher habitat value. Site placement is shown in Figure 1 and the location of random meanders in Figure 2. Select attributes from each survey site is also given in Table 1. The location of all remnant trees and their identity and size are given in Table 2.

5 RESULTS

Quadrat results and a comprehensive list of flora species identified during the current survey appears in Appendix 1.

At the time of survey all paddocks were cropped or recently left fallow. Only the semi-natural drainage line had not been cropped (Figure 4) though it also was predominantly of non-native composition (see sites 4-9, Table 1).

A total of 60 live native trees were recorded on the site with one standing dead habitat tree (refer Table 2). All remnant trees showed signs of use by native fauna with the majority containing nesting hollows and visible mud and stick based nests. A total of 141 hollows were recorded in these trees.

TABLE 1: Selected attributes of survey sites on Area 3.

Site	Native Taxa	Introduced Taxa	Tree Hollows	Fallen Logs (m)	Native Species Percent Cover					Introduced Species Percent Cover		
					Over storey	Mid storey	Grasses	Shrubs	Other	Over storey	Mid storey	Ground
GAR01	7	24	0	0	0	0	0	0	6	0	0	100
GAR02	4	13	0	0	11	0	0	0	2	0	0	98
GAR03	3	11	1	0	22.5	0	0	0	0	0	0	94
GAR04	14	24	0	0	0	0	2	0	18	0	0	72
GAR05	9	24	13	13	35.5	0	0	0	8	0	0	100
GAR06	8	22	5	22	29	0	0	0	2	0	0	100
GAR07	6	17	0	0	0	0	0	0	10	0	0	100
GAR08	5	14	9	0	22.5	0	0	0	0	0	0	100
GAR09	10	20	11	0	17.5	0	0	0	0	0	0	86
GAR10	8	18	3	3	15.5	0	0	0	0	0	0	94
GAR11	4	10	1	0	0	6.5	0	0	0	0	0	100
GAR12	7	21	0	0	0	0	0	0	28	0	0	68

5.1 White Box – Yellow Box – Blakely's Red gum grassy woodland and derived native grassland

The data collated suggests the entirety of Area 3 would have originally constituted the critically endangered *White Box – Yellow Box – Blakely's Red gum grassy woodland and derived native grassland* community in contrast to the mapping of GHD (2015). Based on current data no-remnant patches meet the requirements of the current determination (DEH 2006). Specifically the minimum condition criteria as outlined in the *White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland* EPBC Act Policy Statement (DEH 2006). In summary to meet these criteria an area/patch must;

1. Have, or have once had, an overstorey dominated by White Box, Yellow Box or Blakely's Red Gum (or Western Grey Box (*E. microcarpa*) or Coastal Grey Box (*E. moluccana*) in the Nandewar bioregion), **[YES]**, and
2. Have a predominantly native ground layer **[NO]**, and
3. Be greater than 0.1ha in size **[YES]**, and
4. Have 12 or more native understorey species present (excluding grasses) and there must be one or more important species as defined by DOTE at, http://www.environment.gov.au/system/files/resources/be2ff840-7e59-48b0-9eb5-4ad003d01481/files/box-gum-species.pdf **[NO]**

Patches that do not meet this last criterion may still be considered part of the listed CEEC if;

5. The patch is greater than 2ha in size, and **[YES]**
6. Has an average of 20 or more mature trees per ha or there is natural regeneration of the dominant overstorey eucalypts. **[NO]**

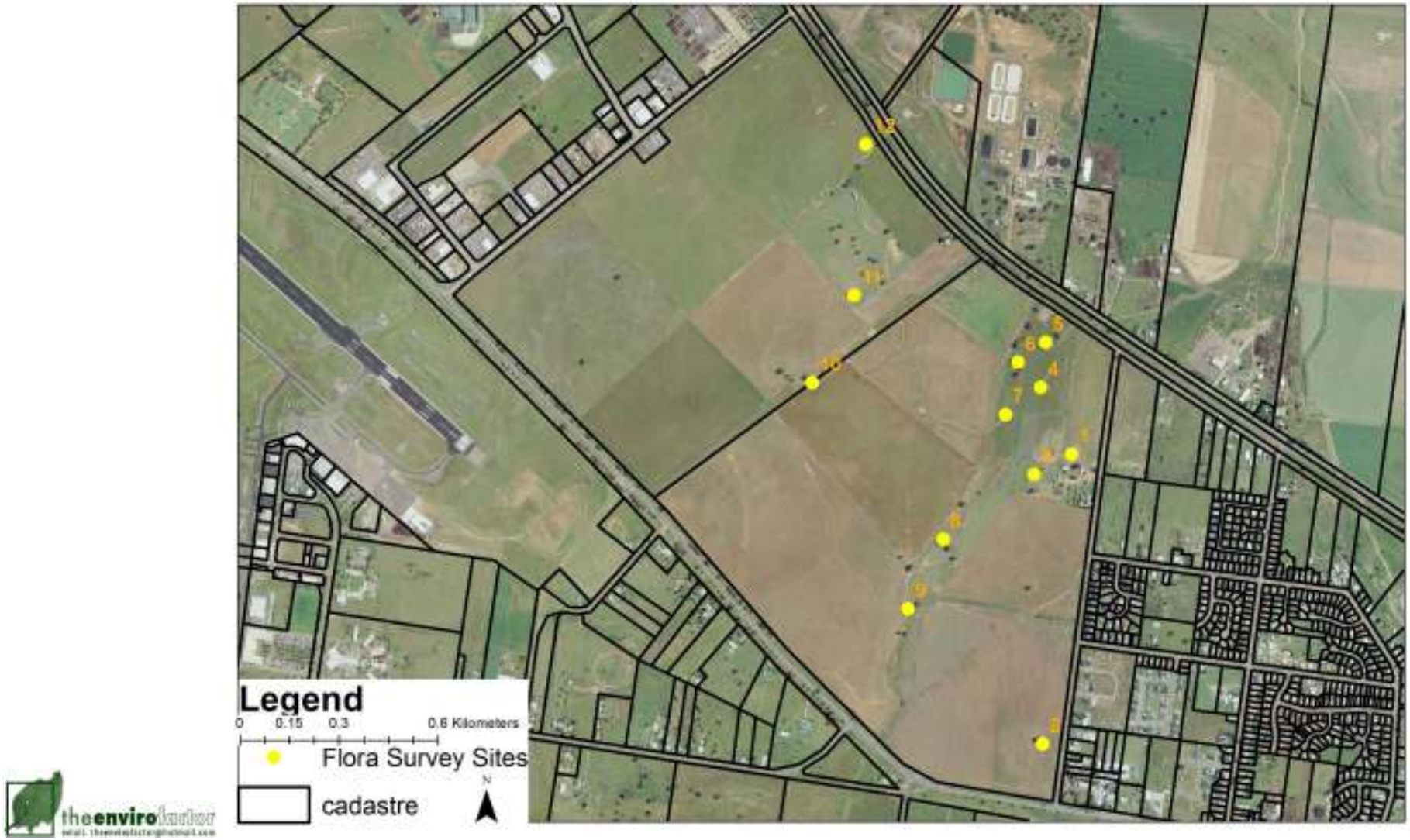

FIGURE 1: Location of 12 full floristic 20 x 50 m sites within Area 3.


Legend
N
0 0.15 0.3 0.6 Kilometers
cadastre

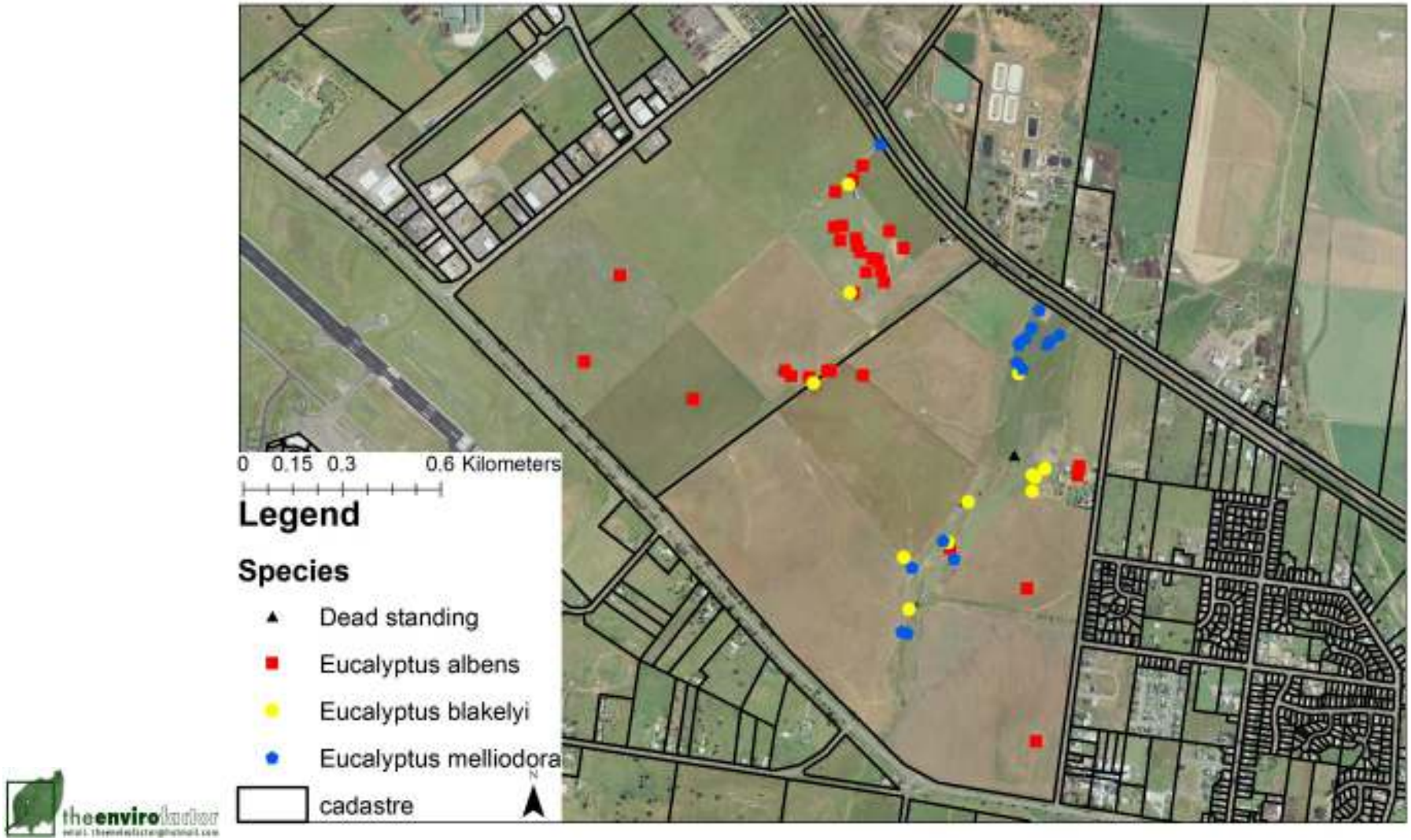

FIGURE 3: Location of remnant trees within Area 3 and their identity.

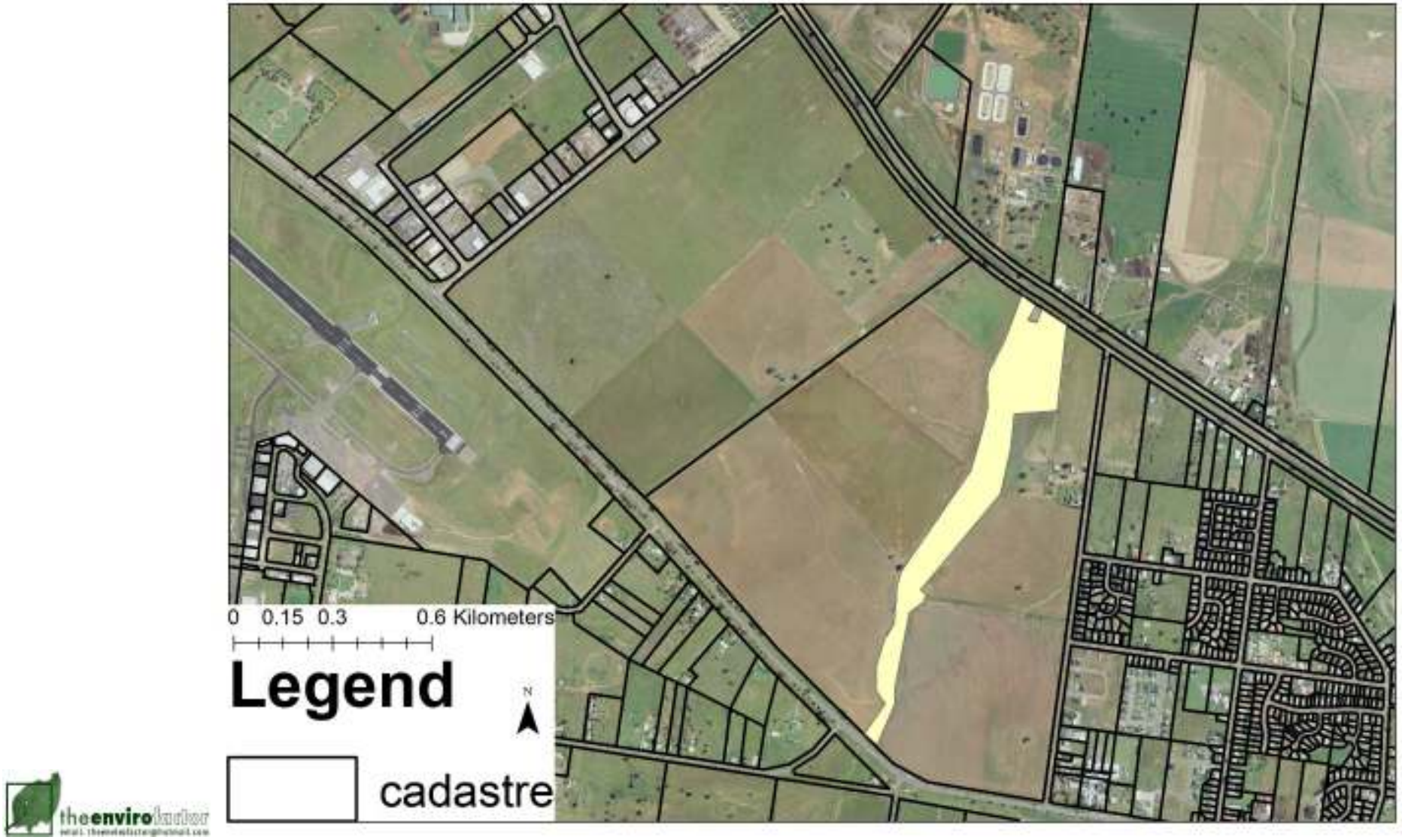

FIGURE 4: Location of non-cropped patch of vegetation that comprises the NSW *White Box Yellow Box Blakely's Red Gum Woodland* Endangered Ecological Community.

While Area 3 meets the size threshold and the remnant trees indicate the original vegetation would have once been dominated by White Box, Yellow Box and/or Blakely's Red Gum, the ground layer is no longer predominantly native and does not support 12 or more native understorey species (excluding grasses). Area 3 also does not have an average of 20 or more mature trees per ha nor is there any natural regeneration of the dominant overstorey species.

In contrast the vegetation within Murroon Creek, although degraded, is considered to be consistent with *White Box Yellow Box Blakely's Red Gum Woodland*, endangered ecological community (EEC) listed under NSW legislation (*Threatened Species Conservation Act 1995*). Under OEH guidelines (NSW NPWS undated) an area will constitute this EEC providing;

1. The site is in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions
2. The site has native species in the understorey, and is likely to respond to assisted natural regeneration
3. White Box, Yellow Box or Blakely's Red Gum, or a combination of these species, are or were present
4. The site is predominantly grassy
5. The understorey of the site is not dominated by shrubs excluding pioneer species.

Area 3 lies within the Nandewar Bioregion, and as shown in Table 1 (refer Sites 4-9) the vegetation along the Murroon Creek drainage depression has native species present in the understorey. Unlike the majority of the site this area has not been cultivated, so is likely to have a native seed bank within the soil that would under appropriate management regenerate.

5.2 Aquatic ecological community

As per the GHD report the creekline and floodplain of Murroon Creek comprises the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* listed under the NSW Fisheries Management Act 1994 (FM Act) (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/636498/FR22-Darling-River-EEC.pdf).

This aquatic ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains of the Darling River within NSW, including the Namoi River (DPI 2007) of which Murroon Creek is a tributary.

5.3 Threatened flora species

No threatened flora species were identified on Area 3 during the current survey.

Threatened flora species, indicated in the GHD (2015) report and reviewed in The Envirofactor (2016) report, that potentially occur within the study area include; *Dichanthium setosum* (TSC and EPBC Acts), *Thesium australe* (TSC Act), *Digitaria porrecta* (TSC Act) and *Picris evae* (TSC & EPBC Acts). Based on the condition of the site, and in particular the long history and of continued extensive cropping that has occurred across the majority of the area, and extensive modification and weed invasion within the

uncropped drainage area, it is highly unlikely that these taxa would be extant. It is possible these species may have once occurred and could occur again if the site was extensively rehabilitated.

TABLE 2: Location and attributes of all native trees found within Area 3.

Species	Zone	Datum	Easting	Northing	Diameter	Hollows	Notes
Dead standing	94	56	296929	6559025	146 cm	9	Nesting birds.
Eucalyptus albens	94	56	296996	6558158	106 cm	4	Nesting birds.
Eucalyptus albens	94	56	296735	6558742	90 cm	4	Fox hole at base of tree. Noisy Minor. Little Lorikeet. Friarbird. Breeding birds.
Eucalyptus albens	94	56	297122	6558962	107 cm	0	
Eucalyptus albens	94	56	297127	6558991	130 cm	3	Woven nest. Red Rump. Starling.
Eucalyptus albens	94	56	296309	6559260	139.5 cm	3	Fox hole at base of tree. Stick nest.
Eucalyptus albens	94	56	296262	655258	97 cm	1	
Eucalyptus albens	94	56	296255	6559264	99.5 cm	3	
Eucalyptus albens	94	56	296236	6559280	125 cm	1	
Eucalyptus albens	94	56	296364	6559279	93.5 cm	1	
Eucalyptus albens	94	56	296374	6559282	74 cm	1	
Eucalyptus albens	94	56	296471	6559267	96 cm	2	
Eucalyptus albens	94	56	295735	6559569	92 cm	5	Stick nest. Galah in hollow. Bees hive.
Eucalyptus albens	94	56	295626	6559308	93 cm	4	Mud nest. Pee Wee. Grass Parrot.
Eucalyptus albens	94	56	295957	6559195	88 cm	0	
Eucalyptus albens	94	56	296444	6559517	86.5 cm	0	
Eucalyptus albens	94	56	296481	6559579	88 + 35 cm	4	
Eucalyptus albens	94	56	296501	6559621	69 cm	2	
Eucalyptus albens	94	56	296518	6559616	70 cm	3	Bees hive.
Eucalyptus albens	94	56	296537	6559549	93 cm	3	
Eucalyptus albens	94	56	296594	6559652	105 cm	1	Grass Parrots.
Eucalyptus albens	94	56	296551	6559705	114 CM	1	
Eucalyptus albens	94	56	296470	6559903	88 cm	1	Stick nest. Pigeon. Falcon.
Eucalyptus albens	94	56	296441	6559860	95 cm	2	Hollow in use. Mud nest.
Eucalyptus albens	94	56	296387	6559823	93.5 cm	3	
Eucalyptus albens	94	56	296409	6559720	77 cm	0	Stick nest.
Eucalyptus albens	94	56	296385	6559716	92 cm	1	Galah using hollow. Stick nest.
Eucalyptus albens	94	56	296403	6559676	88 cm	2	
Eucalyptus albens	94	56	296450	6559681	65 cm	0	
Eucalyptus albens	94	56	296454	6559659	77 cm	2	
Eucalyptus albens	94	56	296464	6559641	88 cm	0	
Eucalyptus albens	94	56	296970	6558620	65 cm	0	
Eucalyptus albens	94	56	296527	6559582	88.5 cm	5	
Eucalyptus blakelyi	94	56	296985	6558965	52 cm	0	
Eucalyptus blakelyi	94	56	296985	6558916	124 cm	0	
Eucalyptus blakelyi	94	56	297023	6558983	67 cm	4	Nesting birds.
Eucalyptus blakelyi	94	56	296945	6559273	115 cm	5	
Eucalyptus blakelyi	94	56	296791	6558884	78.5 & 96 cm	3	Nesting birds. Mud nest. Red Rump. Pee Wee.
Eucalyptus blakelyi	94	56	296730	6558761	103 cm	2	Nesting birds. Stick nest. Nest in hollow. Little Lorikeet. Currawong.
Eucalyptus blakelyi	94	56	296611	6558558	220 cm	11	Friarbird. Willy Wagtail.
Eucalyptus blakelyi	94	56	296321	6559244	69 cm	0	
Eucalyptus blakelyi	94	56	296432	6559518	42 cm	1	
Eucalyptus blakelyi	94	56	296595	6558716	98 cm	0	Stick nest.
Eucalyptus blakelyi	94	56	296427	6559846	104 cm	4	Bees hive. Pee Wee.
Eucalyptus blakelyi	94	56	296993	6558959	125 cm	1	Nesting birds.
Eucalyptus melliodora	94	56	297031	6559361	156 cm	0	
Eucalyptus melliodora	94	56	297039	6559370	151 cm	0	
Eucalyptus melliodora	94	56	297068	6559390	94.5 & 90 cm	0	
Eucalyptus melliodora	94	56	297006	6559465	95 & 70 cm	8	
Eucalyptus melliodora	94	56	296984	6559412	86 cm	0	Fox hole at base of tree.
Eucalyptus melliodora	94	56	296966	6559381	130 cm	5	
Eucalyptus melliodora	94	56	296949	6559371	134 cm	8	
Eucalyptus melliodora	94	56	296945	6559360	96 & 106 cm	3	
Eucalyptus melliodora	94	56	296940	6559306	122.5 cm	0	
Eucalyptus melliodora	94	56	296956	6559286	86 & 61 cm	2	
Eucalyptus melliodora	94	56	296715	6558767	125 cm	3	Nesting birds. Little Lorikeet. Currawong.
Eucalyptus melliodora	94	56	296620	6558685	180 cm	5	Fuscous Honeyeater. Mud Nest. Pee Wee.
Eucalyptus melliodora	94	56	296607	6558485	42 & 76 cm	0	
Eucalyptus melliodora	94	56	296589	6558490	170 & 22 & 20 cm	2	
Eucalyptus melliodora	94	56	296748	6558711	155 cm	2	Ducks roosting.
Eucalyptus melliodora	94	56	296525	6559967	47 cm	0	

5.4 Fauna habitat

Fauna habitat within the project area is suitable for species able to utilize highly modified agricultural land with or without scattered paddock trees, grassy woodland, grassland and ephemeral drainage areas. Sixty mature and old growth eucalypts provide feeding substrates, flowers/nectar and roosting/resting sites. Large and small hollows in old growth trees offer nesting/roosting sites. While scattered occurrences of fallen timber and uncultivated ground cover in the drainage line of Murroon Creek provides some foraging substrates and protection for a range of small woodland, grassland and riparian species, although extensive weed invasion within the ground layer has severely depleted its habitat value for many species. Similarly, the proximity of the project area to existing residential housing and Tamworth Regional Airport is likely to reduce usage of the habitat resources by fauna due to increased human activity, noise, vibration, lighting, vehicle movements and the increased risk of predation due to the presence of domestic cats and dogs.

5.5 Threatened fauna species

A fauna survey was not part of this investigation, however in the collection allometric data for remnant trees, searches were also made of the canopy, trunk and surrounding ground for fauna and/or evidence of their occupation (scats, claw marks, nests). No evidence of Koala occupation was identified within Area 3 (sightings, scats or claw marks) but opportunistic sightings of the Little Lorikeet were made during the current survey.

Area 3 potentially is considered to provide habitat for 20 threatened species listed under State and Federal legislation and 5 migratory species listed under Federal legislation (refer Tables 3 & 4).

TABLE 3:Terrestrial threatened fauna species either known to occur, or likely to occur on Area 3

[#] Status under the TSC, FM and EPBC Acts: **CE**=Critically Endangered, **E**=Endangered, **V**=Vulnerable, **M**=Migratory spp under international agreements CAMBA, JAMBA and RoKAMBA

Species and communities identified on the study site during this current survey

Species recorded within a 20km radius of the study area (Data from BioNet website*: Atlas of NSW Wildlife* – accessed Oct 2016)

Common Name	Scientific Name	TSC Act [#]	EPBC Act[#]	Habitat within Area 3
Birds				
Regent Honeyeater[2]	*Anthochaera phrygia*	CE	E	Woodland patches, isolated paddock trees and clumps of trees
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V		Woodland patches and clumps of trees
Spotted Harrier	*Circus assimilis*	V		Both cultivated and uncultivated areas with or without overstorey trees
Black Falcon	*Falco niger*	V		All vegetation on the project area would provide foraging habitat
Little Lorikeet	*Glossopsitta pusilla*	V		Woodland patches, isolated paddock trees and clumps of trees
Little Eagle	*Hieraaetus morphnoides*	V		Woodland patches, isolated paddock trees and clumps of trees

Common Name	Scientific Name	TSC Act #	EPBC Act#	Habitat within Area 3
Swift Parrot	*Lathamus discolor*	E	E	Woodland patches and isolated paddock trees and clumps of trees would provide foraging habitat
Square-tailed Kite	*Lophoictinia isura*	V		Woodland patches, isolated paddock trees and clumps of trees
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V		Woodland patches, isolated paddock trees and clumps of trees
Barking Owl	*Ninox connivens*	V		Woodland patches, isolated paddock trees and clumps of trees
Scarlet Robin	*Petrocia boodang*	V		Woodland patches, isolated paddock trees and clumps of trees and grassland
Flame Robin	*Petrocia phoenicea*	V		Woodland patches, isolated paddock trees and clumps of trees and grassland
Diamond Firetail	*Stagonopleura guttata*	V		Woodland patches, isolated paddock trees and clumps of trees
Mammals				
Little Pied Bat	*Chalinolobus picatus*	V		Woodland patches, isolated paddock trees and clumps of trees for roosting and foraging
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V		Woodland patches, isolated paddock trees and clumps of trees for roosting and foraging
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	V		Woodland patches, isolated paddock trees and clumps of trees
Koala	*Phascolarctos cinereus*	V	EP	Woodland patches, isolated paddock trees and clumps of trees
Grey-headed Flying Fox	*Pteropus poliocephalus*	V	V	Woodland patches isolated paddock trees and clumps of trees
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	V		Woodland patches, isolated paddock trees and clumps of trees, and grassland
Reptiles				
Pale-headed Snake	*Hoplocephalus bitorquatus*	V		Woodland, woodland patches within the uncultivated Murroon Creek drainage depression

TABLE 4: Migratory fauna species either known to occur, or likely to occur on Area 3

Common Name	Scientific Name	TSC Act #	EPBC Act#	Habitat on Area 3
Fork-tailed Swift	*Apus pacificus*		M	Woodland patches, isolated paddock trees, clumps of trees and grassland
Eastern Great Egret	*Ardea alba*		M	Vegetation associated with Murroon Creek drainage depression
Cattle Egret	*Ardea ibis*		M	Vegetation associated with Murroon Creek drainage depression
White-throated Needletail	*Hirundapus caudacutus*		M	Woodland patches, although may forage over the entire area
Rainbow Bee-eater	*Merops ornatus*		M	Woodland patches, isolated paddock trees, clumps of trees

The original GHD (2015) report identified potential habitat for the Turquoise Parrot (*Neophema pulchella*), Brown Treecreeper (*Climacteris picumnus victoriae*) and Eastern Free-tail Bat (*Mormopterus norfolkensis syn. Micronomus norfolkensis*) on their larger investigation area, of which Area 3 formed part. All 3 of these species generally require much larger and more intact woodland areas, with better landscape connectivity than is evident on Area 3 (NSW Scientific Committee 2001 and 2009; Churchill 2008). None of these species are known to use isolated paddock trees or cultivation areas for foraging, nesting and/or roosting. The small size, poor condition, isolation and on-going disturbance of remnant woodland make it unlikely any of these species would occur on Area 3.

The Envirofactor (2016) review also identified possible habitat for the Bush Stone-curlew (*Burhinus grallarius*) on Area 3. However, this ground dwelling species prefers forests and woodlands with sparse grassy ground cover (OEH website 2016). Given the majority of the area is cropped and the only uncultivated soils along the Murroon Creek drainage line have a dense ground cover dominated by introduced weeds, it is considered unlikely this species would occur on Area 3.

6 PRELIMINARY IMPACT ASSESSMENT

Rezoning of land is for the most part an administrative process which in and of itself has no environmental impact. The environmental impact of rezoning arises from the change in landuse and the subsequent development that it heralds, and as such must take into account the environmental values of the site in question and potential impacts of the landuse change proposed. The degree of any impact on the environment is however determined by; the type of development proposed, the landscape setting, existing vegetation condition and level of disturbance, as well as the avoidance and mitigation measures to be implemented.

In general, and in concurrence with the GHD (2015) report, the impacts of rezoning and development of Area 3 will include:

- habitat loss and isolation
- increased fauna injury and mortality as a result of clearing activities, vehicle strike, competition for reduced resources and increased predation
- erosion, sedimentation and contamination from changed surface water flows, soil disturbance and industry/construction outputs
- changes to surface water flows from increased hardstand areas and landform reshaping
- increased weed invasion and edge effects from changes in landuse and introduction of exotic plants for landscaping
- increased pests and pathogens from construction activities, more concentrated human activity, movement of vehicles and changed surface water flows
- increased and on-going disturbance (human activity, light, noise and vibration).

This preliminary impact assessment aims to provide an indication of the potential impacts subsequent development will have on the broad environmental values of Area 3, and how these impacts may be reduced at the planning, design and construction stages. A more comprehensive assessment of the potential impact of any development on flora and fauna must be undertaken at the development application stage. As the level of impact of any proposed landuse change resulting from rezoning is highly dependent upon; the development footprint, lot sizes/configuration, infrastructure location/design, the types of industry/activities proposed, proximity to remnant habitat, what habitat features are avoided and what mitigation actions are proposed to be implemented.

The impact assessment would need to include an assessment of significance in accordance with section 5A of the NSW *Environment Planning & Assessment Act 1979* (EP&A Act) for threatened biota listed on the TSC Act and FM Acts and an assessment of significance in accordance with the DOE (2013) guidelines for threatened biota and migratory fauna listed under the EPBC Act, which are known or have potential to occur on the area (refer Tables 3 & 4).

6.1 Native vegetation clearing

As per the GHD (2015) report it is considered that, with the exception of those areas reserved for conservation purposes, any subsequent development of the area following rezoning will result in the clearing of vegetation from the entire extent of Area 3. Although extant vegetation on Area 3 is already degraded this clearing is likely to result in further habitat loss and isolation. Given the majority of Area 3 is currently under cultivation the clearing of native vegetation and habitat loss will be limited to the removal of 60 native paddock trees, 43 of which support hollows, and a small area of previously uncultivated land along Murroon Creek.

The GHD (2015) report proposes the conservation of 92.2ha of land along the three creeklines present on their larger investigation site: Tangaratta, Bolton's and Murroon Creeks (refer Figure 4, GHD 2015 report). The findings of this report concur with this proposal for Murroon Creek. Conservation of this area will protect approximately 15ha (refer Figure 4 of this report) of vegetation comprising the NSW listed Box-Gum Woodland EEC, a similar area of the FM Act aquatic EEC, as well as approximately 22 old growth trees and/or dead standing trees, a number of which are hollow bearing. If this recommendation is adopted then clearing for development will potentially involve the removal of 38 paddock trees and the habitat resources they provide.

6.1.1 Loss of old growth trees

Clearing for the development of Area 3 will result in in the loss of potentially 47 old growth trees (refer Table 2). These trees, with a diameter at breast height of greater than 80cm and conservatively estimated between 150-250 years old, are now rare in agricultural landscapes. These trees support a range of habitat features often lacking in younger trees including; an assortment of tree hollow sizes, mistletoe, large areas of feeding substrate (bark), loose bark, and large canopies for shade and shelter. The resources provided by old growth trees are particularly important for species such as; the Swift Parrot, Black-chinned Honeyeater, Little Lorikeet, Regent Honeyeater and Koala.

The recommended retention of approximately 15ha along Murroon Creek (refer Figure 4) for conservation will protect 22 mature and old growth trees, however, the design of subsequent development should, wherever possible, aim to retain old growth trees within public spaces and/or on private land across Area 3 to assist in the maintenance of local fauna populations.

6.1.2 Loss of hollow bearing trees

Large and small tree hollows are a feature of the paddock trees on Area 3 with 141 hollows recorded (refer Table 2). Tree hollows are a well-documented fauna resource with over 300 Australian species reliant on them for shelter and nest sites (NSW Scientific Committee 2007) including 7 threatened species known or likely to occur on the Area 3. They are also recognised for their slow development time taking anywhere between 120-200 years to form. Along with old growth trees this is an important habitat resource that has been largely lost from agricultural landscapes as a result of land clearing, inappropriate fire regimes and on-going removal for firewood.

The recommended retention of approximately 15ha along Murroon Creek for conservation will protect 22 mature and old growth trees, a number of which will be hollow bearing, however, the design of subsequent development should, wherever possible, aim to retain hollow bearing trees within public spaces and/or on private land across Area 3 to assist in the maintenance of local fauna populations.

6.2 Landscape connectivity

Connectivity is the arrangement of suitable habitat within a landscape that allows for the movement of species across hostile areas of non-habitat (eg cleared land, cultivation). A high level of connectivity is important for the maintenance of healthy ecosystems and biodiversity, as it facilitates dispersal/interaction of species and the exchange of genetic material across the landscape.

Landscape connectivity can be continuous (corridors) or discontinuous (patches or remnant trees which act as 'stepping-stones' between areas of habitat). The degree to which any landscape in connected is dependent upon individual species movement abilities. Remnant overstorey trees on Area 3 do provide 'stepping stones' that facilitate the movement of highly mobile species (eg birds and bats) across the landscape. As per the findings of the GHD (2015) report, it is considered the removal of scattered canopy trees for development may increase existing gaps between 'stepping stones' and potentially reduce landscape connectivity.

Existing areas of cultivation are unlikely to be important for connectivity although when under crop it is likely some fauna species will move through the area. In contrast the uncultivated Murroon Creek drainage depression does form an important connection for fauna movement between the road reserves along Wallamore Road and the Oxley Highway. The retention of approximately 15ha of habitat along Murroon Creek for conservation (refer Figure 4) will maintain existing local connectivity for fauna movements within the ground layer, as well as protect 22 overstorey trees. However, to maintain existing landscape connectivity for mobile aerial species the design of subsequent development should, wherever possible, aim to retain existing remnant trees within public species and on private land across Area 3.

6.3 Aquatic habitat

Murroon Creek provides ephemeral aquatic habitat on Area 3, and forms part of the endangered *Aquatic ecological community of the natural drainage system of the lowland catchment of the Darling River* listed under the FM Act. Although degraded by past and current landuse it also provides habitat for a range of wetland and aquatic species (eg frogs, fish, insects) including 3 threatened and/or migratory species likely to occur on the area; the Pale–headed Snake, Cattle Egret and Eastern Great Egret (refer Tables 3 & 4). It is recommended that approximately 15ha along Murroon Creek (refer Figure 4) be retained and managed for conservation to protect the occurrence of the aquatic EEC and habitat for these species. As stated in the GHD (2015) report the habitat value of this area for fauna may be further degraded by edge effects resulting from clearing adjoining vegetation, increased runoff from hardstand areas and potential contamination from sedimentation and industrial operations that may reduce water quality. However, outlined in section 7 are mitigation actions that if implemented will minimise these impacts on this area of remnant habitat.

It is understood there is a potential requirement to construct a storm water retention basin within this conservation area to slow water flows from subsequent development, reduce soil erosion and maintain water quality. No precise location within the Murroon Creek drainage depression, or design plans for such a structure are currently available, so no specific assessment of its potential impact can be made. However a preliminary assessment based on the condition of native vegetation and fauna habitat suggests the impact of such a structure can be minimised by:

- locating the retention basin such that no removal of existing trees is required
- designing the basin to hold water for only short periods during and after storm events to avoid changing the natural flow regime of the Murroon Creek, and
- using endemic native ground layer species for all soil stabilisation plantings.

6.4 Impacts on threatened biota

6.4.1 Threatened ecological communities

As previously identified, vegetation within the Murroon Creek drainage depression constitutes an area of *White Box Yellow Box Blakely's Red Gum Woodland* an EEC listed under the NSW TSC Act, and forms part of the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* EEC listed under the NSW FM Act. It is recommended that 15ha that comprises the Murroon Creek drainage depression be retained and managed for conservation. Protection of this area will ensure the continued survival of both ecological communities on site and substantially limit any impacts that may result from the rezoning and subsequent development of Area 3 would have on these communities.

As described in section 6.3, it is likely any development of Area 3 will require the construction of a storm water retention basin within Murroon Creek drainage depression to slow water flows from any subsequent development, reduce soil erosion and maintain water quality. Although a more detailed assessment of this proposal will be required once a location is selected and design plans drawn it is considered the impact of such a structure can be minimised by the implementation of mitigation actions outlined in sections 6.3 and 7.

6.4.2 Threatened flora

No threatened flora species were identified on Area 3 during the current survey. Given the poor condition of the site and its history of prolonged disturbance it is considered unlikely any threatened flora species occur, although historically they may have been present. Consequently, it is unlikely the subsequent development of Area 3 following rezoning will impact on any threatened flora species.

6.4.3 Threatened fauna

Based on the vegetation and habitat present, it is considered Area 3 provides habitat for 20 threatened fauna species listed under State and Federal legislation and 5 migratory species listed under Federal legislation (refer Tables 3 & 4). Only one threatened fauna species the Little Lorikeet has been identified as occurring on Area 3.

The primary impact resulting from the development of Area 3, for the majority of threatened species, is the loss of the remaining 60 mature and old growth overstorey trees and the resources they provide (refer sections 6.1.1, 6.1.2 and 6.2) as well as the further degradation of Murroon Creek drainage depression (refer section 6.3). The significance of these impacts on threatened species will require more detailed assessment under the EP&A Act and EPBC Act at the development application stage, when the design and footprint of the proposed landuse change is known. However, a preliminary assessment based on current vegetation condition and landscape setting suggests the recommended retention of approximately 15ha along Murroon Creek for conservation (refer Figure 4) and designing the development to retain, wherever possible, existing paddock trees within conservation areas, public spaces and on private land will retain existing habitat resources on site and limit the impact of development on threatened and migratory fauna populations.

6.4.4 Key threatening processes

The rezoning and development of Area 3 will potentially result in actions that constitute, or increase the operation of, listed key threatening processes (KTPS) (refer Table 5) that adversely impact threatened species. These KTPs will need to be considered in the impact assessment at the development stage.

TABLE 5: Key Threatening Processes (KTPs) likely to be increased by development of Area 3

Key Threatening Process	Legislation	Comments
Clearing native vegetation	TSC and EPBC Acts	The proposed rezoning and subsequent development will involve the clearing of vegetation that potentially will result in an increase in the operation of this KTP. Approximately 246ha of vegetation that includes 60 native paddock trees and clumps of trees may be removed for subsequent development. However, if the Murroon Creek drainage depression is retained as a conservation area it will protect approximately 15ha of vegetation that comprises the NSW Box-Gum Woodland EEC and 22 mature and old growth trees.
Clearing of hollow-bearing trees	TSC and EPBC Acts	The proposed rezoning and subsequent development will potentially result in the removal of up to 43 hollow bearing trees which support 141 hollows. Approximately 22 trees (some of which are hollow-bearing) will be retained if the Murroon Creek drainage line is protected and managed for conservation. The design of the

Key Threatening Process	Legislation	Comments
		subsequent development should wherever possible aim to retain other hollow-bearing trees within public spaces or on private land.
Bushrock removal	TSC Act	Given the extent of cropping and ground layer disturbance across Area 3 it is likely that the detrimental impacts of this KTP has already occurred. The proposed rezoning and subsequent development may potentially result in the removal of remaining surface rock from uncultivated areas within Murroon Creek drainage depression. Retention of this area for conservation should however protect this what areas of this resource remain on site.
Removal of dead wood and standing dead trees	TSC Act	Only one dead standing tree was recorded on Area 3 and data collected indicates fallen woody debris is rare or often absent from the majority of the area, probably as a result of clearing and on-going cultivation. Retention of the Murroon Creek drainage depression area for conservation will protect, and over time potentially enhance, this resource on site thereby avoiding the impact of this KTP.
Invasion of plant communities by perennial exotic grasses	TSC Act	Fallow and uncultivated land across Area 3 already supports moderate to severe infestations of perennial exotic grasses. Construction activities, increased human, vehicle and machinery movements and changed surface water flows are likely to facilitate the spread of these grasses and other weed species to off-site areas. Appropriate erosion and sediment control and machinery hygiene procedures should be implemented at the construction phase to reduce the potential spread of weed species. Areas retained for conservation should be managed to reduce the incidence and spread of weeds. These mitigation measures are likely to effectively limit the operation of this KTP.
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	TSC and FM Acts	The natural hydrology of Area 3 is already substantially modified by clearing for agriculture and ongoing cultivation. However, the change in landuse from agriculture to industrial estate will further alter surface water flows as a result of vegetation clearing, increased hardstand areas and land reshaping, thus exacerbating this KTP. The proposed construction of a storm water retention basin within Murroon Creek will potentially mitigate increased surface water flows during storm events within this drainage line, reducing the risk of erosion and sedimentation on-site and downstream and maintaining water quality. The retention of the area along Murroon Creek drainage depression for conservation will additionally provide a riparian buffer that will further reduce the risk of erosion, sedimentation and contamination thereby maintaining water quality.
The degradation of native riparian vegetation along NSW water courses	FM Act	Native riparian vegetation along Murroon Creek although degraded as a result of historic and current landuse, constitutes the aquatic endangered ecological community of the lower Darling River, as well as the NSW Box-Gum woodland EEC. Protection of this drainage depression for conservation will retain both these EECs on-site and limit the impact of this KTP.
Removal of large woody debris from NSW rivers and streams	FM Act	Instream woody debris is likely to be present within Murroon Creek. Protection of this drainage depression for conservation will retain this resource on-site and limit the impact of this KTP.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	TSC and EPBC Acts	Construction activities following the proposed rezoning have the potential to introduce amphibian chytrid to Area 3 which could lead to the potential extinction of local frog populations. The implementation of appropriate mitigation measures during the development stage including erosion and sediment control and machinery/vehicle hygiene procedures should limit the impact of this KTP.

Key Threatening Process	Legislation	Comments
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	TSC and EPBC Acts	Fallow and uncultivated land across Area 3 already supports moderate to severe infestations of exotic plant species. Landscaping activities associated with the development of Area 3 have the potential to exacerbate the existing levels of weed invasion through the escape of exotic garden plants. Landscaped areas and areas retained for conservation should be managed to reduce the incidence and spread of escaped garden plants to limit the operation of this KTP.

6.4.5 State Environmental Planning Policy No 44 (SEPP 44) – Koala Habitat Protection

This policy aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas. To ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. The SEPP achieves this aim by:

(a) requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat; and

(b) encouraging the identification of areas of core koala habitat, and

(c) encouraging the inclusion of areas of core koala habitat in environment protection zones.

As indicated in GHD (2015) report Tamworth Regional Council is not listed under Schedule 1 of SEPP 44, however their conclusion that SEPP 44 is therefore not applicable is incorrect. Schedule 1 does list the constituent councils that were amalgamated to form the Tamworth Regional Council, consequently SEPP 44 is applicable to the Tamworth local government area.

Area 3 does support areas of remnant overstorey trees dominated by White Box (*Eucalyptus albens*) a food tree listed under Schedule 1 of the SEPP and therefore constitute "*potential koala habitat*". However, the *Atlas of NSW Wildlife* (OEH accessed 2016) indicate no Koalas have been recorded on the project area, and an assessment of remnant trees undertaken as part the current survey failed to identify any signs of Koala occurrence (individuals, scats or claw marks). Consequently, there is no evidence a "*resident population*" of Koalas occur on Area 3 and the area is not considered '*core koala habitat'.* Preparation of a Koala Management Plan is therefore not required.

Two other preferred koala food trees, Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*) identified in *Northern Tablelands Koala Recovery Strategy 2015-2025* (Hawes *et al* 2016) also occur on Area 3. Consequently, the assessment undertaken at the development application stage for Area 3 must include an assessment of the impact on Koala habitat under section 5A under the EP&A Act and EPBC Act significance guidelines.

6.5 Fauna injury and mortality

As previously described Area 3 provides habitat resources for range of native fauna species. The principal cause of fauna injury and mortality will arise from vegetation removal that may be associated with the subsequent development of Area 3 following rezoning. While highly

mobile species such as birds and large terrestrial mammals are unlikely to be affected as they can readily remove themselves from the area, small terrestrial fauna (eg mammals, lizards and frogs) sheltering in vegetation within Area 3 will be vulnerable. However, nesting birds, arboreal mammals (gliders and koalas) and roosting /hibernating microbats are at risk of injury or mortality if present during tree clearing activities. The risk of injury and mortality from clearing activities can be reduced by;

- ensuring wherever possible that clearing occurs outside the main breeding and hibernation periods for birds and bats (spring and winter)
- designing the development to retain as many mature and old growth trees as possible within areas protected for conservation, public places and on private land, and
- where clearing is unavoidable implementing habitat tree felling procedures as outlined in section 7, that include pre-clearing inspections to identify any resident fauna prior to felling, staged felling protocols for hollow-bearing trees and safe management of native fauna where detected will reduce the risk of injury and mortality.

Following development of Area 3, there is potential for fauna injury and mortality as a result of vehicle collision due to the increased traffic volume resulting from more intensive human activity. Recommended mitigation measures to reduce this impact would include signposting of high fauna activity areas and enforcing safe speed limits (see section 7).

6.6 Weed invasion and edge effects

As outlined in the GHD (2015) report the term 'edge effects' refers to the changes in populations and/or community structures that occur at the boundary of vegetation patches as a result of adjoining landuse. Edge effects that impact on habitat values include; different physical conditions (light penetration, wind, temperature and moisture), changed vegetation structure, increased weeds, chemical impacts (eg herbicide, fertiliser) and risk of increased predation.

As a consequence of current and historic landuse many of these impacts have already occurred on Area 3. Construction activities, landscaping and industrial processes on rezoned lands may increase the degree of weed infestation, through the dispersal of weed propagules (seeds, stems and flowers) into areas retained for conservation. The result of the increased movement of people, vehicles, machinery and water across the landscape. Appropriate erosion and sediment control and vehicle/machinery hygiene procedures should be implemented before, during and after development and construction to reduce the potential spread of weed species into habitat areas.

Appropriate best management practices for various industrial processes that may occur on site must be implemented to prevent potential industrial contaminants from entering the environment post development. Areas retained for conservation or as public spaces should be managed to reduce the incidence and spread of weeds. If implemented these mitigation measures will assist in reducing weed invasion and potential edge effects, thereby maintaining and potentially improving habitat values on Area 3.

6.7 Pests and pathogens

As detailed in the GHD (2015) report, construction activities associated with the development of area 3 have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Puccinia psidii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) through soil disturbance, importation of soil and plant material, and the increased movement of people, vehicles, machinery and water across the landscape. There is little available information about the distribution of these pathogens within the locality (GHD 2015). No evidence of these pathogens was observed during the GHD (2015) or current survey.

Chytrid fungus affects both tadpoles and adult frogs and can eliminate entire populations once introduced into an area. This pathogen has the potential to impact on frogs living in Murroon Creek.

The implementation of appropriate mitigation measures during the construction stage (as outlined in section 7) including; erosion and sediment control, machinery/vehicle hygiene procedures and ensuring any soil, plants or other materials entering the site are certified free of weeds and pathogens will help prevent the introduction or spread of these diseases.

Agricultural pest species such as foxes, feral cats and rabbits will already be present on Area 3 due to its current and historic landuse. A fox burrow was identified on the area during the current survey (refer Table 2). The proximity of Area 3 to existing residential/rural residential and industrial development would also indicate that domestic dogs and cats are likely to be present. It is unlikely rezoning and subsequent development of Area 3 will increase populations of agricultural pests as the available habitat area for these species will decrease with development. While there is potential that industrial development will increase the impact of predation by domestic dogs and cats it is considered generally unlikely, as these are more often kept as companion animals in residential areas. Retained vegetation in conservation areas and public spaces should be managed to control and reduce pest animal populations.

6.8 Light, noise and vibration

As identified in the GHD (2015) report, the development of Area 3 following rezoning has the potential to result in an increase the level of light, noise and vibration disturbance in retained habitats within Area 3 and adjacent areas. These disturbances and increased human activity will potentially reduce the value of retained habitat for some fauna species. However, given the proximity of Area 3 to existing residential/rural residential, industrial development, including the Tamworth Regional Airport, and the highly disturbed nature of remnant vegetation on site it is considered these impacts will be relatively minor, although this is highly dependent upon the types of industry that occupy the development.

7 RECOMMENDED MITIGATION

Any subsequent development as a result of the rezoning of Area 3 and has the potential to adversely impact native biota and their habitats. Following are recommended mitigation measures likely to be required to avoid or minimise such impacts. As per the GHD (2015) report these measures are presented according to the hierarchy of avoidance and minimisation of impacts, and the provision of offsets to counter residual impacts of the proposed rezoning. They should be should be considered at the planning stage of the development and be revised as more detailed and accurate assessment of the potential impacts is undertaken during the development application stage.

7.1 Impact avoidance

The primary fauna habitat resources likely to be adversely impacted by development resulting from rezoning of Area 3 are the 60 mature and old growth paddock trees and the vegetation within Murroon Creek drainage depression. Although degraded, vegetation along Murroon Creek constitutes both an area of *White Box Yellow Box Blakely's Red Gum Woodland* EEC and forms part of the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* (refer section 6.3). To protect the occurrence of these EECs on site it is recommended that 15ha along Murroon Creek be retained as a conservation area (refer Figure 4). Retention of this area will also protect 22 mature and old growth trees (some of which are hollow-bearing), assist in maintaining landscape connectivity and protect water quality. It is also recommended that any subsequent development be designed to maintain mature and old growth trees within public spaces and on private land across on Area 3.

7.2 Impact mitigation

Many impacts that will result from the development of Area 3 cannot be avoided but can be minimised with appropriate mitigation. The GHD (2015) report recommends the preparation of a Construction Environment Management Plan (CEMP) prior to any site development. This management plan would include a number of sub-plans outlining measures to safeguard the environmental values of the development site including;

- an erosion and sediment control plan
- vegetation management plan
- weed management plan, and
- fauna management plan.

Whether or not mitigation measures are presented within a single management plan, is a decision for Tamworth Regional Council staff. The following sections outline mitigation measures to maintain flora and fauna habitat and two endangered ecological communities on Area 3, as well as protect surface water quality and prevent further spread of invasive species.

7.2.1 Preparation of a development plan

A plan for Area 3 should be prepared prior to any development identifying; lot sizes, the location of infrastructure (powerline easements, roads, stormwater retention basins), trees to removed, public spaces and conservation areas. The plan should aim to preserve as many of the mature and old growth trees within the development footprint as possible, and any storm water retention structure within the Murroon Creek drainage depression must be sited within derived grassland to avoid any tree removal.

Any stormwater retention basin within Murroon Creek must be designed to slow water flows and hold water only temporarily during and following rainfall events.

Once the development plan has been finalised an impact assessment will need to be undertaken in accordance with section 5A of the NSW *Environment Planning & Assessment Act 1979* (EP&A Act) for the 20 threatened species listed under the TSC Act and FM Acts, and an assessment of significance in accordance with the DOE (2013) guidelines for the 4 threatened and 5 migratory fauna listed under the EPBC Act, for which Area 3 provides habitat. These threatened and migratory species are listed in Tables 3, 4 and 5 (refer section 5.5).

Mitigation measures presented in this report should be revised in light of the results of this assessment.

7.2.2 Prior to construction

Communicate to construction personnel the conservation value of remnant habitat and retained vegetation, and their responsibilities with regard to protecting these habitats during construction.

Prior to the commencement of any construction works within Murroon Creek drainage depression consultation with NSW Department of Primary Industries (Fisheries) must be undertaken, and any approvals under the *Water Management Act 2000* (WMA) obtained.

Identify locations for the stockpiling of construction materials and spoil within cultivated areas and a minimum of 20 meters from the dripline of any remnant trees.

Areas retained for conservation and as public spaces must be clearly identified.

Should tree removal be required within the development footprint then the following protocol must be followed

- Prior to felling, all trees must be inspected for hollows and potential sheltering or nesting fauna species by an appropriately qualified person.
- Live trees with a diameter at breast height greater than 30cm and all dead standing trees are potentially hollow-bearing and therefore must be cleared using the following prescriptions;
    - i) clearing of trees wherever possible should be avoided during spring and winter to avoid the disturbance, injury and death of breeding fauna (birds and arboreal mammals) and hibernating fauna (microbats and gliders).
    - ii) where applicable all other vegetation must be cleared around these trees a minimum of two days before actual felling. The noise and vibration of the

machinery and the time lag will encourage any fauna to move away prior to felling.

iii) when felling, the trunk should be hit several times (eg with the bucket of a front-end loader) to alert any sheltering fauna to potential danger and encourage them to move away.

iv) where possible these large, potentially hollow-bearing trees should be felled in stages, again to alert fauna to the danger and encourage their flight.

v) once felled these trees must be inspected for hollows. Any hollows removed must be replaced with artificial nest-boxes of similar dimensions on a one-for-one basis (ie one nest box for each hollow removed). Nest boxes should be placed in trees within areas reserved for conservation or as public spaces or where trees within these areas are unsuitable at other appropriate sites within the immediate locality. Nest-boxes must be located in trees without hollows, with a diameter at breast height greater than 20cm, at a minimum height of 5m and using attachment methods that allow for tree growth in live trees.

vi) felled timber may be used to supplement the habitat values within the area reserved for conservation. To avoid creating a feral pest harbour (for rabbits and foxes) this timber must not be stacked or windrowed but must be laid individually on the ground across the area.

vii) any native fauna species discovered inhabiting trees to be cleared and/or disturbed by clearing must be captured and removed by persons licensed under the NPW Act 1974.

viii) contact WIRES or a local veterinarian should any orphaned, injured and/or sick fauna be discovered.

ix) for each tree removed from the development site 3 endemic Eucalyptus spp [see species listed in recommendation in section 7.2.5 below] must be replanted within the conservation area along Murroon Creek. Trees should be planted in clumps and tree guards used to give some protection from water stress and pests. Trees should not be staked. Plantings must be monitored for 2 years post-planting and any losses in this time replaced.

Best practice erosion and sediment control measures must be implemented before, during and after construction works commence to minimise the movement of sediment and/or chemicals in surface water.

7.2.3 During construction

Undertake regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality.

Manage material stockpiles to ensure no offsite impacts occur as a result of dust generation or sedimentation.

Treat all soil from Area 3 as 'contaminated' by weed seed and stockpile/re-spread only on areas with similar levels of infestation.

Machinery and equipment used in the development of Area 3 must be thoroughly cleaned, in accordance best practice and Australian Government's (2015) '*Arrive Clean, Leave Clean*' guidelines, to remove all soil and vegetative material before being brought on-site and then before being moved to a new location, to prevent the spread of noxious pests, weeds and pathogens.

The transportation, storage, handling and waste disposal of all chemical substances and potential pollutants used on the project area; including those related to machinery operation (fuel and oil), construction materials (lime and concrete mix) and rehabilitation (fertilisers), must comply with the requirements of *Protection of the Environment Operations Act 1997*.

All construction activities must be excluded from areas reserved for conservation or public spaces. Activities that must not occur within these areas (excluding those areas requiring soil disturbance for the construction of a storm water retention structure) include;

- clearing native vegetation including native regrowth
- stockpiling of construction materials, spoil etc.
- machinery/vehicle movement or parking
- excavation or spreading of soil/mulch
- 'tidying-up', under-shrubbing or disturbance of fallen timber
- planting non-native or non-endemic native; tree, shrub and ground layer species
- collection of standing or fallen dead timber for firewood
- grazing of domestic stock
- inappropriate fire regimes, and
- dumping of rubbish and/or garden waste.

7.2.4 Post construction

Undertake regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality.

Any planting for soil stabilisation must use endemic native grasses.

Signposting should be installed on roads to identify areas of high fauna activity. Appropriate speed zones should be enforced to reduce potential injury and death of fauna from vehicle strike.

A weed control and management plan should be developed for areas retained for conservation and as public spaces. Removal of weeds (introduced species) must be carried out using appropriate control methods including:

- removing weeds by hand ensuring that all plant parts which can reproduce are removed and soils do not become prone to erosion.
- use of carefully selected herbicide according to label directions and/or current off label permit, ensuring minimal off target damage.

- using appropriate control measures as recommended in the Department of Primary Industries *Noxious and Environmental Weed Control* 5th Edition 2011 or equivalent replacements for control of weeds, ensuring minimal off-target damage.

7.2.5 Management of retained vegetation for conservation

Activities which can occur within areas reserved for conservation or as public spaces which will enhance their habitat value include;

- replanting of endemic native overstorey [white box (*Eucalyptus albens*), yellow box (*E. melliodora*), Blakely's red gum (*E. blakelyi*) only]
- replanting of endemic native shrubs [native olive (*Notelaea microcarpa*), hickory wattle (*Acacia implexa*), western golden wattle (*Acacia decora*) only]
- planting endemic native grasses and forbs
- supplementation of key habitat elements such as the addition of woody debris and/or nest boxes
- control of introduced species trees shrubs and ground layer species.

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APPENDIX A:

FLORA SPECIES RECORDED ON GLEN ARTNEY AREA 3, TAMWORTH NSW

October 2016.

	Monocotyledon
	Cyperaceae
Native	*Carex inversa* R.Br. Knob Sedge
Introduced	*Cyperus eragrostis* Vahl Umbrella Sedge
Native	*Eleocharis plana* S.T.Blake Spike Rush
	Juncaceae
Native	*Juncus usitatus* L.A.S.Johnson Common Rush
	Poaceae
Native	*Austrostipa aristiglumis* (F.Muell.) S.W.L.Jacobs & J.Everett Plains Grass
Native	*Austrostipa verticillata* (Nees ex Spreng.) S.W.L.Jacobs & J.Everett Slender Bamboo Grass
Introduced	*Avena fatua* L. Wild Oats
Native	*Bothriochloa biloba* S.T.Blake Bluegrass
Introduced	*Briza maxima* L. Quaking Grass
Introduced	*Bromus catharticus* Vahl Prairie Grass
Introduced	*Bromus diandrus* Roth Great Brome
Introduced	*Bromus molliformis* Jn. Lloyd Soft Brome
Native	*Enteropogon acicularis* (Lindl.) Lazarides Curly Windmill Grass
Introduced	*Hordeum leporinum* Link Barley Grass
Native	*Leptochloa ciliolata* (Jedwabn.) S.T.Blake Canegrass
Introduced	*Lolium perenne* L. Perennial Ryegrass
Introduced	*Paspalum dilatatum* Poir. Paspalum
Introduced	*Phalaris paradoxa* L. Paradoxa Grass
Introduced	*Poa annua* L. Winter Grass, Annual Poa
Native	*Pseudoraphis spinescens* (R.Br.) Vickery Spiny Mudgrass
Introduced	*Vulpia bromoides* (L.) Gray Squirrel Tail Fescue
Introduced	*Vulpia muralis* (Kunth) Nees Fescue
	Dicotyledon
	Apiaceae
Introduced	C*iclospermum leptophyllum* (Pers.) Sprague Slender Celery
Introduced	*Conium maculatum* L. Hemlock
Native	*Daucus glochidiatus* (Labill.) Fisch., C.A.Mey. & Ave-Lall. Native Carrot
	Asteraceae
Introduced	*Arctotheca calendula* (L.) Levyns
Native	*Calotis lappulacea* Benth. Yellow Burr-daisy
Introduced	*Carduus tenuiflorus* S.Curtis Winged Slender Thistle
Introduced	*Centaurea melitensis* L. Maltese Cockspur
Introduced	*Chondrilla juncea* L. Skeleton Weed
Native	*Chrysocephalum apiculatum* (Labill.) Steetz Common Everlasting
Introduced	*Cirsium vulgare* (Savi) Ten. Spear Thistle
Introduced	*Conyza bonariensis* (L.) Cronq. Flaxleaf Fleabane
Native	*Cotula australis* (Sieber ex Spreng.) Hook.f. Common Cotula, Carrot Weed
Native	*Euchiton involucratus* (G.Forst.) Holub Star Cudweed
Introduced	*Gnaphalium polycaulon* Pers. Cudweed

Introduced	*Lactuca serriola* L. forma *integrifolia* Prickly Lettuce
Introduced	*Schkuhria pinnata* var. *abrotanoides* (Roth) Cabrera Dwarf Marigold
Introduced	*Silybum marianum* (L.) Gaertn. Variegated Thistle
Introduced	*Sonchus oleraceus* L. Common Sowthistle
Introduced	*Taraxacum officinale* Weber Dandelion
	Boraginaceae
Introduced	*Echium plantagineum* L. Paterson's Curse, Salvation Ja
	Brassicaceae
Introduced	*Capsella bursapastoris* (L.) Medikus Shepherd's Purse
Introduced	*Lepidium africanum* (Burman f.) DC. Peppercress
Introduced	*Lepidium bonariense* L. Peppercress
Introduced	*Rapistrum rugosum* (L.) All. Turnip Weed, Giant Mustard
Introduced	*Sisymbrium erysimoides* Desf. Smooth Mustard
	Campanulaceae
Native	*Wahlenbergia communis* Carolin Tufted Bluebell
Native	*Wahlenbergia stricta* (R.Br.) Sweet subsp. *stricta* Tall Bluebell
Native	*Wahlenbergia tumidifructa* P.J.Sm. Bluebell
	Caryophyllaceae
Introduced	*Cerastium balearicum* Herm. Mouse-ear Chickweed
Introduced	*Paronychia brasiliana* DC. Brazilian Whitlow
Introduced	*Silene dioica* (L.) Clairv.
	Chenopodiaceae
Native	*Chenopodium carinatum* R.Br. Crowned Goosefoot
Native	*Maireana aphylla* (R.Br.) Paul G.Wilson Cotton Bush
	Crassulaceae
Native	*Crassula colorata* var. *acuminata* (Reader) Toelken Stonecrop
	Euphorbiaceae
Native	*Poranthera microphylla* Brongn. Small Poranthera
	Fabaceae
Introduced	*Medicago minima* (L.) Bartal. Woolly Burr Medic
Introduced	*Medicago polymorpha* L. Burr Medic
Native	*Swainsona reticulata* J.M.Black Variable Swainsona
Introduced	*Trifolium arvense* L. Hares Foot Clover
Introduced	*Trifolium dubium* Sibth. Yellow Suckling Clover
Introduced	*Trifolium glomeratum* L. Clustered Clover
Introduced	*Trifolium subterraneum* L. Subterranean Clover
Introduced	*Trifolium tomentosum* L. Woolly Clover
	Fumariaceae
Introduced	*Fumaria muralis* Sond. ex Koch subsp. *muralis* Wall Fumitory
	Geraniaceae
Introduced	*Erodium cicutarium* (L.) L'Her. ex Aiton Common Storksbill/Crowfoot
Native	*Erodium crinitum* Carolin Blue Storksbill, Blue Crowfoot
Introduced	*Erodium moschatum* (L.) L'Her. ex Aiton Musky Crowfoot/Storksbill
Introduced	*Geranium molle* L. subsp. *molle* Cranesbill Geranium
Native	*Geranium solanderi* Carolin var. *solanderi* Native Geranium
	Goodeniaceae
Native	*Goodenia pinnatifida* Schldl. Scrambled Eggs
	Lamiaceae

Introduced	*Lamium amplexicaule* L. Dead Nettle
Introduced	*Marrubium vulgare* L. Horehound
Introduced	*Stachys arvensis* (L.) L. Stagger Weed
	Linaceae
Native	*Linum marginale* A.Cunn. ex Planchon Native Flax, Wild Flax
	Lobeliaceae
Native	*Pratia concolor* F.Wimmer Darling Pratia
	Loranthaceae
Native	*Amyema pendulum* (Sieber ex Spreng.) Tiegh. Drooping Mistletoe
	Malvaceae
Introduced	*Malva parviflora* L. Small-flowered Mallow
	Myrtaceae
Native	*Eucalyptus albens* Benth. White Box
Native	*Eucalyptus blakelyi* Maiden Blakely's Red Gum
Native	*Eucalyptus melliodora* A.Cunn. ex Schauer Yellow Box
	Oleaceae
Native	*Jasminum suavissimum* Lindl. Small-leaved Jasmine
	Oxalidaceae
Native	*Oxalis corniculata* L. Creeping Oxalis
Native	*Oxalis perennans* Haw. Wood Sorrel
	Plantaginaceae
Introduced	*Plantago lanceolata* L. Lamb's Tongues, Plantain
Introduced	*Plantago major* L. Large Plantain
	Polygonaceae
Introduced	*Polygonum aviculare* L. Wireweed
Native	*Rumex brownii* Campd. Swamp Dock
Native	*Rumex tenax* Rech.f. Dock
	Primulaceae
Introduced	*Anagallis arvensis* L. Scarlet or Blue Pimpernel
	Rubiaceae
Native	*Asperula conferta* Hook.f. Common Woodruff
	Rubiaceae
Introduced	*Galium aparine* L. Goosegrass, Cleavers
	Scrophulariaceae
Introduced	*Misopates orontium* (L.) Raf. Lesser Snapdragon
	Solanaceae
Introduced	*Lycium ferocissimum* Miers African Boxthorn
	Sterculiaceae
Native	*Brachychiton populneus* R.Br. Kurrajong
	Urticaceae
Native	*Urtica incisa* Poir. Stinging Nettle
Introduced	*Urtica urens* L. Small Nettle
	Verbenaceae
Introduced	*Verbena bonariensis* L. Purpletop

APPENDIX B:

FLORA SURVEY QUADRAT DATA COLLECTED ON THE GLEN ARTNEY AREA 3, TAMWORTH NSW

October 2016

Current Survey: **S#** = Site number; ***** - introduced species; **Braun Blanquet cover abundance:** **1**=<5% (rare number of individuals in quad); **2**= <5% (species common in quad); **3**= 5-25%; **4**= 25-50%; **5**=51-75%; **6**= 76-100%;

		Current survey											
Scientific Name	**Common Name**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8-**	**S9**	**S10**	**S11**	**S12**
Amyema pendulum	Drooping Mistletoe						1						
*Anagallis arvensis**	Pimpernel	1	2	2	2					1	2		3
*Arctotheca calendula**	Capeweed	4	1	3	1		1	1	2		1	2	
Asperula conferta	Common Woodruff						1						
Austrostipa aristiglumis	Plain's Grass					1				1			
Austrostipa verticillata	Slender Bamboo Grass									1	1		
*Avena fatua**	Wild Oats		4		2	2	2	2		2	2		
Bothriochloa biloba	Lobed Redgrass												3
*Briza maxima**	Quaking Grass												2
*Bromus catharticus**	Prairie Grass				2		2						
*Bromus diandrus**	Great Brome					2				2			
*Bromus molliformis**	Soft Brome				2	2		4	3	2	3		2
Calotis lappulacea	Yellow Burr-daisy	1											
*Capsella bursapastoris**	Shepherd's Purse	1		2	1	2	2	2				2	
*Carduus tenuiflorus**	Winged Slender Thistle	2											
Carex inversa	Knob Sedge				2	2	2	2			1		
*Centaurea melitensis**	Maltese Cockspurr			1	2	2	2		2				
*Cerastium balearicum**	Mouse-eared Chickweed												2
Chenopodium carinatum	Crowned Goosefoot	1											
*Chondrilla juncea**	Skeleton Weed	1	1				2	1					

		Current survey											
Scientific Name	Common Name	S1	S2	S3	S4	S5	S6	S7	S8~	S9	S10	S11	S12
Chrysocephalum apiculatum	Common Everlasting	1			2								
*Ciclospermum leptophyllum**	Slender Celery	2			3	3	2	2		1	2		2
*Cirsium vulgare**	Black Thistle	1			1		2		1	1			
*Conium maculatum**	Hemlock					2					1		
Conyza bonariensis	Flaxleaf Fleabane	2				1							
Cotula australis	Common Cotula	3			2	2		2			1	1	3
Crassula colorata	Stonecrop												2
*Cyperus eragrostis**	Umbrella Sedge				2					2			
Daucus glochidiatus	Native Carrot		3		3		1	1					
*Echium plantagineum **	Paterson's Curse	1			1	2	2			1	1	2	
Eleocharis plana	Spike Rush				4								
Enteropogon acicularis	Curly Windmill Grass												2
*Erodium cicutarium**	Common Storksbill								1				1
Erodium crinitum	Blue Storksbill		1			2							
*Erodium moschatum**	Musty Crowfoot						1						
Eucalyptus albens	White Box		1						1		1	1	
Eucalyptus blakelyi	Blakely's Red Gum			3			1		1	1	1	1	
Eucalyptus melliodora	Yellow Box					3	3		1				
Euchiton involucratus	Star Cudweed	2			1								
*Fumaria muralis **	Wall Fumitory				2							2	
*Galium aparine**	Goosegrass					1	2			1			
*Geranium molle**	Cranesbill Geranium				2	2	1	1	2	1			
Geranium solanderi	Australian Cranesbill				2					1			
*Gnaphalium polycaulon**	Cudweed	2											1
Goodenia pinnatifida	Scrambled Eggs				2								
*Hordeum leporinum**	Barley Grass	2	3	5	2	5	3	4	6	4	5	6	2

		Current survey											
Scientific Name	Common Name	S1	S2	S3	S4	S5	S6	S7	S8~	S9	S10	S11	S12
Jasminum suavissimum	Small-leaved Jasmine	1											
Juncus usitatus	Common Rush				2					1	1		
*Lactuca serriola**	Prickly Lettuce	1	1			2	1						2
*Lamium amplexicaule**	Dead Nettle			1							2		1
*Lepidium africanum**	Peppercress		1										2
*Lepidium bonariense**	Cut-leaf Peppercress	2											
Leptochloa ciliolata	Canegrass	1											1
Linum marginale	Native Flax												2
*Lolium perenne**	Perennial Ryegrass		4		3	4	5	4		2	2		3
*Lycium ferocissimum **	African Boxthorn						1			2	1		
Maireana aphylla	Cotton Bush									1			
*Malva parviflora**	Small-flowered Mallow	2		2			1		3			1	2
*Marrubium vulgare**	White Horehound					2							
*Medicago minima**	Woolly Burr Medic				2								
*Medicago polymorpha**	Burr Medic				2		2	2					
*Misopates orontium**	Lesser Snapdragon				2		1	1					1
*Oxalis corniculata**	Creeping Oxalis					1							
Oxalis perennans	Soursob			1							1		
*Paronychia brasiliana**	Brazilian Whitlow	2											
*Paspalum dilatatum**	Paspalum				2	1		1		2			
*Phalaris paradoxa**	Paradoxa Grass										2		
*Plantago lanceolata**	Ribwort				2	2	2	2		2	1		
*Plantago major**	Large Plantain	2											2
*Poa annua**	Winter Grass			2	1			2	1				
*Polygonum aviculare**	Wireweed		2	2		2		1	1	2	2	1	2
Poranthera microphylla	Small Poranthera					1							

		Current survey											
Scientific Name	**Common Name**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8~**	**S9**	**S10**	**S11**	**S12**
Pratia concolor	Darling Pratia				2					1			
Pseudoraphis spinescens	Spiny Mudgrass				2					3			
*Rapistrum rugosum**	Turnip Weed		2						1				
Rumex brownii	Slender Dock			1		2	2	1		1	1		
Rumex tenax	Dock	1			2			2	1	2		2	
*Schkuhria pinnata**	Dwarf Marigold												2
*Silene dioica**		3											
*Silybum marianum**	Variegated Thistle	1				2			2	3	4		
Sisymbrium erysimoides	Smooth Mustard					2		2	2	2	2	2	
*Sonchus oleraceus**	Common Sowthistle	1	1		1	2	1						1
*Stachys arvensis**	Stagger Weed	1											
Swainsona reticulata	Variable Swainsona				1								
*Trifolium arvense**	Hare's-foot Clover												1
*Trifolium dubium**	Yellow Suckling Clover*				2								2
*Trifolium glomeratum**	Clustered Clover	1				2					1	3	
*Trifolium subterraneum**	Subterranean Clover		1	1					1				
*Trifolium tomentosum**	Woolly Clover	1											
Urtica incisa	Stinging Nettle									1			
Urtica urens	Small Nettle	2		3		2	1		4	2	4	2	
*Verbena bonariensis**	Purple Top	1				1		1		2			1
*Vulpia bromoides**	Squirrel Tail Fescue	2											
*Vulpia muralis**	Rat-tail Fescue				3								
Wahlenbergia communis	Tufted Bluebell				2	1	1	1					3
Wahlenbergia stricta	Tall Bluebell	2											
Wahlenbergia tumidifructa	Bluebell		1										

APPENDIX C: PHOTOGRAPHS OF FLORA SURVEY SITES – GLEN ARTNEY AREA 3.