

BIODIVERSITY SURVEY AND ASSESSMENT

CHARLES STURT UNIVERSITY ORANGE



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EXECUTIVE SUMMARY AND RECOMMENDATIONS

A biodiversity survey was conducted on lands managed by Charles Sturt University, Orange over seven days in June and August 2012. The key findings of the survey were:

Flora

- The CSU Orange campus and farm (the study area) supports at least 173 species of flora, of which 55 (31.8%) are native, 76 (43.9%) are wild growing introduced plants and 42 (24.3%) are planted species that include Australian natives from other regions and exotic ornamental species.
- The CSU farm area supports eight species of remnant native *Eucalyptus* trees which occur as woodlots, small groups and isolated paddock trees.
- The original native shrub and ground cover has been almost entirely eliminated over most of the study area, except for some areas dominated by a few species of native grasses.
- The original vegetation of the study area is considered to have comprised three main communities:
 - Ribbon Gum – Apple Box – Broad-leaved Peppermint grassy open woodland and forest.
 - Ribbon Gum – Apple Box – Snow Gum – Candlebark grassy open woodland and forest.
This community is equivalent to the *Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions Endangered Ecological Community* listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act).
 - Yellow Box – Apple Box grassy open woodland with patches of White Box and Blakely's Red Gum.
This vegetation, known commonly as Box-Gum Woodland, is part of the *White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community* listed under the NSW TSC Act and the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community* listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Most of the current vegetation on the study area comprises exotic pastures for livestock grazing. There are also distinctive vegetation types associated with a small area of swampland, native grasslands and alluvial creek flats along Summer Hill Creek.
- The study area also has a range of mainly native plantings for a range of purposes including; a large shelterbelt on the western, southern and eastern sides of the built parts of the campus, windbreaks on paddock boundaries, research, environmental restoration and visual amenity.
- Five weeds listed as Noxious under the NSW Noxious Weeds Act were found on the study area. Two of these, Blackberry and Willows, are listed as Weeds of National Significance by the Australian Weeds Committee.

Fauna

- Sixty two native and introduced fauna species were recorded for the study area in this survey, including 54 birds (52 native, 2 introduced), six mammals (3 native, 3 introduced), no reptiles and two frogs (both native).
- Previous surveys and observations have recorded 113 birds (110 native, 3 introduced), six frogs (all native), eight reptiles (all native) and eleven mammals (5 native, 6 introduced).
- An outstanding feature of the College Farm is the presence of 59 habitat trees, comprising fifty living old growth trees of seven species and nine dead trees (stags).
- A fauna habitat assessment found that the existing vegetation on all parts of the study area compares very poorly with the benchmarks for the original vegetation and can be regarded as highly degraded.
- Three introduced mammal species recorded by the survey and /or previously, the European Rabbit, Red Fox and House Cat, are regarded as pest animals. The effects of each on the environment and biodiversity are listed as Key Threatening Processes under the NSW TSC Act.

Threatened Biodiversity

- Two remnants of Box-Gum Woodland qualify for protection under the Commonwealth EPBC Act on the basis of their size (>2ha) and tree density.
- Three native eucalypt species planted on the study area, Narrow-leaved Black Peppermint (*Eucalyptus nicholii*), Wallangara White Gum (*Eucalyptus scoparia*) and Paddys River Box (*Eucalyptus macarthurii*) are listed as threatened under the TSC Act and the first two are also listed as Vulnerable under the EPBC Act in their native habitats. No other threatened flora species was detected or reported during the survey.
- Six threatened bird species have been recorded in surveys of the study area. The Flame Robin (*Petroica phoenicea*), was detected during this and previous surveys. The Little Eagle (*Hieraaetus morphoides*), Superb Parrot (*Polytelis swainsonii*), Speckled Warbler (*Chthonicola sagittata*), Scarlet Robin (*Petroica multicolour*) and Varied Sitella (*Daphoenositta chrysoptera*), have been recorded previously, albeit rarely.

Environmentally Important Areas

- The most environmentally important elements on the CSU Orange campus are considered to be the 59 habitat trees which provide nesting and denning opportunities for a wide range of birds, microbats and arboreal mammals. These trees appear to support a widespread population of Sugar Gliders (*Petaurus breviceps*) that den in the habitat trees and feed on the sap of Ribbon Gums. It is possible that the threatened Squirrel Glider (*Petaurus norfolcensis*) is also present.
- The native shelterbelt and windbreaks provide roosting and nesting habitat for a variety of native birds.
- The native grassland areas are a rare habitat on the NSW Central Tablelands where most grazing paddocks have been converted to exotic pastures.
- The larger farm dams provide refuge for many water birds.

Environmental Issues

A number of environmental issues were observed during inspections of the study area including;

- Soil erosion in Mendhams Creek has resulted in deep incision of the creek which would formerly have been a shallow 'chain of ponds' structure.
- Major infestations of the environmental weeds, Willows and Blackberry, occur on Summer Hill Creek in Banjo's Paddock.
- Loss of stags due to firewood harvesting is evident.
- The noxious animal, Red Fox (*Vulpes vulpes*) is abundant on the College Farm and is likely to be having a serious detrimental effect on biodiversity.
- The noxious weed, St. Johns Wort (*Hypericum perforatum*), is common in the Brick Kilns paddocks.

Impact Assessment

- Assessments (Seven Part Tests of Significance) under the NSW TSC Act of the likely impact of future development projects around the existing campus infrastructure showed there would not be significant effects on any threatened flora or fauna.
- It is concluded that future developments on the CSU Orange campus that adversely affected trees of the Narrow-leaved Black Peppermint, Wallangara White Gum and Paddys River Box would have no impact on natural populations of these species. However, the trees planted in the university woodlots are part of large cultivated populations, scattered over many parts of south eastern Australia, that guarantee the survival of the species should they decline further in the wild. It is therefore desirable that harm to these trees is avoided wherever feasible.
- It is concluded that future developments on the CSU Orange campus would not adversely affect populations of the threatened Silky Swainson-pea or Austral Toadflax, as suitable habitat for these species is absent, and no populations are known or likely to occur on CSU land.
- It is concluded that future developments on the CSU Orange campus would not significantly affect populations of the 13 threatened fauna species, as suitable breeding habitat for all of the species is absent in areas likely to be developed. However, future developments that affect food resources for these species may result in a slight decrease in the foraging habitat available.
- Ribbon Gums are listed in Schedule 2 of NSW SEPP 44 as a preferred food tree of the Koala. Remnant mature Ribbon Gum trees occur on the study area. SEPP 44 requires consideration of the study area as potential Koala habitat. However, the study area does not include 'core' Koala habitat and a SEPP 44 plan of management is not required.
- Any development proposal that would adversely impact on two Box-Gum Woodland remnants identified as qualifying for protection under the EPBC Act would potentially require referral to the Commonwealth Department of Sustainability Environment Water Population and Communities. However, these remnants occur in areas unlikely to be developed.

RECOMMENDATIONS

The report contains a set of recommendations for biodiversity enhancement including the following;

- That two remnants of Box-Gum Woodland meeting Commonwealth EPBC Act protection criteria be formally protected under the College Farm management plan and that they be prioritised for vegetation enhancement activities.
- That the 59 habitat trees and stags be protected and that the original ecosystem context of these trees be restored by planting appropriate seedling trees, shrubs and ground covers around them.
- That the remnant native grasslands on the College Farm be utilised for rehabilitation of the original vegetation communities where practicable.
- That revegetation projects aim to re-establish the original vegetation communities according to their likely distribution and floristic composition on the property.
- That a network of vegetation corridors be established to link remnant woodland patches and habitat trees across the property.
- That control programs be implemented along Summer Hill Creek for the declared noxious weed Blackberry, and Willows.
- That exotic berry producing species, including Blackberry, Hawthorn, Cotoneaster and Firethorn, be eradicated in order to reduce predation of native birds by Pied Currawongs.
- That trees and other plant forms characteristic of the original communities be established along Mendhams Creek and Summer Hill Creek.
- That the value for water birds of the two largest dams on the property be increased by restricting access by stock, allowing tall emergent water plants to grow in the shallow backwaters and planting appropriate tree species.

Additional recommendations are;

- That CSU participates in local and regional control programs for the Red Fox.
- That any future development proposals avoid, as far as practicable, harm to plantings of the Narrow-leaved Black Peppermint, Wallangara White Gum and Paddys River Box on the study area.
- That works be undertaken with the advice of a Soil Conservationist to halt erosion in Mendhams Creek and to begin restoration of the creek to its original 'chain of ponds' condition.
- That stags be protected on the College Farm and that firewood harvesting of stags be banned.

INTRODUCTION

FloraSearch was commissioned by Charles Sturt University (CSU) to conduct a biodiversity survey and assessment on the Orange campus (the Study Area) of the university as part of a planning process for future developments. The survey and assessment is conducted in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), *NSW State Environmental Planning Policy No. 44* (SEPP44) and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1995* (EPBC Act).

The objectives of the surveys and this report are to:

- define, describe and map the natural vegetation communities occurring on the Study Area;
- compile lists of flora and fauna species found on the Study Area;
- conduct targeted searches for threatened flora and fauna species, populations, ecological communities and critical habitat, considered possible occurrences within the study area (including those listed under the schedules of the *NSW Threatened Species Conservation Act 1995* (TSC Act) and the EPBC Act, and any flora species listed as rare or poorly known in *Rare or Threatened Australian Plants* [ROTAP]), and map the location of any threatened species identified;
- assess the condition of the vegetation;
- assess the potential impact of possible future developments on threatened flora and fauna species, populations, ecological communities and critical habitat via Seven Part Tests of Significance;
- define areas of environmental significance;
- define areas that harbour noxious weeds or pests;
- identify any land subject to Local, State or Federal environmental planning instruments or other legislation having implications for planning or land management;
- recommend how current levels of biodiversity can be maintained or enhanced in the longer term;

THE STUDY AREA

The study area comprises all lands vested in the university (Figure 1), except those designated for future transfer to the NSW Department of Primary Industries. The latter includes parcels 300/1047282, the part of 301/1047282 west of Leeds Parade, 2/7214, 3/7214, 4/7214 and 5/7214. The study area thus includes the built areas of the campus and extensive grazing paddocks to their north, north east and east. The southern two thirds of the eastern boundary fronts Ophir Road and the northern third extends east of Ophir Road to Summer Hill Creek (Figure 1). A short section of Summer Hill Creek traverses the south eastern corner of the property.

The study area lies on the northern margin of the Orange Plateau which extends from Orange in the north to Blayney in the south, almost to Cargo in the west and the Orange Basin in the east. The general elevation of the plateau is approximately 900 m AHD. Elevations on the CSU Orange property range between approximately 800 and 910 m AHD. The highest elevations are in the flatter plateau areas of the southern and western parts of the property, where most of the campus infrastructure is located. Elevations drop sharply from the plateau into the valley of Mendhams Creek, which traverses the northern parts of the property from west to east (Figure 1a). This creek has two tributaries on the property, one rising on the north side of the main campus area (Lens Gully) and the other draining from the north parallel to the Ophir Road. Mendhams Creek crosses Ophir Road into the south side of the 'Brick Kilns' paddocks before joining Summer Hill Creek (Figure 1a). Six water storage dams, two quite large, are situated on Lens Gully and five other small dams occur elsewhere in the southern and western elevated parts of the property.

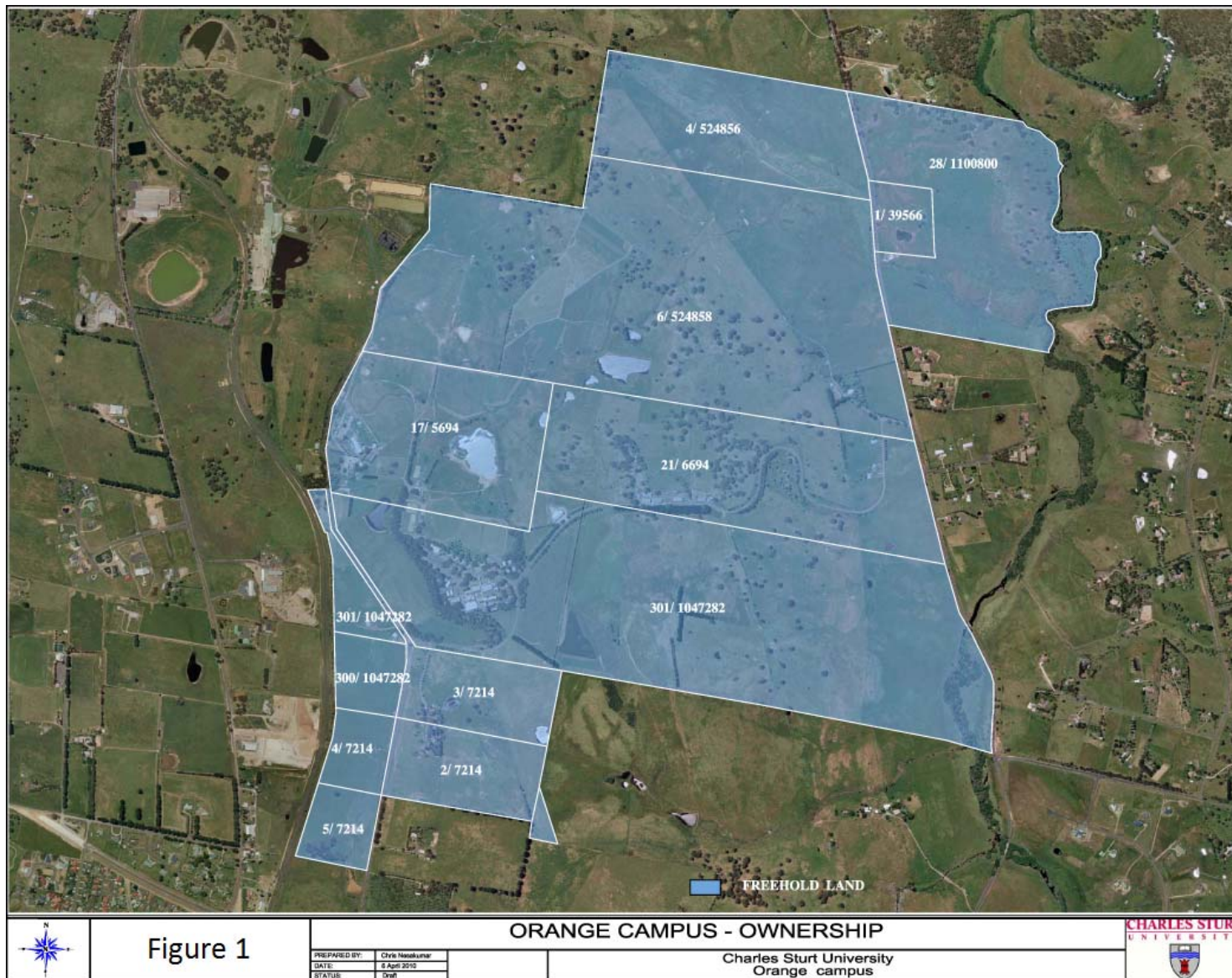




Figure 1a. Paddock names and layout, Charles Sturt University Farm, Orange

Current and Former Land Use

The Orange campus became part of Charles Sturt University in 2005 (<http://www.csu.edu.au/about/history/university-campuses/orange>). The campus was established in 1973 as the Orange Agricultural College, originally specialising in farm management courses. Between 1990 and 1994, the Orange Agricultural College became an external campus of the University of New England before transferring to the University of Sydney in 1994. In 2000, the Orange Agricultural College was dissolved, while remaining part of Sydney University until 2005.

Several former grazing properties were amalgamated to form the Orange campus. The layout and names of paddocks are shown on Figure 1a.

Broadly speaking, the CSU Orange campus currently includes the following predominant land uses:

- Buildings occupy a relatively small proportion of the study area, mainly in the south west corner.
- The majority of the study area comprises a working sheep and cattle grazing property, the College Farm. The whole property has been cleared of its natural vegetation cover, except for scattered remnant trees on slopes and areas of shallow soils, mainly in a north-south oriented band through the centre, but also on a ridge in the Brick Kiln paddocks east of the Ophir Road.
- Two significant vineyard areas have been established; a Chardonnay planting immediately east of the main built part of the campus and red wine grape plantings north of the main dam.
- A horse management facility adjacent to Leeds Parade on the western side of the property has recently been closed. This area included stables, sheds, horse paddocks and a training track.
- A row of workshops, maintenance, grounds staff and vehicle management buildings, and a shearing shed, are located in the centre of the property beside a public road linking Leeds Parade to the Ophir Road via the teaching and administration area of the campus. A wine tasting and sales outlet for Charles Sturt University wines is also situated along this road, as is the original 'Rosedale Park' farm cottage.
- Various large and small plantings of native and exotic trees and shrubs have taken place around the main campus buildings, along fence lines, creek lines and beside the Leeds Parade – Ophir Road link. Some of these plantings date back to the 1970s when the campus was established. Others have been planted more recently, including some for research purposes and others for catchment protection with funding from the Central West Catchment Management Authority to the Summer Hill Creek Landcare Group. The plantings are described in detail later.

Geology and Soils

The study area is underlain by the Molong Rise geological formation, comprising volcanics and metasediments of Ordovician age (490 to 434 million years ago) (Pogson and Watkins, 1998). The rocks comprise mafic volcanic sandstone, basalt, siltstone, black shale, chert, breccia and conglomerate. The deposits were laid down in a deep marine basin adjacent to active intermediate to mafic volcanism in an arc of volcanic islands.

Two broad Soil Landscapes have been described for the study area (Kovac and Lawrie 1990); the North Orange Soil Landscape and the Macquarie Soil Landscape.

1. *North Orange Soil Landscape.* The majority of the study area comprising the undulating plateau and the steeper slopes on its margins belongs to the North Orange Soil Landscape. The soils comprise red earths on upper slopes, yellow earths on lower slopes, yellow podzolics and some solodics in drainage depressions. Shallow sands may occur on some crests and side slopes.
2. *Macquarie Soil Landscape.* This soil landscape is confined to broad alluvial areas along Summer Hill Creek and the low lying areas in the valley of Mendhams Creek. Prairie soils predominate on the floodplain and swamps. Earthy loams, loams, wiesenboden and black earths may also be present. Terraces may have red podzolics, red earths, yellow podzolics and yellow solodics.

A soil map of the College Farm was included in the draft 1997 College Farm Property Plan. Five major soil types were identified; yellow earths, red earths, euchrozems, prairie soils and yellow solodics. Yellow earths and red earths predominate in a mosaic pattern over much of the study area. Euchrozems form a single large occurrence in the centre of the study area, mainly northwards of the wine cellar door sale centre and the workshop area. Prairie soils dominate the low lying areas west of Summer Hill Creek in the south eastern corner of the study area. Yellow solodics dominate the margins of Summer Hill Creek, and 'Mendhams' Creek and its northern and southern tributaries in the north of the study area.

Climate

The nearest Bureau of Meteorology weather stations to the study area with long runs of data are Orange Post Office (OPO) (1870 to 1968) and Orange Agricultural Institute (OAI) (1966 to 2012). These two stations indicate the climate of the study area is generally mild with moderate maximum temperatures in summer, but cold winters. The mean daily maximum temperatures vary from 9.4 (OAI) and 10.6 (OPO) degrees C in July to 26.5 (OAI) and 28.1 (OPO) degrees C in January. The highest maximum temperatures recorded in summer have been 38.3 (OAI) and 38.4 (OPO) degrees C. The corresponding mean daily minimum temperatures vary from 1.5 (OAI) and 0.4 (OPO) degrees C in July to 14.7 (OAI) (January) and 15.4 (OPO) (February) degrees C. The lowest recorded temperatures in winter were -5.6 (OAI) and -7.3 (OPO) degrees C. Frosts are common in winter.

Rainfall is moderate to high by Australian standards. Average annual rainfall is 934.8 mm (OAI) and 877.6 (OPO) and is spread fairly evenly throughout the year with slight winter and spring dominance. Rainfall tends to be lower in autumn.

Biogeographical and Botanical Regions

The study area lies in the north of the South Eastern Highlands Bioregion (SEH) as defined in the Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway and Cresswell, 1995). Within the SEH Bioregion, the study area falls within the Orange Subregion (Sahukar *et al.*, 2003), which is characterised by a low hilly to hilly plateau of Ordovician, Silurian and Tertiary volcanic origins (Sahukar *et al.*, 2003).

The study area also lies within the NSW Central Tablelands Botanical Division (Anderson, 1961) and the catchment of the Macquarie River in the Central West Catchment Authority area.

LITERATURE REVIEW

There have been no comprehensive region-wide flora surveys of the western parts of the Central Tablelands (DEC 2006) encompassing an area of approximately 2 million hectares from Mudgee to Oberon and west to Orange. Although a number of studies have taken place in conservation reserves within this area, no study has surveyed, classified and mapped the vegetation on a regional scale. Consequently, no complete documentation of the vegetation of the western Central Tablelands is available. All vegetation classification and mapping studies within the nearby region have been confined to relatively small parcels of land, mainly conservation reserves under state or local government control, including Nature Reserves (NR), State Conservation Areas (SCA) and other smaller reserves. Reserves that have been surveyed within the northern part of the South Eastern Highlands Bioregion around Orange include Barton NR, Mount Canobolas SCA, Mullion Range SCA, Freemantle NR and Giralang NR. These studies were commissioned by the Office of Environment and Heritage, or its predecessors, and only one has been published in a scientific journal, Hunter's survey of the Mount Canobolas SCA (Hunter, 2002). However, these surveys generally have limited relevance to this study, as they involve lands on different geologies with different vegetation types than those on the study area.

Other relevant publications include Giles (1961) that listed the plants around Mt. Canobolas, Bower, Semple and Harcombe (2002), which discusses the native trees and their associations in Central Western NSW and Bower (2012) on the vegetation of reserves managed by Orange City Council. A number of studies have been associated with environmental impact assessments for various stages of the Cadia and Ridgeway Mines development (Bower and Medd, 1995; Bower, Kenna and Medd, 1998; Bower, 1999). Most relevant to the current study area are previous surveys by FloraSearch (2007, 2008, 2012) which assessed the flora and fauna on the Dentistry School site and two proposed new residential sites on the CSU Orange campus. Data from the latter studies is included in this assessment.

As for flora, there have been few studies of native fauna in the Orange region. Goldney and Bowie (1987) includes a regional compilation of fauna for Central Western NSW and two assessments of fauna have been made for the Cadia Hill (Fisher and Goldney 1995), Ridgeway (Resource Strategies 2000) and Cadia East (Western Research Institute and Resource Strategies, 2009) gold mines to the south west of Orange. Fauna was also considered in the Dentistry School and residential site environmental assessments for CSU Orange by FloraSearch (2007, 2008, 2012) and the data from these is included in this report.

A comprehensive list of native fauna species has been compiled for the CSU Orange campus by Dr Cilla Kinross (Appendix 1), adjunct lecturer in Environmental Management. This list has resulted from regular monitoring of remnant woodlands, and planted shelterbelts and windbreaks for Dr Kinross's PhD dissertation, and other opportunistic observations. The list includes 113 bird species (109 native, 4 introduced), six species of frogs, eight reptiles and 11 mammals (5 native, 6 introduced).

THREATENED BIODIVERSITY

Database searches were made in August 2012 of the following data sources to compile lists of threatened biodiversity that has been recorded in the surrounding region and may therefore have potential to occur on the study area. This involved searching for historical records of threatened flora and fauna species, populations, ecological communities and critical habitat. The databases consulted, and the search areas within them, were:

- BioNet website – Searches the NSW National Parks and Wildlife Service, NSW State Forests, Australian Museum and Royal Botanic Gardens Sydney databases. The search area comprised the Orange, Hill End, Molong and Cudal 1:50 000 topographic map sheets. This search returns a list of threatened species records from within the search area.
- Commonwealth Department of Sustainability, Environment, Water, Population and Communities website – Protected Matters search tool. The search area comprised the local government areas of Orange and Cabonne. The Protected Matters search tool uses actual records and habitat modelling to return a list of ‘protected matters’ that are known or predicted to occur in the search area, including threatened species, migratory species, ecological communities, wetlands of international significance, and national and world heritage properties.

Threatened Flora and Fauna Species

The searches returned 14 threatened flora species and 41 threatened fauna species that may have potential to occur in the broader region around Orange (Tables 1 and 2). The habitat requirements of these species were reviewed and compared with the habitats available on the study area. Threatened species whose habitats do not occur on the study area are not considered further in this report. Habitat filtering identified four flora species that are considered to have a moderate to high likelihood of having once occurred on the study area (Table 1). Similarly, potential habitat is considered to exist on the study area for 16 fauna species that have low to high likelihoods of occurring (Table 2). These four plants and 16 animals were targeted in searches of potential habitat on the study area. The possible impact of developments on the study area on these species is evaluated in the assessment sections of this report.

Endangered Populations

Twenty four plant populations and 20 terrestrial fauna populations are listed as endangered under NSW TSC Act, as at August 2012. None are applicable to the study area.

Table 1
Threatened Flora Species Returned by Database Searches of the Surrounding Region.

Family Name	Scientific Name	Common Name	Conservation Status		Likely former presence?	Justification
			TSC Act ¹	EPBC Act ²		
Apocynaceae	<i>Tylophora linearis</i>	-	V	E	Nil	<i>Tylophora linearis</i> occurs in relatively dry woodlands and forests, principally on the NSW Western Slopes. The ironbark, cypress pine and Allocasuarina species with which it is usually found do not occur on the study area (OEH, 2012a).
Fabaceae (Faboideae)	<i>Swainsona sericea</i>	Silky Swainson-pea	V	-	High	The Silky Swainson-pea was formerly a widespread, common species in Box-Gum woodlands and is likely to have been common in the Orange district (OEH, 2012a).
Fabaceae (Mimosoideae)	<i>Acacia ausfeldii</i>	Ausfield's Wattle	V	-	Nil	A single record of this species occurred in the database search area near Kerrs Creek. Investigation of this record by R. Medd (pers. comm.) showed it is a misidentification of <i>Acacia oswaldii</i> .
Lamiaceae	<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	Wollemi Mint-bush	V	V	Nil	The database searches revealed a single record of the Wollemi Mint Bush west of Manildra on the Molong map sheet. This is likely to represent a database error, since the Wollemi Mint Bush is known to be restricted to Narrabeen Sandstone areas of northern and western Wollemi National Park in the Glen Davis and Denman areas (NPWS, 2000).
Myrtaceae	<i>Eucalyptus aggregata</i>	Black Gum	V	-	Moderate to High	Black Gum occurs south of Orange in low lying swampy areas along Gosling Creek. It may formerly have occurred along Summer Hill Creek and Mendhams Creek.
	<i>Eucalyptus canobolensis</i>	Silver-leaf Candlebark	V	V	Moderate	Silver-leaf Candlebark appears to be restricted to basalt flow areas from Mt Canobolas. Most of the known population is in the Mt Canobolas SCA with scattered remnant trees within a radius of 10 km, including the Pinnacle Reserve and the Black Sallee Reserve.
	<i>Eucalyptus robertsonii</i> subsp. <i>hemisphaerica</i>	Robertson's Peppermint	V	V	Low	Robertson's Peppermint is known only from the northern Mullions Range east of Mullion Creek and Kerrs Creek on different geology and in different plant associations than those on the study area.
	<i>Austrostipa metatoris</i>	A Speargrass	V	V	Nil	This speargrass was predicted to potentially occur on the study area by the EPBC Act Protected matters Search Tool. However, it is a low altitude species that occurs only in sandy areas of the inland riverine plains (PlantNet, 2012).

Family Name	Scientific Name	Common Name	Conservation Status		Likely former presence?	Justification
			TSC Act ¹	EPBC Act ²		
	<i>Austrostipa wakoolica</i>		E	E	Nil	This speargrass was predicted to potentially occur on the study area by the EPBC Act Protected Matters Search Tool. However, it is a low altitude species that occurs only on flood plains west of a line between Forbes and Albury (AVH, 2012).
Poaceae	<i>Dichanthium setosum</i>	Bluegrass	V	V	Nil	Bluegrass has been recorded at Borenore Caves Reserve (BioNet, 2012). This record is a long distance from the core distribution of the species on the Northern Tablelands and North West Slopes of NSW (BioNet, 2012) and is considered doubtful. The black basaltic soils favoured by this species do not occur on the study area (OEH, 2012a).
Rutaceae	<i>Philothea ericifolia</i>	-	-	V	Nil	<i>Philothea ericifolia</i> grows chiefly in dry sclerophyll forest and heath on damp sandy flats and in gullies. The species has been collected from open woodland, heathland, dry sandy creek beds and rocky ridge and cliff tops. Preferred soils have a sandy, gravelly or rocky component (SEWPaC, 2012a). The study area lacks suitable habitat for this species.
	<i>Zieria obcordata</i>	-	E	E	Nil	<i>Zieria obcordata</i> grows on gentle to moderately steep, west-to north-facing slopes of low hills or ridges at altitudes from 500 to 830 m. All sites have granite boulders, outcrops, and/or exposed granite. Plants typically occur around the base of granite boulders and in crevices between them (OEH, 2012a). No habitat for <i>Z. obcordata</i> occurs on the study area.
Santalaceae	<i>Thesium australe</i>	Austral Toadflax	V	V	High	Austral Toadflax was formerly widespread in grasslands and grassy woodlands in eastern Australia from the Bunya Mountains in Queensland to Tasmania. It is hemiparasitic on Kangaroo Grass (<i>Themeda australis</i>) and possibly <i>Poa</i> species on a wide range of substrates (DSE, 2003).
Scrophulariaceae	<i>Euphrasia arguta</i>	-	CE	CE	Low	<i>Euphrasia arguta</i> has been recorded from grassy areas near rivers at elevations up to 700 m above sea level, with an annual rainfall of 600 mm and grassy forests or regrowth vegetation (SEWPaC, 2012a). The study area is higher than known locations for this species, although potential habitat may occur along Summer Hill Creek.

¹ NSW *Threatened Species Conservation Act, 1995.*

² Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999.*

E Endangered.

CE Critically Endangered

V Vulnerable.

**Table 2
Threatened Fauna Species Returned by Database Searches of the Surrounding Region**

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act ¹	EPBC Act ²		
Actinopterygii (ray-finned fishes) ³	Percichthyidae	<i>Maccullochella macquariensis</i>	Trout Cod	E	E	Nil	The three fish species listed here only occur in large permanent rivers with deep waterholes. Such habitat does not occur on the study area.
		<i>Maccullochella peelii</i>	Murray Cod	-	V	Nil	
		<i>Macquaria australasica</i>	Macquarie Perch	E	E	Nil	
Amphibia	Hylidae	<i>Litoria booroolongensis</i>	Booroolong Frog	E	E	Nil	The Booroolong Frog is a small riverine frog that inhabits rocky permanent streams ranging from small slow-flowing creeks to large rivers (SEWPaC, 2012a). Suitable habitat for this species does not occur on the study area.
Reptilia	Varanidae	<i>Varanus rosenbergi</i>	Heath Monitor	V	-	Nil	There is a single record of Rosenberg's Goanna in the database search area on Black Rock Range south of Cargo. Requires large areas of natural habitat (OEH, 2012AA). The presence of termite mounds for egg laying and incubation is critical (OEH, 2012a). Suitable habitat is lacking on the study area.
Aves (birds)	Megapodiidae	<i>Leipoa ocellata</i>	Mallee Fowl	E	V	Nil	The Mallee Fowl was predicted to potentially occur on the study area by the EPBC Act Protected Matters Search Tool. Mallee Fowl are found in semi-arid to arid shrublands and low woodlands, especially those dominated by mallee and/or acacias. A sandy substrate and abundance of leaf litter are required for breeding (Benshemesh, 2007). Suitable habitat is absent from the study area and surrounding region.
	Anatidae	<i>Oxyura australis</i>	Blue-billed Duck	V	-	Nil	The Blue-billed Duck is regularly recorded on the Spring Creek Reservoir on the south eastern outskirts of Orange. It requires deep water with dense emergent vegetation of Cumbungi, Lignum or similar (OEH, 2012a). Suitable habitat is lacking on the study area.
		<i>Stictonetta naevosa</i>	Freckled Duck	V	-	Nil	The Freckled Duck is regularly recorded on the Spring Creek Reservoir on the south eastern outskirts of Orange. It requires deep water with dense emergent vegetation of Cumbungi, Lignum or similar (OEH, 2012a). Suitable habitat is lacking on the study area.
	Ardeidae	<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Nil	The Australasian Bittern was predicted to potentially occur on the study area by the EPBC Act Protected Matters Search Tool. It requires permanent freshwater wetlands with dense emergent vegetation of Cumbungi, Lignum or similar (OEH, 2012a). Suitable habitat is lacking on the study area.

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act ¹	EPBC Act ²		
	Accipitridae	<i>Erythrotriorchis radiatus</i>	Red Goshawk	CE	V	Nil	The Red Goshawk was predicted to potentially occur on the study area by the EPBC Act Protected Matters Search Tool. This species is largely confined to north eastern NSW (BioNet, 2012). It requires dense forests near permanent water or major streams, usually in coastal areas. Suitable habitat is absent on the study area.
		<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	High	Little Eagle occurs throughout NSW and soars over open country looking for prey (Blakers <i>et al.</i> , 1984). There are two records in the region around Orange in the BioNet (2012). It is likely to hunt over the grazing paddocks on the study area .
Aves (birds)	Rostratulidae	<i>Rostratula australis</i>	Australian Painted Snipe	E	V	Nil	Australian Painted Snipe inhabits freshwater swamps and marshes (Blakers <i>et al.</i> , 1984). Suitable habitat is absent from the study area.
	Cacatuidae	<i>Calyptorhynchus lathamii</i>	Glossy Black Cockatoo	V	-	Nil	Recorded from the Hervey and Nangar Ranges in the western parts of the Molong and Cudal map sheets, respectively (BioNet, 2012). Depends of the presence of large stands of <i>Casuarina</i> or <i>Allocasuarina</i> species. Suitable habitat is absent on the study area.
	Psittacidae	<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	High	The Little Lorikeet is occasionally recorded close to Orange and in the surrounding region (Bower, personal observations; BioNet, 2012). It can be expected to occur on the study area when woodland eucalypts are in flower.
		<i>Lathamus discolor</i>	Swift Parrot	E	E	Low	The Swift Parrot is a migratory species that breeds in Tasmania and winters on the mainland, where it feeds on flowering eucalypts. There are only two records near Orange (BioNet, 2012). It may potentially feed on flowering Red Ironbark (<i>Eucalyptus sideroxylon</i>) trees on the CSU campus.
		<i>Neophema pulchella</i>	Turquoise parrot	V	-	Nil	Recorded from the Hervey and Nangar Ranges in the western parts of the Molong and Cudal map sheets, respectively (BioNet, 2012). Usually found at the interface of native woodland and clearings. Suitable woodland habitat is absent from the study area.
		<i>Polytelis swainsonii</i>	Superb Parrot	V	V	High	The Superb Parrot occurs in tall woodlands and forests west of the Tablelands (Blakers <i>et al.</i> , 1984). There are many records of the species close to Orange and the university. Suitable woodland habitat with old growth trees having hollow limbs is present on the study area.
	Strigidae	<i>Ninox connivens</i>	Barking Owl	V	-	Moderate	The Barking Owl occurs in eucalypt woodland and is widespread in eastern NSW. It is known to occur in the Orange area (Nicholls, pers. comm.) and there are records from Hill End and the Archery Range Reserve on Lewis Ponds Road in NSW BioNet (2012).

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act ¹	EPBC Act ²		
		<i>Ninox strenua</i>	Powerful Owl	V	-	Nil	There is one record for the Powerful Owl close to Orange (Archery Range Reserve on Lewis Ponds Road) (BioNet, 2012). It prefers dense woodlands and forests with numerous hollow trees for their prey (possums and gliders) and for nesting. Suitable habitat is absent on the study area.
	Climacteridae	<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	Low	There are several records of this subspecies close to the study area (Ophir Road, Archery Range Reserve on Lewis Ponds Road, Girralang Nature Reserve) with further records to the north east and west (BioNet, 2012). It inhabits grassy woodlands with rough-barked trees at close to natural densities, sparse shrub cover and fallen timber on the ground (OEH, 2012a). Suitable habitat does not occur on the study area.
	Acanthizidae	<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	Low	A sedentary species of natural relatively undisturbed open woodland on rocky ridges or in gullies. Recorded sparsely but widely in the surrounding region in larger blocks of remnant woodland (BioNet, 2012). Has been recorded on the study area, but now locally extinct (Appendix 1).
	Meliphagidae	<i>Anthochaera phrygia</i>	Regent Honeyeater	E	E	Low	A nomadic nectar-dependent species found in flowering eucalypts, which has been recorded rarely in the region around the study area (BioNet, 2012). It has potential to visit the study area when Eucalypts are flowering, especially Yellow Box.
		<i>Ephianura albifrons</i>	White-fronted Chat	V	-	Nil	There are two records for the White-fronted Chat in the region; Molong and Nangar Range, both at considerably lower altitudes than the study area (BioNet, 2012). The preferred habitat is wet grasslands or marshes, of which there is only a very small sample on the study area.
		<i>Melithreptus gularis</i>	Black-chinned Honeyeater	V	-	Low	The BioNet has only one record for the Black-chinned Honeyeater in the search area; Murga near the western edge of the Cudal map sheet (BioNet, 2012). Although at lower altitudes, there is similar habitat on the study area; Box-Gum Woodland.
	Pomatostomidae	<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	-	Nil	There are only two records of the Grey-crowned Babbler in the database search area, both in the lower altitude western areas; to the west of Manildra and in the Murga Valley (BioNet, 2012). Grey-crowned Babbler prefer open Box or Box-Pine woodlands with dense low trees below the canopy (OEH, 2012a). Suitable habitat does not occur on the study area.
	Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	High	Birds of woodlands and open forests, usually with rough-barked eucalypts. Known to occur on the study area and regularly recorded in the surrounding region (BioNet, 2012).

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act ¹	EPBC Act ²		
	Pachycephalidae	<i>Pachycephala inornata</i>	Gilbert's Whistler	V	-	Nil	Gilbert's Whistler is recorded only for the Murga Valley west of Toogong in the database search (BioNet, 2012). A key habitat requirement for Gilbert's Whistler is a dense shrub layer, which is missing from the study area.
	Petroicidae	<i>Petroica boodang</i>	Scarlet Robin	V	-	Low	Breeds in eucalypt forest with an open understorey (Blakers <i>et al.</i> , 1984). Juveniles disperse in autumn and most likely represent the few records near Orange (BioNet, 2012). Has been recorded on the study area (Appendix 1).
		<i>Petroica phoenicea</i>	Flame Robin	V	-	Moderate-High	Records of the Flame Robin include the Archery Range Reserve on Lewis Ponds Road, the western outskirts of Orange, the Nangar Range and several sightings on Mt Canobolas (BioNet, 2012). The Flame Robin breeds in high altitude forests and disperses to lower more open habitats in winter. Has been recorded on the study area (Appendix 1 and this study).
		<i>Melanodryas cucullata</i>	Hooded Robin			Nil	The Hooded Robin is not known to occur close to Orange. Regional records include the Freemantle area, the Bridle Track on the Macquarie River and the Nangar Ranges. Hooded Robins occur in open eucalypt woodlands with saplings, shrubs and native grasses. Suitable habitat is absent on the study area.
	Estrildidae	<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Moderate	Widespread in open forest and woodland mostly on the inland side of the Great Dividing Range in eastern NSW (Blakers <i>et al.</i> , 1984). Recorded close to the study area near Ophir Road to the north, the Archery Range Reserve on Lewis Ponds road, the western outskirts of Orange, the Freemantle area, west of Mullion Creek, Molong and the Nangar Ranges. Favours open grassy woodlands.
Mammalia (mammals)	Dasyuridae	<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Nil	Generally confined to areas of native forest and woodland where it nests in rock caves or hollow logs (Edgar, 1983). It occurs in wooded country along the Macquarie River, in the Ophir Reserve, Giralang Nature Reserve and around Mullion Creek (BioNet, 2012), but no suitable habitat remains on the study area.
	Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala	V	-	Nil	Koalas are widespread in eastern NSW with populations in timbered country around Mullion Creek, and in the hills flanking the Macquarie River, and particularly around Hill End, and west and north West of Manildra (BioNet, 2012). However, there are no records close to Orange.
	Burramyidae	<i>Cercatetus nanus</i>	Eastern Pygmy Possum	V	-	Nil	Eastern Pygmy Possums mainly occur in dense woodlands, heaths and forests with nectar-rich shrubs and abundant insects for food. Shelter includes tree hollows, old bird and Ring-tail possum nests etc. One record exists in the database search area in the western parts of the Molong map sheet in the Hervey Ranges. Suitable habitat is absent from the study area.

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act ¹	EPBC Act ²		
	Petauridae	<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	Nil	One record exists for the Yellow-bellied Glider on Mt Canobolas (BioNet, 2012), which despite searching has not been repeated. Families of Yellow-bellied Gliders require 20 to 85 hectares of mature tall forest habitat. Suitable habitat no longer exists on the study area.
		<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Low	Two occurrences of Squirrel Gliders are known in the Orange district; at Cadia (BioNet, 2012) and the Bloomfield Hospital. Squirrel Gliders require mature trees with hollows with an understorey of shrubs and acacias. While abundant hollow trees are present on the study area, they lack a suitable understorey.
	Macropodidae	<i>Petrogale penicillata</i>	Brush-tailed Rock Wallaby	E	V	Nil	Inhabits rocky areas in sclerophyll forest, usually slopes that receive direct sunlight for most of the day and with caves, crevices or jumbled boulders to provide shelter (Maynes and Sharman 1983). No such habitat occurs on the study area.
	Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Low	The Grey-headed Flying Fox mostly occurs on the eastern side of the Great Dividing Range, but may establish temporary roosts west of the divide when food supplies are abundant. There are two records in BioNet (2012) close to Orange in 2006 and 2010.
	Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail Bat	V	-	Low	The Yellow-bellied Sheathtail Bat has been recorded thrice in the region; Cadia (Richards and Associates, 2000), Mt Canobolas and north of the Freemantle Nature Reserve (BioNet, 2012). It roosts in tree hollows and forages over the tree canopy or open country. There is potential for it to occur on the study area.
	Miniopteridae	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat			Moderate	The Eastern Bentwing Bat is widespread in the Orange region having been recorded at Cadia (Richards and Associates, 2000), to the west of Mullion Creek, just east of Orange, Borenore Caves, Ophir Reserve, north of Freemantle Reserve, Hill End and Molong (BioNet, 2012). It roosts in caves and man-made structures such as mines and storm water drains. It forages in wooded areas, flying above the tree tops. Roosting habitat is absent from the study area, but foraging may occur.
	Vespertilionidae	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Nil	Large-eared pied Bat has been recorded to the north east of the study area at Ophir Reserve and Hill End (BioNet, 2012). It roosts in caves, mine tunnels and the abandoned nest of Fairy Martins (Dwyer, 1983). The Large-eared Pied Bat forages over areas of continuous forest habitat (Richards and Associates, 2000), which is lacking on the study area.

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act ¹	EPBC Act ²		
		<i>Nyctophilus corbeni</i>	South-eastern Long-eared Bat	V	V	Nil	The South-eastern Long-eared Bat was predicted to potentially occur on the study area by the EPBC Act Protected Matters Search Tool. No records of the species are recorded for the search area in BioNet (2012). It is predominantly a western species in NSW, the nearest records to the study area being in the Hervey and Nangar Ranges and near Canowindra. It is unlikely to occur on the study area.
	Muridae	<i>Pseudomys fumeus</i>	Smoky Mouse	CE	E	Nil	The Smoky Mouse was predicted to potentially occur on the study area by the EPBC Act Protected Matters Search Tool. The Smoky Mouse appears to prefer heath habitat on ridge tops and slopes in sclerophyll forest, heathland and open-forest from the coast (in Victoria) to sub-alpine regions of up to 1800 metres, but sometimes occurs in ferny gullies. Suitable habitat is absent from the study area.
		<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	Nil	The New Holland Mouse was predicted to potentially occur on the study area by the EPBC Act Protected Matters Search Tool. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. Such habitat does not occur on the study area.
Insecta (Insects)	Lycaenidae	<i>Paralucia spinifera</i>	Orange Copper Butterfly	E	V	Nil	The Orange Copper Butterfly occurs above 900 m altitude in the ranges east of Orange where there are populations of its larval host plant, <i>Bursaria spinosa</i> subsp. <i>lasiophylla</i> (NPWS, 2001). The host plant is absent from the study area.

¹ NSW *Threatened Species Conservation Act, 1995*.

² Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*.

³ NSW *Fisheries Management Act 1994*.

E Endangered.

CE Critically Endangered

V Vulnerable.

Threatened Ecological Communities

The database searches indicated that five endangered ecological communities listed in the schedules of the NSW TSC Act may potentially occur on the study area (Table 3). Three of these are also listed as Endangered under the EPBC Act. Review of the literature indicated two of these communities are unlikely to occur as they are distributed on the NSW western slopes and plains, and have not been recorded from the tablelands. The remaining three communities are known to occur on the NSW Central Tablelands as follows:

- *'White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community'*, is considered a possible occurrence in the study area. The community is also listed under the Commonwealth EPBC Act as the *'White Box-Yellow Box-Blakely's Red Gum grassy woodlands and derived native grasslands critically endangered ecological community'*. This community is commonly referred to as Box-Gum Woodland.
- *Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions Endangered Ecological Community.*
- *Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions Endangered Ecological Community.*

Critical Habitat

No Critical Habitat for flora has been declared on or near the study area under the TSC Act or the EPBC Act.

METHODS

SURVEY TIMING

Field surveys were carried out over 7 days in June (9, 10, 16-19) and August (22) 2012. The survey encompassed all remnants of native woodland vegetation, planted windbreaks and shelterbelts, amenity tree plantings and open space within the study area in order to sample and identify all vegetation types present and to record as much of the wildlife as practicable. All habitat types were surveyed to maximise the chances of finding populations of any threatened species that may occur.

The winter timing of the survey meant that reptiles were not active and that summer migratory bird species were absent. Similarly, the vegetation lacked fresh flowers, fruits and seeds, such that species identification depended on knowledge of vegetative characters along with any remnants of reproductive structures. However, the conditions were ideal for winter active amphibians with high water levels in the farm dams and pooling in some low lying areas.

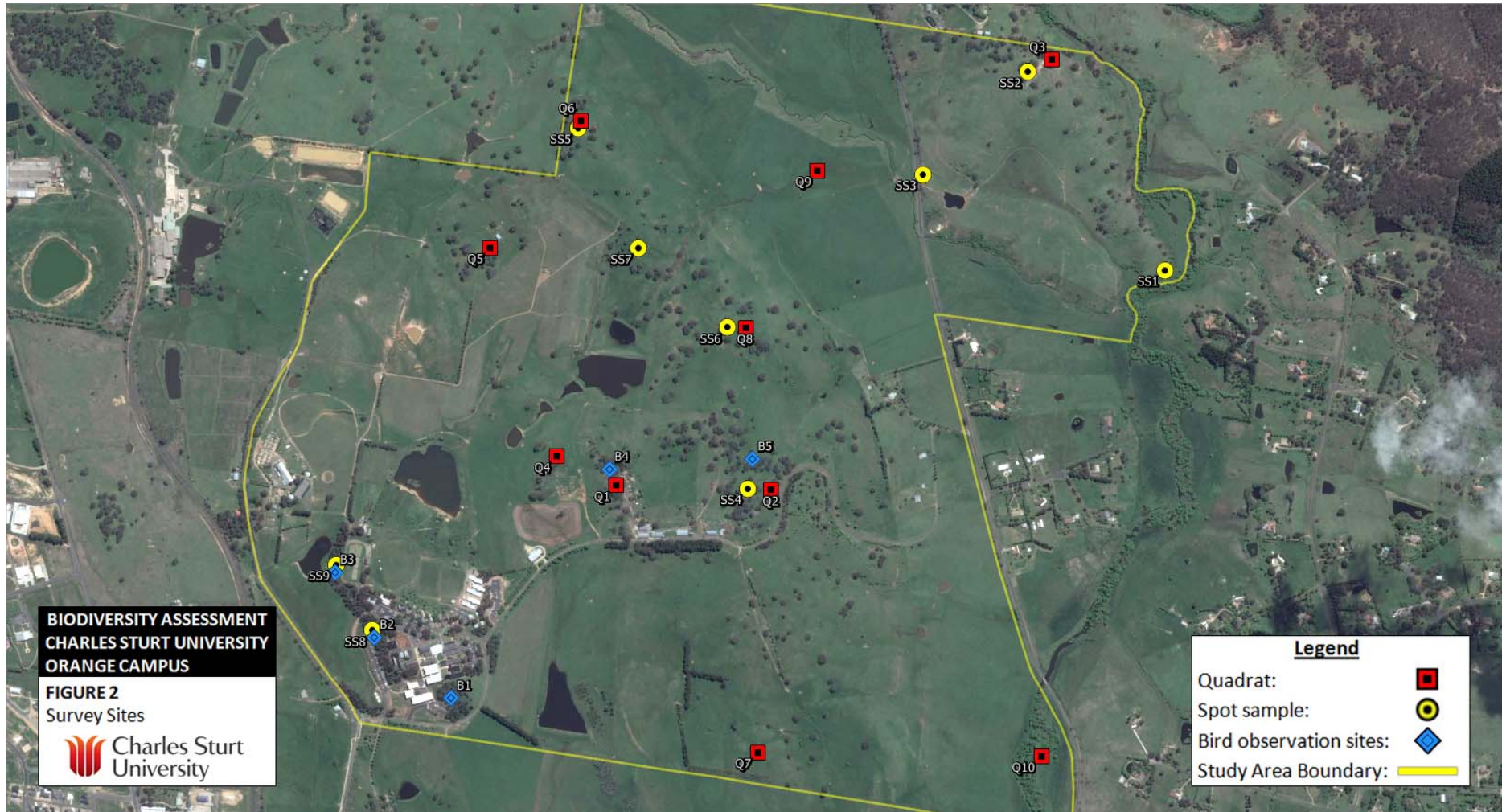
WEATHER CONDITIONS

Field sampling was carried out in a wet season with above average rainfall. Conditions in the preceding summer and autumn were ideal for plant growth and reproduction resulting in high ground cover vegetation levels throughout the study area, despite intensive grazing by domestic farm animals.

**Table 3
Threatened Terrestrial Ecological Communities Known to Occur within the Wider Region**

Title(s)	Conservation Status ¹		Comment	Likelihood of Occurrence
	TSC Act	EPBC Act		
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Nandewar and Brigalow Belt South Bioregions (TSC Act) Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EPBC Act)	E	E	This ecological community was identified by the SEWPaC Protected Matters Search Tool (SEWPaC, 2012b) as potentially occurring on or near the study area. Inland Grey Box (<i>Eucalyptus microcarpa</i>) woodlands occur on the NSW western slopes and plains (NSW Scientific Committee, 2011a) and have not been recorded on the tablelands. The nearest occurrences to the study area are in the Cudal area west of Orange and near Kerrs Creek, north of Orange. The community is unlikely to occur on the study area.	Nil
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (TSC Act) Weeping Myall Woodlands (EPBC Act)	E	E	This ecological community was identified by the SEWPaC Protected Matters Search Tool (SEWPaC, 2012b) as potentially occurring on or near the Study area. Myall (<i>Acacia pendula</i>) woodlands occur on alluvial or stagnant alluvial soil landscapes on the lower south west slopes and plains of NSW (NSW Scientific Committee, 2011b). Associated tree species include Belah (<i>Casuarina cristata</i>), Yarran (<i>Acacia homalophylla</i>), Miljee (<i>Acacia oswaldii</i>), Rosewood (<i>Alectryon oleifolius</i>) and Warrior Bush (<i>Apophyllum anomalum</i>). None of these species occur close to Orange. The nearest local government areas in which the community is known or predicted to occur are the Forbes and Parkes Shires (NSW Scientific Committee, 2011b).	Nil
White Box Yellow Box Blakely's Red Gum Woodland (TSC Act) White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act)	E	CE	This ecological community is commonly known as Box-Gum Woodland and is widespread in the South Eastern Highlands (SEH) and NSW South West Slopes Bioregions (DEH, 2006). The study area is part of the SEH Bioregion. Box-Gum Woodland is widespread on the western slopes and tablelands of New South Wales and was formerly one of the dominant communities in the region around Orange. Because it occurs on relatively deep high fertility soils, it has been extensively cleared historically for cropping and grazing over its entire range (DEH, 2006).	High
Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions Endangered Ecological Community	E	-	This ecological community is confined to high altitude areas (600 to 1400 m AHD) of the NSW Central and Southern Tablelands (NSW Scientific Committee, 2011c). The community occupies 'valley floors, the margins of frost hollows, footslopes and undulating hills'. It is considered to occur in the local government areas of Orange and Cabonne, which include the study area (NSW Scientific Committee, 2011c).	Moderate
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions Endangered Ecological Community	E	-	Like the preceding community, this EEC occurs on high fertility soils on undulating or hilly terrain of the Central and Southern Tablelands of NSW between 600 and 900 m AHD (NSW Scientific Committee, 2011d). This community is not recorded for the Orange or Cabonne local government areas in the Final Determination of the Scientific Committee (2011d), but has been documented in the Pinnacle Reserve and Mount Canobolas State Conservation Area south west of Orange (Bower, 2012).	Low

E Endangered; CE Critically Endangered.



VEGETATION SAMPLING

Two methods of documenting the vegetation were employed; quadrat sampling and spot sampling, detailed below. Figure 2 shows the locations of flora sample sites.

Quadrat Sampling

Ten 20 × 20 m (0.04 ha) flora quadrat sites were sampled on the study area (Figure 2). Within each plot the dominant species in each vegetation stratum were recorded, with an estimate of the percentage of the ground surface covered by their canopies. A list of all vascular plant species present within the quadrat was also made with each being assigned a cover abundance rating using a modified Braun-Blanquet scale (Table 4). Details recorded for each site included its Global Positioning System (GPS) position (Table 5), landform, physiography, soil characteristics, disturbance, vegetation structural formation and general comments. Plots were placed mainly in remnant woodland areas distributed across the whole study area (Table 5).

Table 4
Modified Braun-Blanquet Cover Abundance Rating Scale

Rating	Percent Ground Cover	Rating	Percent Ground Cover
1	<1, rare	5	6 to 25
2	<5, uncommon	6	26 to 50
3	<5, common	7	51 to 75
4	<5, abundant	8	76 to 100

Table 5
Locations of Vegetation Quadrat Samples

Quadrat Sample Number	Easting ¹	Northing	Location
1	0697805	6319813	Woodland west of Cottages 7 to 9
2	0698251	6319791	Woodland in SW corner of Taylors 3 paddocks
3	0699087	6321010	Woodland in the Brick Kiln paddock east of Ophir Road
4	0697633	6319899	Woodland between main farm dam and 132kV power line in College 3 paddock
5	0697453	6320505	Woodland south of hay shed and west of red winegrape vineyard in Fields paddock
6	0697724	6320863	Woodland on western edge of Rogers 3 paddock
7	0698196	6319039	Weston 1 paddock
8	0698187	6320260	Woodland in Taylors 1 paddock
9	0698405	6320707	Swampy area in Mendhams 3 paddock
10	0699017	6319010	Alluvial flats east of Summer Hill Creek in Risky Paddock

¹ GDA94

Spot Sampling

In addition to the quadrat samples, and in order to more comprehensively document the native and introduced flora over the entire study area, seven spot samples were conducted (Figure 2), generally at sites supporting flora not recorded elsewhere. Spot samples listed all vascular plants present within approximately 20 m of the point at which the GPS reading was taken. The locations of spot samples are given in Table 6.

Table 6
Locations of Vegetation Spot Samples

Spot Sample Number	Easting	Northing	Location
1	0699401	6320401	Brick Kiln Creek paddock east of Ophir Road
2	0699017	6320978	Woodland in Brick Kiln paddock east of Ophir Road
3	0698708	6320689	South of entrance gate into Brick Kiln paddock
4	0698184	6319795	Woodland in SW corner of Taylors 3 paddock
5	0697713	6320843	Woodland in west of Rogers 3 paddock
6	0698135	6320262	Woodland in east of Taylors 1 paddock
7	0697882	6320495	Woodland east of red winegrape vineyard in Lens Gully paddock

Plantings

Plantings of native and introduced species in windbreaks, shelterbelts and garden beds around buildings were examined to record the main species used, with particular reference to the presence of any listed threatened species.

Searches for Threatened Species

The entire area of the built campus and farm lands were searched for potential habitat of threatened flora species. The known habitats of the species in Tables 1 and 2 are described in fact sheets and profiles of threatened species published on the websites of the NSW OEH and the Commonwealth SEWPaC, as well as on the PlantNet website of the Royal Botanic Gardens Sydney. The high levels of historical disturbance suggest there is a low likelihood that any habitat for threatened flora species remains.

Flora Species Listing

All observed plant species were recorded, whether identified on formal sample sites or not. Some less common plants were only observed on one occasion whilst moving around the site. Where plants could not be quickly identified in the field, a sample was taken for examination. Samples were preserved in a plant press and later identified using a binocular microscope and flora keys. The principal reference was the Flora of New South Wales (Ed. G. Harden 1990-2002) and it is used as the basis for nomenclature in this report along with any updates on the PlantNet web site of the Royal Botanic Gardens and Domain Trust, Sydney.

FAUNA SAMPLING

Owing to the highly modified and developed nature of the study area, surveys for fauna comprised observational techniques and habitat quality assessment, rather than intensive trapping methods.

Amphibians

Searches for amphibians were conducted on two nights (June 17 and 19) around the dams and wet areas in College 3 paddock. Amphibian calls were also heard during the day when moving around the study area. Calls were identified using the David Stewart (2001) frog call CD.

Reptiles

No searches for reptiles were conducted owing to the winter timing of the survey. Since they are poikilothermic (cold-blooded) reptiles are torpid (inactive) in cold weather. It was not considered appropriate to dislodge reptiles from their shelter when temperatures were too cold for them to retreat back to cover.

Birds

Birds were systematically surveyed at five fixed observation sites (Figure 2). Three sites were in the mature shelterbelt on the western side of the built parts of the campus and two were in remnant woodland patches north of the road linking Leeds Parade and the Ophir Road. The numbers of each bird species seen and/or heard during 10 minute morning observations at each site were recorded. Observations were made on four mornings; 10 and 16 - 18 June. The characteristics of each observation site are given in Table 7.

Birds were also recorded opportunistically while conducting the flora surveys and moving around the study area.

Table 7
Characteristics of Bird Observation Sites

Site Number	Easting ¹	Northing	Characteristics
1	0697315	6319212	Mature tall remnant Ribbon Gums, Candlebark, Broad-leaved Peppermint, Apple Box and Silver Wattle with planted Black Wattle.
2	0737998	6297577	Planted shelterbelt with Small-leaved Gum, Broad-leaved Peppermint, Narrow-leaved Peppermint, Mountain Grey Gum, Green Wattle and Cootamundra Wattle.
3	0738121	6297573	Planted shelterbelt with Apple Box (remnant native), Narrow-leaved Peppermint, Mountain Grey Gum, Green Wattle, Weeping Boree and Silver Wattle (remnant native), adjacent to farm dam.
4	0738244	6297543	Remnant mature White Box Woodland with two Ribbon Gums.
5	0737786	6297538	Remnant mature Yellow Box woodland.

¹ GDA94

Mammals

Native and introduced mammals were recorded while moving around the study area and by spot lighting on the nights of 17 and 19 June 2012. Spot lighting was carried out in patches of remnant

native woodland where there are remnant eucalypt trees with hollow limbs suitable for wildlife denning. Observations were also made of claw marks and gum feeding sites on trees indicating use by arboreal mammals. Fauna scats were sought and identified using the Triggs (2004) field guide.

Habitat Trees

All native trees in remnant woodland patches were examined individually for the presence of hollow limbs, spouts and openings in the trunk that may potentially be used by possums, gliders and bats for denning, or birds for nesting. Each tree with hollows was identified to species and its GPS coordinates taken.

Habitat Quality

The value of the native vegetation on the study area as fauna habitat was measured using methodology adapted from the 'BioMetric' terrestrial biodiversity assessment tool (Gibbons *et al.* 2005). 'BioMetric' measurements form part of the input to the NSW Property Vegetation Plan Developer, which is used to assist decision making for applications to clear native vegetation under the NSW *Native Vegetation Act*. This methodology allows the value of vegetation to be assessed in a repeatable fashion for comparison with established benchmarks for the original vegetation likely to have occurred on the study area (DECC, 2008).

The ten 20 × 20 m flora survey plots were extended to 50 × 20 m for 'Biometric' measurements (Figure 2). The ten condition parameters used in BioMetric to assess site value were measured in each plot. The measurement methods were based on Appendix 3 of the BioMetric Operational Manual (Gibbons *et al.*, 2005). The parameters and methodology are:

- Native plant species diversity: - the number of native plant species in the 20 × 20 m subplot.
- Native overstorey cover: – mean percent cover of ground by the foliage of the uppermost vegetation layer; trees or tall shrubs (>1m) at 10 points along a 50 m transect along the long axis of the plot.
- Native midstorey cover: – mean percent cover of ground by the foliage of the middle vegetation layer; tall shrubs (>1m), low trees and regeneration at 10 points along a 50 m transect along the long axis of the plot.
- Native groundcover – grasses: - presence or absence of native grasses at 50 points 1m apart on a 50m transect along the long axis of the plot.
- Native groundcover – shrubs: - mean percent cover of ground by the foliage of low shrubs (>1m) and regeneration at 10 points along a 50 m transect along the long axis of the plot.
- Native groundcover – other: - Presence or absence of native herbs, sedges, rushes, ferns and other groundcover species at 50 points 1m apart on a 50m transect along the long axis of the plot.
- Exotic plant cover: – Presence or absence of exotic species at 50 points 1m apart on a 50m transect along the long axis of the plot.
- Number of trees with hollows: - All living and dead standing trees with their centres in the 50 × 20 quadrat were examined for hollows capable of harbouring wildlife. Hollows are defined as tree holes > 5 cm diameter, having depth, and > 1 m above the ground.
- Regeneration: - The proportion of overstorey trees species on the 50 × 20 m quadrat that are regenerating.
- Total length of fallen logs: - The length of fallen logs > 10 cm diam and > 0.5 m long was totalled for the whole 50 × 20 m quadrat.

Fauna Species Listing

Lists were compiled of all amphibian, bird and mammal species observed, or inferred from evidence of scats, on the study area.

RESULTS AND DISCUSSION

FLORA

A complete list of the plant species found on the study area is given in Appendix 2. In addition to flora species recorded at quadrat and spot sample sites, Appendix 2 includes many of the species planted in gardens, windbreaks, shelterbelts and along roadways. The list also includes flora species recorded in environmental assessment reports conducted for two residential developments (FloraSearch; 2007, 2012) and for the dentistry school development (FloraSearch, 2008).

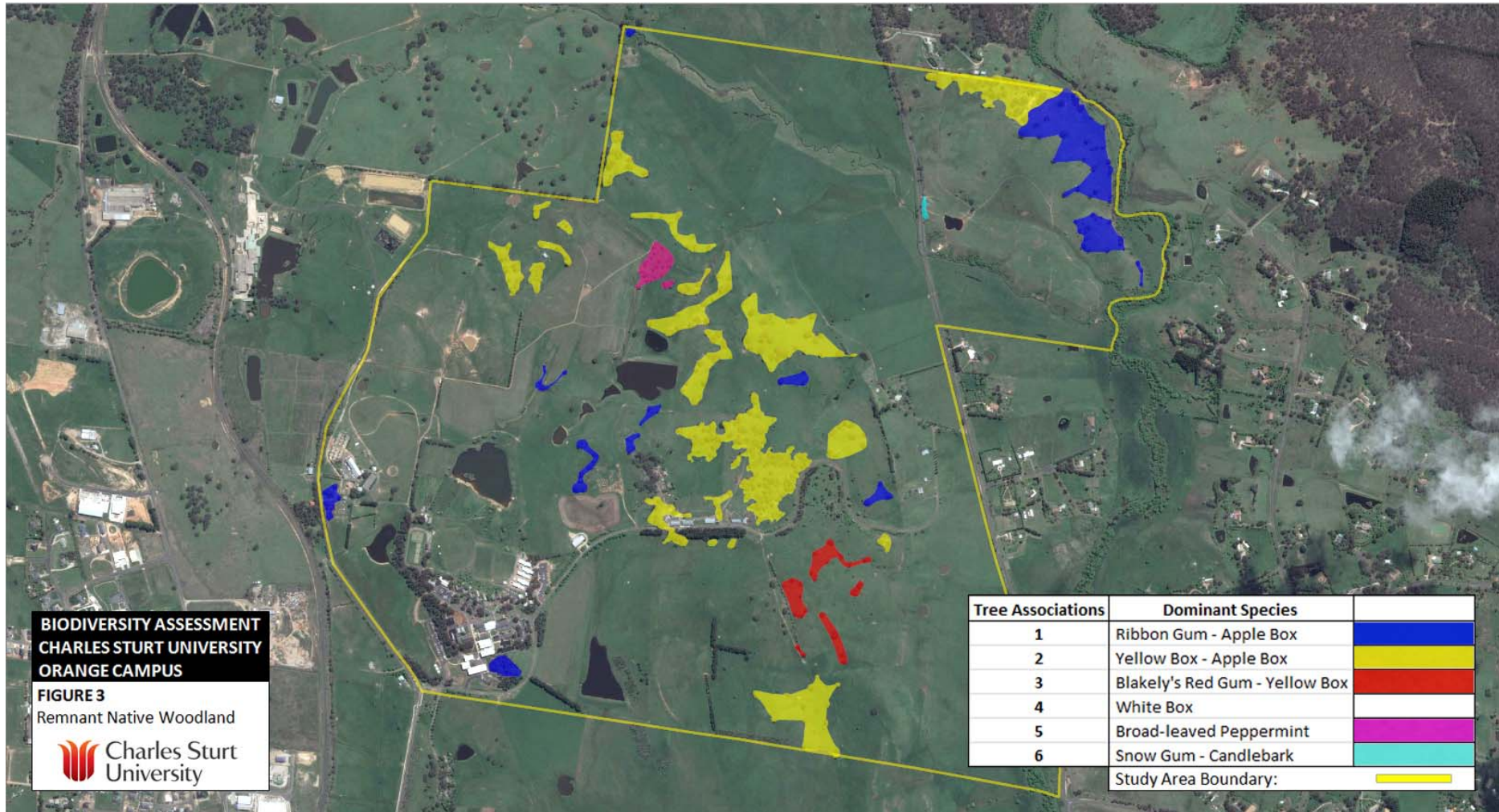
A total of 173 species was recorded, of which 55 (31.8%) are native to the area, 76 (43.9%) are wild growing introduced plants and 42 (24.3%) are planted species that may be Australian natives from other areas or exotic ornamental species. It is likely that some exotic and native planted species have not been listed since it was not practical to document all gardens around the built parts of the campus. The main plant families represented are the Poaceae (Grasses) (33 species), Myrtaceae (Eucalypts and relatives) (28 species), Asteraceae (Daisies) (20 species), and the Fabaceae (Pea flowers and Wattles) (15 species).

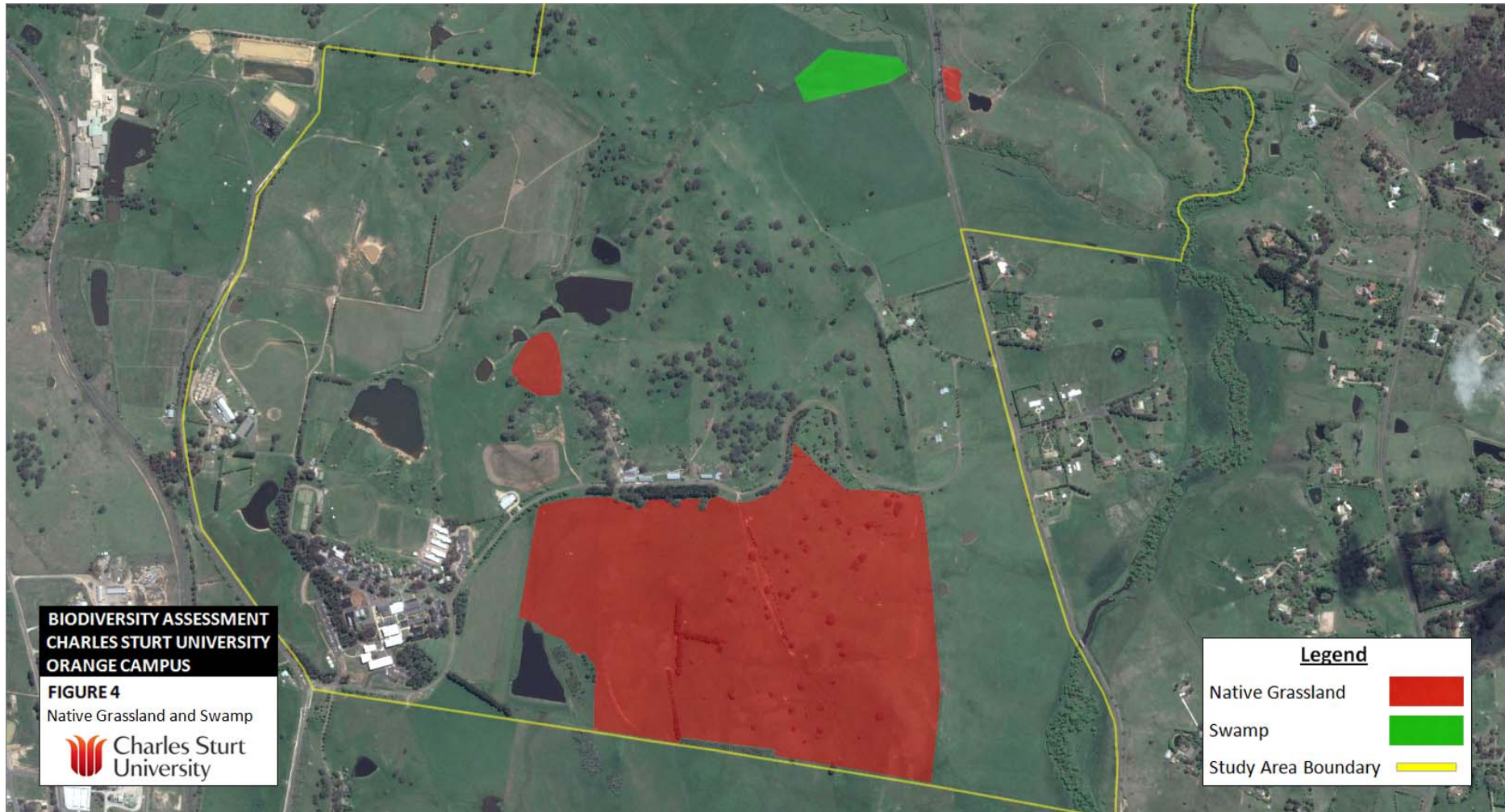
Remnant Native Vegetation

Remnant native trees remain as isolated paddock trees, small groups, or thinned woodlands across parts of the CSU Orange campus and associated farmland (Figure 3). Eight species of remnant native trees are present, the most prominent being Yellow Box (*Eucalyptus melliodora*), Apple Box (*Eucalyptus bridgesiana*), Ribbon Gum (*Eucalyptus viminalis*) and Broad-leaved Peppermint (*Eucalyptus dives*). Smaller occurrences of White Box (*Eucalyptus albens*) and Blakely's Red Gum (*Eucalyptus blakelyi*) are present, while Candlebark (*Eucalyptus rubida*) and Snow Gum (*Eucalyptus pauciflora*) are rare.

Apart from the remnant trees, very little of the original vegetation remains. The only native low trees and shrubs present are rare Silver Wattle (*Acacia dealbata*) plants in three locations and a small patch of Chinese Shrub (*Cassinia arcuata*) west of the tennis courts (Appendix A). A few native shrubs including Hoary Guinea Flower (*Hibbertia obtusifolia*) and the Egg and Bacon Pea, *Pultenaea subternata*, occur along the Ophir Road just outside the fence of the Brick Kiln paddock. Similarly, native ground cover forbs and grasses have been largely displaced by introduced species over much of the study area. The most common native grass is Smooth-flower Wallaby Grass (*Rytidosperma pilosa*) which dominates the native grassland areas. Other native grasses are much less common and include Kneed Spear-grass (*Austrostipa bigeniculata*), Speargrass (*Austrostipa scabra*), Windmill Grass (*Chloris truncata*), Couch (*Cynodon dactylon*), Common Wheatgrass (*Elymus scaber*), Common Tussock-grass (*Poa labillardieri*), Fine-leafed Tussock Grass (*Poa sieberiana*), Ringed Wallaby Grass (*Rytidosperma caespitosum*) and Kangaroo Grass (*Themeda australis*).

Areas where native grasses remain a prominent component of the ground cover, albeit in a mosaic with introduced species, are shown in Figure 4. It is of interest that the main representation of native grass is in Weston paddocks 1 to 4 on the south side of the link road between Leeds Parade and Ophir Road. This is likely to reflect the historical management of this aggregation of paddocks where intensive pasture improvement may not have taken place.





The Original Vegetation

The remnant trees are a sample of the original pre-European woodlands and provide an insight into the former distribution of plant communities on the study area. The current native tree distribution shown in Figure 3 can be used to understand the site characteristics of each tree species association, for estimating the pre-European distribution of plant communities, as shown in Figure 5. The paragraphs below discuss the characteristic landscape positions of each vegetation association as evidenced by the remnant trees on the study area. The ecological preferences of these associations elsewhere in the Orange district were also taken into account.

Association 1. Ribbon Gum/Apple Box/Broad-leaved Peppermint

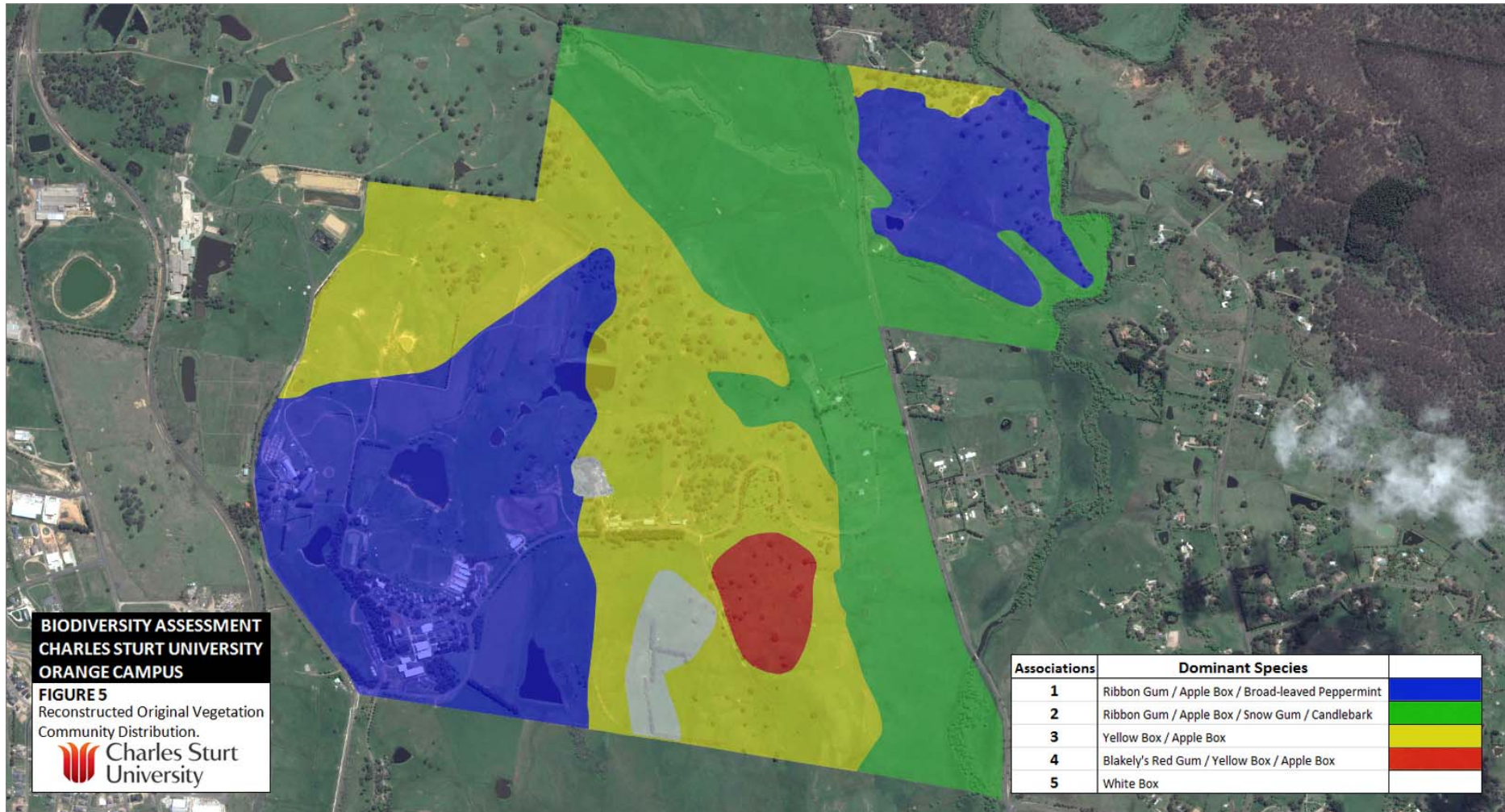
This association is severely depleted on the study area. However, remnants occur in the following situations:

- Plateau areas in the south west of the study area (Plate 1),
- A broad ridge and associated east and north east facing slopes in the Brick Kiln paddock east of Ophir Road,
- Sheltered gullies with deep soils and steep slopes with a southerly aspect.

The elevated south western parts of the study area would likely have been dominated by this association (Figure 5), possibly with small occurrences of Snow Gum, Candlebark and Yellow Box in some situations. A few natural Yellow Box trees occur in the former Horse Unit area and a Candlebark is present next to Dentistry School car park.



Plate 1. Mature remnant Ribbon Gum trees adjacent to the Dentistry School car park.



Association 2. Ribbon Gum/Apple Box/Snow Gum/Candlebark

This association has been almost completely eliminated from the study area. Small remnants are limited to:

- The eastern margin of the block east of Ophir Road and along the roadside adjacent to the floodplain of Mendhams Creek,
- Close to Summer Hill Creek in a small side gully in the same block.

It is considered that this association once dominated the low lying paddocks adjacent to Summer Hill Creek and Mendhams Creek and the adjoining footslopes of the steeper hills (Figure 5). These areas are also likely to have supported Ribbon Gum and Apple Box as dominant species as in similar localities elsewhere around Orange. It is also likely that Black Sally (*Eucalyptus stellulata*), remnants of which occur along Ophir Road, and possibly Black Gum (*Eucalyptus aggregata*), also occurred, the latter in swampy situations.

Association 3. Yellow Box/Apple Box

The largest and most extensive woodland remnants on the study area belong to this association (Plate 2), which is characterised by:

- Dissected ridges and slopes with north, north-easterly and easterly aspects on the edge of the plateau.

The above characteristics indicate this association formerly occurred in a broad ark through the centre of the study area (Figure 5). A small patch was also present in the Brick Kiln Paddock east of Ophir Road.



Plate 2. Yellow Box woodland, Quadrat 2.

Association 4. Blakely's Red Gum/Yellow Box/Apple Box

Blakely's Red Gum is not a prominent species in the study area. Small remnants are restricted to:

- Relatively steep easterly facing slopes south of the link road.

This association could be regarded as a variant of the Yellow Box/Apple Box association and occupies a similar landscape setting. Blakely's Red Gum often occurs where there are elevated soil moisture levels owing to the presence of soaks or impeded drainage.

Association 5. White Box

Two remnant patches of White Box are extant on the study area as follows:

- West and north of Cottages 7 to 9 on a low north trending ridgetop with shallow rocky soils (Plate 3),
- South east of the above patch on the upper easterly slopes of the same ridge.

The former distribution of White Box on the study area is likely to have been limited to the southern ridge line in the Weston Paddocks and the low rocky ridge adjacent to Cottages 7 to 9 (Figure 5).



Plate 3. White Box woodland, Quadrat 1.

Identity of the Former Vegetation Communities on the Study Area.

In this section the remnant vegetation associations on the study area are aligned with communities that have been defined in the literature for the surrounding region and any relevant Endangered Ecological Communities (EEC) listed under the TSC and EPBC Acts (Table 8). It is considered that the study area formerly supported two EECs, viz.

- *Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions Endangered Ecological Community.*

This community equates to Association 2 above and formerly occurred on the flats and lower slopes associated with Mendhams Creek and Lens Gully on the study area (Figure 5). This community has been eliminated by past clearing, cropping and grazing.

- *White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community* (TSC Act), which is equivalent to the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community* (EPBC Act).

This community equates to Associations 3 to 5 above and remnant patches of trees remain in the centre and north-east of the study area (Figure 5).

Table 8.
Ecological Communities Occurring or Formerly Occurring on the Study Area

Association (this study)	Biometric community (OEH, 2008)	EEC	EEC name	Comment
1. Ribbon Gum / Apple Box / Broad-leaved Peppermint	LA101. Apple Box - Broad-leaved Peppermint dry open forest of the South Eastern Highlands (This community is the nearest approximation in the literature to Association 1 identified in this study).	No	N/A	There is no community in the existing botanical literature equivalent to Association 1 of this study. Association 1 is widespread in the Orange area.
2. Ribbon Gum / Apple Box / Snow Gum / Candlebark	LA205. Snow Gum – Candlebark grassland / woodland of the South Eastern Highlands	Yes	Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions Endangered Ecological Community	While LA205 is related to Association 2, the latter differs in being heavily dominated by Ribbon Gum and Apple Box in the Orange area, with Snow Gum and Candlebark as relatively minor components. There is some doubt as to whether Association 2 belongs to the EEC (Bower, 2012). However, to be conservative, it is assumed to be part of the EEC for this report.
3. Yellow Box / Apple Box	LA217. White Box – Blakely's Red Gum – Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	Yes	White Box Yellow Box Blakely's Red Gum Woodland (TSC Act)	
4. Blakely's Red Gum / Yellow Box / Apple Box			White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act)	
5. White Box				

Association 1 (Table 8) is a widespread community in the Orange district for which there are no equivalents described in the botanical literature (Bower, 2012). It appears to be confined to the north-western extremity of the Central Tablelands where it occurs on fertile soils on plateaux, upper slopes and ridgetops.

Current Vegetation on the College Farm

Apart from the extant native trees on the study area, most of the current vegetation comprises introduced pasture grasses and legumes deliberately established for livestock grazing, and exotic self-sown weeds. The current vegetation can be divided into four broad categories, as follows;

- Exotic pasture
- Native grassland
- Swampland
- Alluvial creek flats

Exotic Pasture

With few exceptions, the College Farm grazing paddocks are dominated by exotic cold climate pasture grasses, predominantly Phalaris (*Phalaris aquatica*), Cocksfoot (*Dactylis glomerata*) and Perennial Ryegrass (*Lolium perenne*) with White Clover (*Trifolium repens*). Also common are Prairie Grass (*Bromus cartharticus*) and Goose Grass (*Eleusine tristachya*) (Plate 4). These species dominate both in open pasture land and in remnant eucalypt woodlands. Only one native grass species occurs commonly in the grazing paddocks, Smooth-flower Wallaby Grass (*Rytidosperma pilosa*), which forms patches of tussocks in favourable locations, sometimes dominating small areas.

Prominent weeds in the pastures include Spear Thistle (*Cirsium vulgare*), Flatweed (*Hypochaeris radicata*), Paterson's Curse (*Echium plantagineum*), Hairy Brassica (*Hirschfeldia incana*), Chickweed (*Stellaria media*) and Lamb's Tongues (*Plantago lanceolata*). Woody weeds tend to be confined to the woodland areas and include mainly Hawthorn (*Crataegus monogyna*) and Blackberry (*Rubus anglocandicans*).



Plate 4. Remnant Apple Box trees in a pasture dominated by Cocksfoot, Phalaris, Prairie Grass, Spear Thistle and Paterson's Curse, Quadrat 4.

Native Grassland

Areas of grassland dominated by native species are scattered across the College Farm (Plate 5). The larger, more continuous areas are shown on Figure 4. Large parts of the Weston paddocks, south of the Leeds Parade – Ophir Road link are dominated by native grasses. By far the main species is Smooth-flower Wallaby Grass (*Rytidosperma pilosa*), which appears to be quite tolerant of intensive livestock grazing. However, a variety of other native grasses occurs in Weston paddocks 1 to 4, usually on steeper slopes and in gullies, including Knead Speargrass (*Austrostipa bigeniculata*), Common Wheatgrass (*Elymus scaber*), Common Tussock Grass (*Poa labillardieri*) and Ringed Wallaby Grass (*Rytidosperma caespitosum*).



Plate 5. Native tussock grasses, mainly Smooth-flower Wallaby Grass and Knead Speargrass, Quadrat 7.

Swampland

A small area of swamp vegetation occurs at the lower end of Lens Gully before its confluence with Mendhams Creek (Figure 4). This area was very wet and boggy at the time of the survey and is dominated by a suite of semi-aquatic native species and introduced grasses (Plate 6). The dominant native species could not be conclusively identified since the plants were not flowering, although it is likely to be a *Carex*, possibly *C. fascicularis*, or *Bolboschoenus* species. Other native species included *Juncus laeviusculus* subsp. *laeviusculus*, Woolly Waterlily (*Philydrum lanuginosum*) and Water Couch (*Paspalum distichum*). Prominent introduced species included Lesser Canary Grass (*Phalaris minor*), Tall Fescue (*Festuca arundinacea*), Phalaris (*Phalaris aquatica*), Creeping Bent (*Agrostis stolonifera*), Yorkshire Fog (*Holcus lanatus*) and Clustered Dock (*Rumex conglomeratus*).



Plate 6. Swampland on lower Lens Gully, Quadrat 9.

Alluvial Creek Flats

Alluvial creek flats occur beside Summer Hill Creek in Risky paddock in the far south-eastern corner of the study area. Summer Hill Creek is choked with the exotic Basket Willow (*Salix fragilis* var. *fragilis*) and an impenetrable Blackberry (*Rubus anglocandicans*) infestation to four metres high (Figure 4). A quadrat was conducted on the adjoining grassy floodplain (Plate 7). The grassland is dominated by tussocks of introduced Phalaris (*Phalaris aquatica*) with flood eroded channels between them. The native grass Water Couch (*Paspalum distichum*) dominates a deeper broad hollow and is the only native species present. Other prominent introduced species include Creeping Buttercup (*Ranunculus repens*), Curled Dock (*Rumex crispus*), Goosegrass (*Galium aparine*) and Common Bittercress (*Cardamine hirsuta*). The introduced shrub Hawthorn (*Crataegus monogyna*) is also common.



Plate 7. Alluvial flat beside Summer Hill Creek, Quadrat 10.

Exotic and Native Tree Plantings

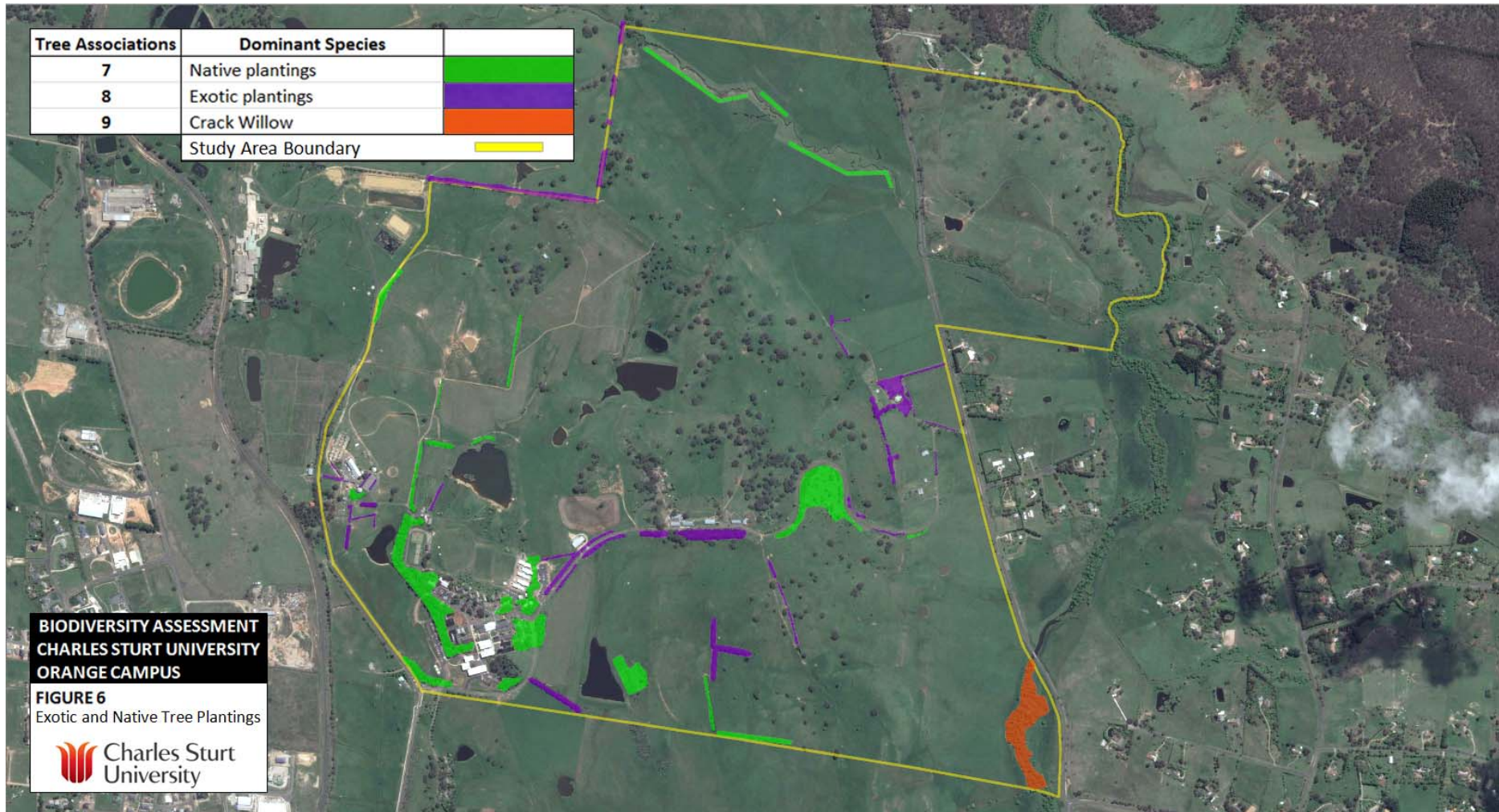
Plantings of exotic and native trees and shrubs have been undertaken for various purposes and at various times since the original college was established in the 1970s. Older plantings of exotic trees are present around the original Rosedale Farm cottage. Since the 1970s, plantings have been established for windbreaks in farm paddocks, as shelterbelts and gardens around buildings, as roadside amenity plantings along the Leeds Parade – Ophir Road link, for research purposes and most recently for environmental restoration. The locations of the main plantings are shown on Figure 6.

Shelterbelts

A major feature of the built area of the CSU Orange campus is a broad shelterbelt planted in the 1970s to screen buildings from southerly, westerly and easterly winds. In recent years parts of the shelterbelt have been lost to develop the Dentistry School and new residential buildings. The shelterbelt comprises a variety of native tree and shrub species, many of which are not endemic to the western Central Tablelands. A list of planted species in the shelterbelt is given in Table 9.

Table 9.
Tree and Shrub Species in CSU Orange Campus Shelterbelts

Common name	Scientific name	Growth form
Cootamundra Wattle	<i>Acacia baileyana</i>	Shrub
Green Wattle	<i>Acacia mearnsii</i>	Low tree
Black Wattle	<i>Acacia melanoxylon</i>	Low tree
Silver Wattle	<i>Acacia dealbata</i>	Low tree
Weeping Boree	<i>Acacia vestita</i>	Shrub
Drooping Sheoak	<i>Allocasuarina verticillata</i>	Tall shrub
River Sheoak	<i>Casuarina cunninghamii</i>	Tree
Argyle Apple	<i>Eucalyptus cinerea</i>	Tree
Eurabbie	<i>Eucalyptus bicostata</i>	Tree
Slaty Box	<i>Eucalyptus dawsonii</i>	Tree
Broad-leaved Peppermint	<i>Eucalyptus dives</i>	Tree
Brittle Gum	<i>Eucalyptus mannifera</i>	Tree
Yellow Box	<i>Eucalyptus melliodora</i>	Tree
Narrow-leaved Black Peppermint	<i>Eucalyptus nicholii</i>	Tree
Blue Mountains Ash	<i>Eucalyptus oreades</i>	Tree
Small-leaved Gum	<i>Eucalyptus parvula</i>	Tree
Narrow-leaved Peppermint	<i>Eucalyptus radiata</i>	Tree
Snow Gum	<i>Eucalyptus pauciflora</i>	Tree
Red Ironbark	<i>Eucalyptus sideroxylon</i>	Tree
Black Sally	<i>Eucalyptus stellulata</i>	Tree
Ribbon Gum	<i>Eucalyptus viminalis</i>	Tree
Rosemary Grevillea	<i>Grevillea rosmarinifolia</i>	Shrub
Tick Bush	<i>Kunzea ambigua</i>	Shrub
Bracelet Honeymyrtle	<i>Melaleuca armillaris</i>	Shrub
Black Tea-tree	<i>Melaleuca bracteata</i>	Shrub



The shelterbelt plantings are now over thirty years old and some of the shorter lived species are declining. In particular, many of the Green Wattles have died with fallen dead trunks on the ground. Other trees are succumbing to competition as the weaker trees are shaded out by more vigorous specimens in the relatively dense plantings.

Some introduced weedy shrubs have also invaded the shelterbelt including Hawthorn (*Crataegus monogyna*), Silver-leaf Cotoneaster (*Cotoneaster pannosus*) and Blackberry (*Rubus fruticosus*). The combination of introduced shrubs, planted shrubs and fallen timber below a dense eucalypt and acacia canopy has created suitable habitat for a suite of native birds that require dense shrubby forest conditions.

The understorey of the shelterbelt comprises mainly shade tolerant introduced grasses and herbs; native species are virtually absent. The most common ground cover species are the grasses Cocksfoot (*Dactylis glomerata*) and Panic Veldt Grass (*Erharta erecta*). Common introduced herbs include Sheep Sorrell (*Acetosella vulgaris*), Chickweed (*Stellaria media*), Goosegrass (*Galium aparine*), Flatweed (*Hypochaeris radicata*) and Spear Thistle (*Cirsium vulgare*).

The native shrub Chinese Shrub or Biddy Bush (*Cassinia arcuata*) has survived in the north-western end of the shelterbelt where it is narrower and more open opposite the tennis courts. A plant of the native herb Sticky Everlasting (*Xerochrysum viscosum*) was also observed there. This area also has remnant Apple Box trees and is likely to have been a natural remnant incorporated into the shelterbelt.

Windbreaks

In common with general practice in the 1970s and earlier, windbreaks of exotic Monterey Pine (*Pinus radiata*) were established along paddock fence lines. These trees are now very large and include broken windbreaks on the north side of Fields paddock and the west side of Rogers 3 in the north of the farm. Others occur in the south on the south side of the Chardonnay Vineyard, the north sides of Weston 2 and College 4b (part only), and forming a T shape on the high ridge in paddocks Weston 1 and 2. There is also an interrupted Monterey Pine windbreak on the western side of Rosedale Park 3 and 4.

Other windbreaks comprise a variety of other exotic species including Poplars (*Populus nigra*) (around the Rosedale Farm cottage area), Deodar Cedar (*Cedrus deodara*) (south west of the main dam and south of the Horse Unit) and Cypress Pines (*Cupressus* species) (on the western side of Weston 3 paddock and beside the Leeds Parade – Ophir Road link). These exotic windbreaks are considered to have little biodiversity value.

More recent windbreaks have used a variety of native tree species, particularly along the Red Winegrape Vineyard access road, on the western side of the vineyard and north of the main dam. Native tree species utilised include Wallangara White Gum (*Eucalyptus scoparia*), Red Stringybark (*Eucalyptus macrorhyncha*), Narrow-leaved Black Peppermint (*Eucalyptus nicholii*), River Sheoak (*Casuarina cunninghamiana*) and Rough-barked Manna Gum (*Eucalyptus viminalis* subsp. *cygnetensis*).

Roadside plantings

Extensive older tree and shrub plantings have taken place along the Leeds Parade – Ophir Road link, downhill from the maintenance buildings and mainly on the south side of the road. These plantings comprise a mix of native and introduced species with native species predominating. Each species is grouped in the plantings in blocks or rows. Native trees include Yellow Box (*Eucalyptus melliodora*), Red Ironbark (*Eucalyptus sideroxylon*), Argyle Apple (*Eucalyptus cinerea*), Snow Gum (*Eucalyptus pauciflora*), Narrow-leaved Black Peppermint (*Eucalyptus nicholii*), Brittle Gum (*Eucalyptus mannifera*) and Wallangara White Gum (*Eucalyptus scoparia*). Introduced trees include Deodar Cypress (*Cedrus deodara*), Liquidamber (*Liquidamber styraciflua*) and Lombardy Poplar (*Populus nigra*). Introduced shrubs comprise Firethorn (*Pyracantha crenulata*), Photinia (*Photinia X fraseri*) and Silver-leaf Cotoneaster (*Cotoneaster pannosus*).

Research plantings

Research plantings comprise blocks of native vegetation established for studies of their values as native bird habitat in farm landscapes (Dr Cilla Kinross) and as harbour for predatory and parasitic arthropods for biocontrol of agricultural pests (Dr Geoff Gurr).

Research plantings include:

- *A block of young eucalypt trees east of the dam in the south of College 4b paddock.* These comprise Ribbon Gum (*Eucalyptus viminalis* subsp. *viminalis*), Snow Gum (*Eucalyptus pauciflora*) and Eurabbie (*Eucalyptus bicostata*) (Plate 8). Adjacent to this planting is a small patch of older planted trees comprising Narrow-leaved Black Peppermint (*Eucalyptus nicholii*), Eurabbie (*Eucalyptus bicostata*), Black Sally (*Eucalyptus stellulata*) and Paddys River Box (*Eucalyptus macarthurii*).



Plate 8. Research planting in paddock College 4b.

- *A strip of trees and shrubs running south of the water tank in paddock Weston 1.* The trees in this windbreak include Yellow Box (*Eucalyptus melliodora*), Ribbon Gum (*Eucalyptus viminalis* subsp. *viminalis*), Wallangara White Gum (*Eucalyptus scoparia*), River Sheoak (*Casuarina cunninghamiana*) and Sydney Green Wattle (*Acacia decurrens*). Shrubs include River Bottlebrush (*Callistemon sieberi*), Slender Honey Myrtle (*Melaleuca gibbosa*), Bracelet

Honeymyrtle (*Melaleuca armillaris*), Willow-leaved Hakea (*Hakea salicifolia*) and Rosemary Grevillea (*Grevillea rosmarinifolia*). The structural and floristic diversity of this planting make it attractive to a range of native bird species.

- A newer windbreak planting established in 2002-3 on the southern boundary of Weston 1 paddock. The trees include Yellow Box (*Eucalyptus melliodora*), Blakely's Red Gum (*Eucalyptus blakelyi*), Wallangara White Gum (*Eucalyptus scoparia*), Snow Gum (*Eucalyptus pauciflora*), Red Stringybark (*Eucalyptus macrorhyncha*), River Sheoak (*Casuarina cunninghamiana*) and Hickory Wattle (*Acacia implexa*). Shrubs include Silver Wattle (*Acacia dealbata*), Woolly Tea-tree (*Leptospermum lanigerum*) and Weeping Boree (*Acacia vestita*).

Environmental restoration

Environmental plantings have been made since 2009 with funding from the Central West CMA to the Summer Hill Creek Landcare Group. These plantings aim to stabilise the soils of riparian environments and drainage lines, establish wildlife corridors and enhance biodiversity on the farm. These include:

- The windbreak on the Red Winegrape Vineyard access road (described above) and an extension down a fenceline to the main dam.
- Extensive fenced out plantings beside Mendhams Creek in Mendhams 1 and 2 paddocks. Trees planted here include Ribbon Gum (*Eucalyptus viminalis* subsp. *viminalis*), Candlebark (*Eucalyptus rubida*) and Apple Box (*Eucalyptus bridgesiana*), which are likely to have been native to this area.
- Other environmental plantings have taken place to the east of the main dam and along the lower parts of Mendhams Creek where it traverses the Brick Kiln Flat paddock east of Ophir Road (C. Kinross, pers. comm.).

Noxious and Nationally Significant Weeds

Weeds declared as Noxious in the Orange City Council area under the NSW *Noxious Weeds Act 1993* and/or are listed as Weeds of National Significance that were found on the study area are listed in Table 10. Weeds of National Significance are declared by the Australian Weeds Committee of the Commonwealth Government (www.weeds.org.au).

Of the five species listed in Table 10, only Sweet Briar occurred in very low numbers indicating that it was being very effectively suppressed by existing weed control strategies on the farm. Comments on the status of each weed species are given below.

Bathurst Burr

Bathurst Burr was recorded on four quadrat sites and one spot sample site (Appendix 2), all in the remnant woodland areas of the central parts of the farm. Plant densities were generally low and no extensive areas of dense infestation were observed. The low level infestation indicates generally successful control of this weed.

**Table 10
Noxious Weeds and Weeds of National Significance**

Common Name	Scientific Name	Noxious Class in NSW	Weed of National Significance
Bathurst Burr	<i>Xanthium spinosum</i>	4	
Blackberry	<i>Rubus fruticosus</i> species aggregate	4	✓
St. John's Wort	<i>Hypericum perforatum</i>	4	
Sweet Briar	<i>Rosa rubiginosa</i>	4	
Willows	<i>Salix</i> spp.	5	✓

NSW Noxious Class 4 The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its reproduction and the plant must not be knowingly sold or distributed.

NSW Noxious Class 5 The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with.

Blackberry

Blackberry is widespread and common across most of the property. It was recorded on five quadrats, in seven spot samples and on all three previous survey sites (Appendix 2). Infestations are generally small and localised, indicating ongoing control. However, a large infestation was found at Quadrat 3 and the Crack Willows on Summer Hill Creek adjacent to Quadrat 10 are very heavily infested. Blackberry is also quite common within the shelterbelt to the south and west of the main campus.

St. John's Wort

Infestations of St. John's Wort are confined to the Brick Kiln paddocks east of Ophir Road, where it was recorded on all four sample sites. Quite large infestations are present on the west facing slope adjacent to Ophir Road. It is clear that efforts to control this species need to be increased in the Brick Kiln paddocks.

Sweet Briar

Sweet Briar was only recorded at one Quadrat site and in one spot sample, both in low numbers. This weed is under good control.

Willows

A heavy infestation of Crack Willow occurs on the Summer Hill Creek between the Banjo's and Risky paddocks in the south-eastern corner of the property. This infestation completely chokes the creek and is continuous with similar infestations up and down stream. The willows also shelter a very large infestation of Blackberry. Control of the willows in Summer Hill Creek would require a coordinated program between the university and neighbours along the creek involving willow removal and replacement by suitable native trees. A commitment to ongoing maintenance would be essential.

FAUNA

Birds

A total of 54 bird species was recorded in this survey on CSU land of which 52 are native and two are introduced (Appendix 3). This is a relatively good species count for a largely cleared rural property. The bird diversity reflects the diversity of available habitats including open paddocks, remnant woodlands, the shelterbelt, native windbreaks with shrubs and numerous dams. Nine species of water birds were associated with the dams including ducks (4 species), the Australasian Grebe, Little Pied Cormorant, White-faced Heron, Eurasian Coot and Seagulls. The shelterbelt and windbreaks with a dense shrub layer provide habitat for a range of small birds including Thornbills, Scrubwrens, Fairywrens, White-throated Treecreeper, Honeyeaters, Fantails, Whistlers, Shrike-thrushes and Silvereyes. Canopies of the larger trees are frequented by Pardalotes, Weebills, Cuckoo-shrikes, Honeyeaters and Rosellas. Open paddocks and semi-cleared woodlands provide habitat for Plovers, Pacific Heron, Ibis, Crested Pigeon, Kestrels, Kites, Yellow-rumped Thornbill, Red-browed Finch, Swallows, PeeWee, Flame Robin, Cockatoos, Galahs, Red-rumped Parrot and Rosellas.

The birds observed in this survey can be considered as year round residents of the College Farm. Many of them can be expected to breed on the property in trees, shrubs or buildings. Indeed, several species were observed building nests or inspecting nest hollows in trees, including the Australian Magpie, Crimson Rosella, Galah, Wood Duck, Striated Thornbill and Striated Pardalote.

The number of species documented in this survey is approximately half the total number (113) recorded previously by Dr Cilla Kinross and other observers (Appendix 1). Many of the additional species are migratory birds that utilise the study area for breeding in spring and summer, but spend the winter in northern or inland Australia. The Flame Robin observed in this survey is one such species; it nests in high montane forests in spring and summer and disperses to more open country in winter. This bird may be part of a population known to nest on Mt. Canobolas. Others are nomadic species that wander over wide distances and may visit the study area occasionally, for example to feed on nectar when the eucalypts are in flower. Still others may be young birds dispersing through the landscape in search of suitable unoccupied territory to settle in.

Mammals, Reptiles and Frogs

The mammals, reptiles and frogs observed in the survey are listed in Table 11. Three native mammals were recorded during the survey. Approximately 20 Eastern Grey Kangaroos (*Macropus giganteus*) were observed in the Brick Kilns paddocks on two occasions. A pair of Common Brushtail Possums (*Trichosurus vulpecula*) was observed in Yellow Box trees within the mown area immediately to the west of the maintenance workshops. One of the trees has a large hollow in the trunk suitable for a possum den. A single Sugar Glider (*Petaurus breviceps*) was observed in an old growth Ribbon Gum tree north of the Wine Centre.

Other native mammals previously recorded for the farm include the Swamp Wallaby (*Wallabia bicolor*), the Short-beaked Echidna (*Tachyglossus aculeatus*) and the Lesser Long-eared Bat (*Nyctophilus geoffroyi*) (Appendix 1). The Swamp Wallaby and Echidna are considered to be rare (Appendix 1).

Three introduced mammals were recorded in this survey, the Red Fox, European Rabbit and European Hare (Table 11). The Red Fox was observed in the farm paddocks on several occasions, including a pair moving together. Rabbits and hares were uncommon. There are also previous records of the introduced House Cat (*Felis catus*), Black Rat (*Rattus rattus*) and House Mouse (*Mus musculus*) (Appendix 1).

The weather throughout the survey period was too cold for reptile activity and none were seen. Previous observations indicate the presence of at least eight reptile species; four snakes, Eastern Brown Snake (*Pseudonaja textilis*), Red-bellied Black Snake (*Pseudechis porphyriacus*), Copperhead (*Austrelaps superbus*) and Diamond Python (*Morelia spilota*); three lizards, Eastern Blue-tongue (*Tiliqua scincoides*), Shingleback (*Trachydosaurus rugosus*) and Cunningham's Skink (*Egernia cunninghami*), and the Long-necked Tortoise (*Chelodina longicollis*) (Appendix 1).

Wetter than normal conditions in the first half of 2012 were favourable for frogs, which called commonly in the evenings during the survey. However, only two species known to call during winter were recorded; the Common Froglet (*Crinia signifera*), which was common and widespread, and the Beeping Froglet (*Crinia parinsignifera*), which was rare (Table 11). Four other species of frogs have been recorded previously; Eastern Banjo Frog (*Limnodynastes dumerilii*), Spotted Grass Frog (*Limnodynastes tasmaniensis*), Peron's Tree Frog (*Litoria peronii*) and Whistling Tree Frog (*Litoria verreauxii*) (Appendix 1).

Table 11
Mammals, Reptiles and Frogs Recorded on CSU land

Scientific Name	Common Name	No. Observed	Comment
MAMMALIA			
Marsupialia/Diprotodontia			
Macropodidae			
<i>Marcopus giganteus</i>	Eastern Grey Kangaroo	20	Confined to the Brick Kiln paddocks.
Petauridae			
<i>Petaurus breviceps</i>	Sugar Glider	1	One seen in a tree north of the Wine Centre
Phalangeridae			
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	2	A pair observed in trees immediately west of the workshops.
Eutheria/Carnivora			
Canidae			
* <i>Vulpes vulpes</i>	Red Fox	6+	Common on the property.
Eutheria/Lagomorpha			
Leporidae			
* <i>Lepus timidus</i>	Hare	1	Only one observed.
* <i>Oryctolagus cuniculus</i>	European Rabbit	•	Uncommon
AMPHIBIA			
Anura			
Myobatrachidae			
<i>Crinia parinsignifera</i>	Beeping Froglet	•	Common
<i>Crinia signifera</i>	Eastern Common Froglet	•	Uncommon

* Introduced species

Habitat Trees

The most outstanding biodiversity feature of the 'College Farm' is the high number of remnant old growth eucalypts in the paddocks. Many of these trees have large and / or small hollow limbs, hollow trunks and spouts suitable for nesting and denning for a wide range of bird, bat and arboreal mammal species (Plates 9 to 11).



Plate 9. Yellow Box habitat tree.



Plate 10. Stag with Galah nest hollow in the upper trunk.



Plate 11. Habitat Ribbon Gums and Stag in the Horse Unit paddocks.

All trees on CSU land were inspected for the presence of hollows. A total of 59 habitat trees with hollow limbs were identified (Figure 7). Hollows were found in six eucalypt species (Table 11), with Ribbon Gums and Apple Boxes having the most hollows. Despite its abundance on the farm, few Yellow Box trees bore hollows (Table 12). Yellow Box has very durable wood and does not seem to form hollows as readily as Ribbon Gum and Apple Box. All the many native trees in the shelterbelt, windbreak and other plantings lacked hollows, mainly because they are too young. It is known that hollows generally don't begin to develop until eucalypts are 80 or more years old. Consequently, the trees in existing and future plantings are unlikely to develop large hollows until well into next century. Accordingly, the 59 identified habitat trees have very high value for native wildlife and should be protected as an integral part of any biodiversity enhancement strategy.

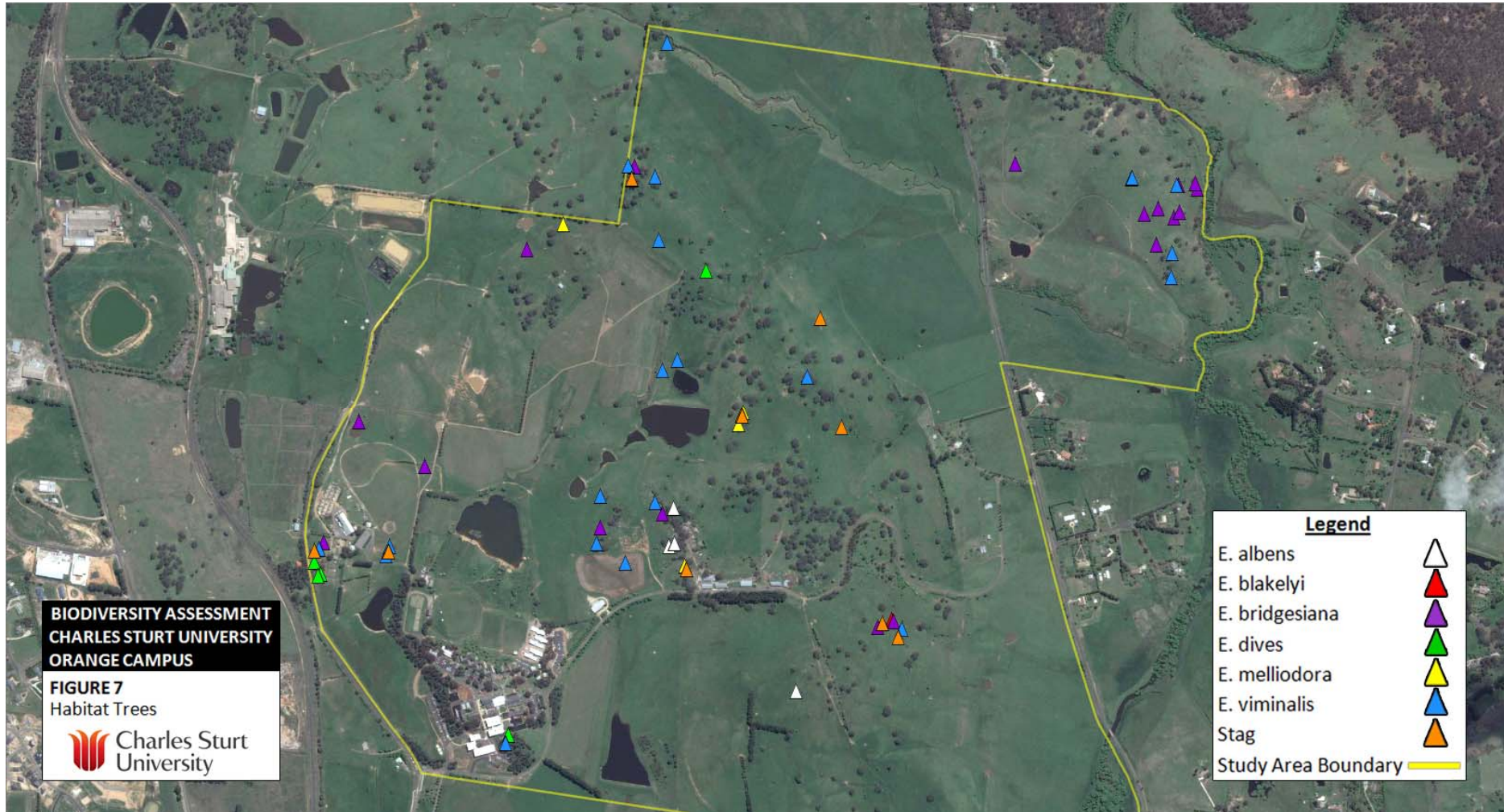
Table 12.
Numbers of Hollow-bearing Trees according to Species

Scientific Name	Common Name	No. of Trees
<i>Eucalyptus albens</i>	White Box	4
<i>E. blakelyi</i>	Blakely's Red Gum	1
<i>E. bridgesiana</i>	Apple Box	18
<i>E. dives</i>	Broad-leaved Peppermint	4
<i>E. melliodora</i>	Yellow Box	4
<i>E. viminalis</i>	Ribbon Gum	19
Stag (dead tree)	-	9
Total		59

Figure 7 shows that habitat trees are clustered in the landscape with the main concentrations in the following areas;

- East and south west of the Horse Unit,
- west of Cottages 7 to 9,
- in the Weston 2 paddock,
- in Taylors 2 paddock,
- on the west side of Rogers 3 paddock, and
- on the eastern side of the Brick Kilns paddocks.

It is important to recognise these concentrations of habitat trees in future biodiversity management on the farm and that they become a focus of biodiversity enhancement activities, including establishment of fenced out regeneration areas around them and linking them into a wildlife corridor network across the farm.



Stag removal

Plate 12 illustrates an unfortunate reality throughout rural Australia in which dead trees (stags) are seen to have value only for firewood. Plate 12 was taken in Taylors 2 paddock where a stag had recently been felled and removed for firewood, presumably by a member of the university staff, in what would be considered a routine activity. Stags such as this have biodiversity value as habitat for a variety of wildlife and should be protected as part of the universities biodiversity enhancement practice.



Plate 12. Removal of a Stag for Firewood (Taylors 2 paddock).

Pest Animals

Three pest animals known to occur on CSU Orange land, the House Cat, the Red Fox and Rabbits are listed as Key Threatening Processes under the *NSW Threatened Species Conservation Act 1995*. Key Threatening Processes are agents that adversely affect threatened species, populations or ecological communities or have potential to cause species, populations or ecological communities that are not threatened to become threatened. There is no requirement for all landholders to control these pest species, if there is no direct threat to threatened species, populations or ecological communities. However, House Cats and Red Foxes on CSU land pose a threat to wildlife attracted to the shelterbelts, windbreaks and other plantings on the farm. Consequently, it is recommended that CSU initiates control of House Cats and Red Foxes to minimise harm to local biodiversity.

Fauna Habitat Value Assessment

Assessment of habitat complexity was undertaken using the NSW Department of Environment and Conservation's 'BioMetric' Terrestrial Biodiversity Assessment Tool (Gibbons *et al.* 2005). Ten variables were assessed at the ten flora quadrat sites; summarised in Table 13. The field data is compared in Table 13 with benchmark data for pristine examples of pre-European vegetation communities similar to those that formerly occurred on the study area. The BioMetric communities selected for comparison were;

- *Apple Box - Broad-leaved Peppermint dry open forest of the South Eastern Highlands* (This is considered the nearest BioMetric community to Association 1 of this study.)
- *Snow Gum – Candlebark grassland/woodland of the South Eastern Highlands* (This is considered the nearest BioMetric community to Association 2 of this study.)
- *White Box – Blakely's Red Gum – Yellow Box grassy woodland of the NSW South Western Slopes Bioregion* (This is the equivalent BioMetric community for Associations 3 to 5 of this study.)

The benchmark data was obtained from the Office of Environment and Heritage website (DECC, 2008). It should be noted that the flora quadrats sample the CSU land with the highest representations of the original biodiversity.

On all but three measures (highlighted in yellow in Table 13) the habitat value of the study area does not compare favourably with pristine habitat. This is to be expected given past disturbances to the area, including complete clearing of all of the original vegetation cover, except for some trees. Native plant species richness is well below the benchmark throughout the study area (Table 13). This reflects the complete lack of native shrubs in the farm paddocks and the dominance of the pastures by exotic grass and weed species. Indeed, cover of the ground surface by exotic vegetation averages between 74 and 79 percent.

The measures for which the benchmarks were met are native overstorey cover and native grass cover in Box – Gum Woodlands and native grass cover in the Ribbon Gum / Apple Box association. These benchmarks were met only because the quadrats were placed preferentially in remnant woodland patches, biasing the tree cover measure, which is not typical of the property as a whole. The native grass cover measures just exceed the lower benchmarks reflecting the presence of patches dominated by native grasses in some grazing paddocks.

Overall, the habitat quality of the remnant native vegetation on the study area compares very poorly with the benchmarks and can be regarded as highly degraded. It can be concluded that the farmed parts of the study area have low habitat value for most native fauna, except those with very broad ecological tolerances.

The above data on vegetation condition also highlight the very poor state of endangered ecological community remnants occurring on the study area.

Table 13
Fauna Habitat Quality Data

Vegetation type	No. of replicates	Recorded Values			Benchmarks	
		Lower	Upper	Average	Lower	Upper
Native plant species richness (number of species)						
Ribbon Gum / Apple Box ¹	1	4	4	4.0	17	
Ribbon Gum / Snow Gum ²	2	1	5	3.0	30	
Box-Gum woodland ³	7	2	9	5.0	23	
Native overstorey cover (%)						
Ribbon Gum / Apple Box	1	4.5	4.5	4.5	21	37
Ribbon Gum / Snow Gum	2	0	0	0	15	25
Box-Gum woodland	7	15	50.5	28.1	8	35
Native midstorey cover (%)						
Ribbon Gum / Apple Box	1	0	0	0	9	20
Ribbon Gum / Snow Gum	2	0	0	0	5	8
Box-Gum woodland	7	0	0	0	1	20
Native groundcover – grasses (%)						
Ribbon Gum / Apple Box	1	3.2	3.2	3.2	1	10
Ribbon Gum / Snow Gum	2	2	8	5.0	8	60
Box-Gum woodland	7	0	72	16.6	15	70
Native groundcover – shrubs (%)						
Ribbon Gum / Apple Box	1	0	0	0	2	10
Ribbon Gum / Snow Gum	2	0	0	0	3	5
Box-Gum woodland	7	0	0	0	3	5
Native groundcover – other (%)						
Ribbon Gum / Apple Box	1	0	0	0	5	14
Ribbon Gum / Snow Gum	2	0	0	0	3	10
Box-Gum woodland	7	0	0	0	3	20
Exotic plant cover (%)						
Ribbon Gum / Apple Box	1	74	74	74.0	-	-
Ribbon Gum / Snow Gum	2	76	82	79.0	-	-
Box-Gum woodland	7	38	98	79.1	-	-
Number of trees with hollows						
Ribbon Gum / Apple Box	1	0	2	1	1	
Ribbon Gum / Snow Gum	2	0	0	0	1	
Box-Gum woodland	7	0	1	0.1	0.8	
Regeneration (proportion of tree species)						
Ribbon Gum / Apple Box	1	0	0	0	-	-
Ribbon Gum / Snow Gum	2	0	0	0	-	-
Box-Gum woodland	7	0	0.5	0.07	-	-
Total length of fallen logs (m)						
Ribbon Gum / Apple Box	1	8.4	8.4	8.4	50	
Ribbon Gum / Snow Gum	2	0	57.4	28.7	35	
Box-Gum woodland	7	0	34.1	15.0	66	

1 Benchmarked against BioMetric community LA101 – *Apple Box - Broad-leaved Peppermint dry open forest of the South Eastern Highlands*

2 Benchmarked against BioMetric community LA205 – *Snow Gum – Candlebark grassland/woodland of the South Eastern Highlands*

3 Benchmarked against BioMetric community LA217 – *White Box – Blakely's Red Gum – Yellow Box grassy woodland of the NSW South Western Slopes Bioregion*

THREATENED BIODIVERSITY

Threatened Flora Species

Three threatened flora species listed under the NSW *Threatened Species Conservation Act, 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* have been planted in some campus woodlots and windbreaks (Figure 8). Some 58 individuals of the three species were recorded by the survey. The main concentrations are around the campus buildings, beside the Leeds Parade – Ophir Road link and in the College 4b and Weston 1 paddocks (Figure 8).

Table 14.
Threatened Flora Species Planted in the Study Area

Common name	Scientific name	No. of plants	Status	
			TSC Act	EPBC Act
Narrow-leaved Black Peppermint	<i>Eucalyptus nicholii</i>	30	Vulnerable	Vulnerable
Wallangara White Gum	<i>Eucalyptus scoparia</i>	27	Endangered	Vulnerable
Paddy's River Box	<i>Eucalyptus macarthurii</i>	1	Vulnerable	N/A

No other threatened flora species were found, including any of the four species listed in Table 1 as having moderate to high potential to have formerly occurred on the study area. Nor were any species identified that are listed as Rare or Poorly Known in *Rare or Threatened Australian Plants (ROTAP)* (Briggs and Leigh, 1995).

The assessment section below considers the impact of potential future campus development on the Narrow-leaved Black Peppermint, Wallangara White Gum and Paddy's River Box. Although none of the threatened species listed in Table 1 was found by the survey, there is a possibility that small residual populations of one or more of them may have been overlooked, since some are small inconspicuous species when not in flower. Consequently, two herbaceous species, Silky Swainson-Pea and Austral Toadflax, considered to have a moderate to high probability of once occurring on the study area, are also subjected to impact assessments below. Brief descriptions of these species are given in Table 15.



Table 15
Threatened Flora Species for Impact Assessment.

Scientific Name	Common Name	Description
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	A small to medium-sized tree with rough bark to the twigs. Juvenile leaves are narrow, linear, opposite for a few pairs, then alternate. Adult leaves are bluish green, narrow, linear to narrow-lanceolate, to 13 × 1 cm. Inflorescences 7 flowered. Natural distribution is restricted to the Northern Tablelands of NSW, mainly from Walcha to Glen Innes. It has been widely cultivated and planted as an ornamental street and park tree.
<i>Eucalyptus scoparia</i>	Wallangara White Gum	Wallangara White Gum is a small tree to 15 m tall with smooth, powdery white to pale grey bark. The adult leaves are shiny green, 10 - 15 cm long and 6 - 10 mm wide. The flower buds are oval-shaped with a conical cap, and the small gumnuts are oval-shaped, 4-5 mm long and wide. The canopy is often open and pendulous. In NSW it is known from only three locations near Tenterfield, including Bald Rock National Park (OEH, 2012AAa).
<i>Eucalyptus macarthurii</i>	Paddys River Box	Paddys River Box is a tall tree reaching up to 40 metres high. The grey-brown, shortly fibrous, thick bark is persistent on the trunk and larger branches. The upper bark is smooth, grey and sheds in short ribbons. Juvenile leaves opposite, dull green and heart-shaped. Adult leaves are dull-green, 8-16 cm long, 0.8-1.5 cm wide. Paddys River Box has a moderately restricted distribution from the Moss Vale district to Kanangra Boyd National Park. The only known record in the conservation estate is within Kanangra Boyd National Park (OEH, 2012AAa).
<i>Swainsona sericea</i>	Silky Swainson-pea	A prostrate or low growing herb to 10 cm high. Plants are densely hairy, including the 2 to 7 cm long leaves with 5 to 13 leaflets. It has upright racemes of 2 to 8 purple pea flowers.
<i>Thesium australe</i>	Austral Toadflax	A small, straggling perennial herb to 40 cm tall with pale green to yellow-green, somewhat succulent leaves, 1 - 4 cm long and 0.5 - 1.5 mm wide. Flowers are minute, pale green, yellow or white and emerge singly from the leaf axils. The fruit is small and nut-like. <i>T. australe</i> is hemiparasitic on the roots of other plants, especially Kangaroo Grass, <i>Themeda australis</i> .

Threatened Ecological Communities

It is considered that the study area formerly supported two EECs, viz.

- *Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions Endangered Ecological Community.*
- *White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community (TSC Act), which is equivalent to the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community (EPBC Act) (commonly known as Box-Gum Woodlands).*

The first has been almost completely eliminated from the study area and there are no viable remnants left. The only evidence of its former occurrence is the persistence of several Snow Gum trees on the lower slopes of the Brick Kilns paddocks and a few small juvenile Snow Gum and Candlebark trees inside the fence adjacent to the Ophir Road. this community is not considered further here.

The presence of many woodlots and isolated paddock trees indicates Box-Gum Woodlands occurred in a broad band through the centre of the property (Associations 3 to 5 on Figure 5). However, apart from the trees, little remains of the original community except for a few native grasses. The

characteristic low trees and shrubs are completely absent and virtually none of the ground cover forbs remain. The community is highly degraded and has been alienated for over a century. It is considered there is no potential for natural recovery of the original community from the soil seed bank on any part of the study area. The criteria listed in Table 16 have been established for determining whether remnants of Box-Gum Woodlands qualify for protection under the TSC and EPBC Acts. Table 16 includes an assessment of the remnants on the CSU College Farm against these criteria.

Table 16.
Identification Criteria for Box-Gum Woodland Remnants
Protected under the TSC and EPBC Acts.

Criterion	TSC Act	CSU	EPBC Act	CSU
Bioregion	NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions	✓	NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Darling Riverine Plains, Sydney Basin, Cobar Peneplain, South Eastern Highlands, NSW South Western Slopes, Riverina or South East Corner Bioregions	✓
Native understorey	Any native species present	some	Predominantly native ground cover defined as 'at least 50 percent of the perennial vegetation cover in the ground layer is made up of native species'.	some
Resilience	Site is 'likely to respond to assisted natural regeneration'	X	NA	-
Trees	Site has, or is likely to have had prior to clearing, White Box, Yellow Box and/or Blakely's Red Gum.	✓	Site has, or is likely to have had prior to clearing, White Box, Yellow Box and/or Blakely's Red Gum.	✓
Ground cover	Predominantly grassy (native not introduced grasses)	some	Native tussock grasses and herbs, and a sparse, scattered shrub layer.	some
Shrubs	'Shrubs are generally sparse or absent, though they may be locally common.'	✓	Patches with 'a continuous shrub layer of more than 30 percent cover' are excluded from the CEEC.	✓
Important species	NA	-	Twelve or more native (non-grass) understorey species present, including at least one 'important species'.	X
Disturbance	Natural soil and associated seed bank are still or at least partially intact.	X	Site is still the CEEC even if treeless, provided it has 'an intact native ground layer with a high diversity of native plant species'.	X
Size	Not important	-	At least 0.1 ha with more than 12 native understorey species (not grasses) OR greater than 2 ha with an average of 20+ trees per ha, or active tree regeneration.	✓

The Box-Gum Woodland remnants on the College Farm do not qualify for protection under the NSW TSC Act because the remnants have lost resilience, i.e. are unlikely to respond to assisted natural regeneration, and are too highly disturbed, such that the seed bank of native species has been almost

completely lost. Similarly, all remnants fail to meet the Commonwealth EPBC Act criteria for the presence of 'an intact native ground layer with a high diversity of native plant species' including at least one 'important species'. However, even if remnants fail the 'high diversity' test, they can still qualify for protection under the EPBC Act on a size and tree density criterion; i.e. a remnant is part of the threatened community if it is greater than 2 ha in size and has an average of more than 20 trees per ha. Two remnants qualify for protection under the size and density criterion as follows;

- A 6.9 ha patch of Yellow Box and Apple Box centred on the Tree Lot paddock and the south west corner of Taylors 3 paddock, and extending into Holdings 1, 3 and 5 paddocks (Figure 3).
- A 2.9 ha patch of Yellow Box and Apple Box on the northern boundary of the Brick Kiln paddock (Figure 3).

These two patches of Box-Gum Woodland are protected under the EPBC Act and represent the best examples of the community on the College Farm. It is recommended that they be afforded formal protection from clearing under university planning and be prioritised for vegetation enhancement activities.

Threatened Fauna Species

One threatened fauna species, the Flame Robin (*Petroica phoenicea*), was found by this survey and this and five others have been recorded on the property previously; Little Eagle (*Hieraaetus morphnoides*), Superb Parrot (*Polytelis swainsonii*), Speckled Warbler (*Chthonicola sagittata*), Scarlet Robin (*Petroica multicolour*) and Varied Sitella (*Daphoenositta chrysoptera*) (Appendix 1). All have been recorded only rarely, suggesting the observations were of vagrant birds rather resident species.

The fauna survey techniques were not designed to detect all potential threatened species, particularly bats and owls. Rather, owing to the highly modified nature of the study area, the approach taken was to conduct an assessment of the value of the habitats on the study area for threatened fauna. The 'Biometric' habitat value assessment (Table 13) showed the natural values of the study area are highly degraded as a result of past land use practices. The following list summarises key wildlife habitat values that have been lost:

- There is no native shrub layer
- Native ground cover forbs have been eliminated
- The ground cover has a very high level of introduced species
- There are few fallen trees, hollow logs, branches or leaf litter on the ground

These factors indicate that the habitat is unsuitable for native fauna that require:

- Relatively large natural areas to maintain viable population sizes
- Natural shrub and ground cover vegetation layers
- Ground debris including logs, branches and leaf litter

Other site characteristics that operate against most wildlife are:

- High levels of human activity
- Intensive grazing of all paddocks

Factors suitable for some wildlife on the study area include:

- A wide variety of tree hollows in 59 habitat trees
- Remnant woodland eucalypt trees, especially Yellow Box, would provide abundant nectar in good seasons
- Large open spaces suitable for foraging by large birds of prey

Table 17
Analysis of Habitat Suitability of the Study Area for Threatened Fauna Species.
(X = factor missing or unsuitable, ✓ = factor present, NA = not applicable)

Species	Factor					Special Requirements	Comments	Habitat Suitable?
	Area	Shrub Layer	Ground Cover	Tree Canopy	Hollows			
Little Eagle	✓	NA	✓	✓	NA	Tall trees as lookouts (Blakers <i>et al.</i> , 1984). Woodland for nesting.	Could forage over the CSU grazing paddocks and may potentially nest in tall trees in the more remote parts of the farm. Has been observed on the property (Appendix 1).	Yes
Little Lorikeet	✓	NA	NA	✓	✓	Requires flowering eucalypts for feeding and tree hollows near water for nesting.	Likely to visit flowering eucalypts.	Yes
Swift Parrot	✓	NA	NA	✓	NA	Requires winter flowering eucalypts	Migratory species, a favoured food tree in the NSW Central West, Red Ironbark, is planted in small numbers on the study area.	Yes, but limited
Superb Parrot	✓	NA	✓	✓	✓	Forages on ground mainly	Nests in high tree hollows. Has been observed on the property (Appendix 1).	Yes
Barking Owl	✓ (30-200 ha)	NA	NA	✓ (for perching)	✓	Need open spout-like hollows in woodland for nesting; suitable hollows may be present.	Could potentially nest elsewhere in the district and forage in the study area.	Yes
Brown Treecreeper	X	X	X	✓	✓	Needs fallen timber and some shrub cover.	A bird of open eucalypt woodlands. Requires a minimum of 100 ha of suitable habitat.	No
Regent Honeyeater	NA	NA	NA	✓	NA	Flowering eucalypts	Nomadic, feeds mainly on nectar	Partially (foraging visitor only)
Black-chinned Honeyeater	✓	NA	NA	X	NA	Appears to require large tracts of natural bushland with flowering shrubs.		No
Varied Sitella	✓	NA	NA	✓	NA	Rough-barked eucalypts for nesting and feeding.	Has been observed on the property (Appendix 1).	Yes (probably foraging only)
Scarlet Robin	✓	✓	✓	✓	NA	Feeds on insects on the ground in winter and perches within 3 m of the ground.	May visit in winter. Has been observed on the property (Appendix 1).	Partially (possible winter visitor)

Species	Factor					Special Requirements	Comments	Habitat Suitable?
	Area	Shrub Layer	Ground Cover	Tree Canopy	Hollows			
Flame Robin	✓	✓	✓	✓	NA	Feeds on insects on the ground in winter and perches within 3 m of the ground.	Winter visitors. Has been observed on the property (Appendix 1) and in this survey.	Yes
Diamond Firetail	✓	X	✓	✓	NA	Native grass seed in open grassy woodlands.	Could utilise the native grassland areas, but there is little cover available.	No
Koala	✓	NA	NA	✓	NA	Preferred food trees, which include <i>Eucalyptus viminalis</i> , must be present	Food trees present in study area.	Vagrants may potentially visit
Squirrel Glider	✓	X	✓	✓	✓	Suitable trees and understorey acacias as nectar and sap sources.	Abundant Ribbon Gum and Apple Box trees may provide potential sap for food.	Possibly
Grey-headed Flying Fox	✓	NA	NA	✓	NA	Feeds on eucalypt nectar and succulent fruits.	May be attracted to flowering eucalypts in the Orange area when poor feeding conditions occur on the coast.	Yes (sporadic visitation only)
Yellow-bellied Sheathtail Bat	✓	NA	NA	✓	✓		Has potential to occur.	Yes

The above considerations can be applied to the threatened species listed in Table 2 that are considered to have low, moderate or high probabilities of occurring on the study area to determine whether suitable habitat critical to the survival of local populations exists there. This analysis, given in Table 17, and using the habitat value results presented in Table 13, shows that for many threatened fauna species, one or more critical habitat requirements are missing from the study area. Consequently, some of the threatened fauna species in Table 17 are considered unlikely to occur on the study area at all and are not considered further here. A few species have the potential to breed on the study area and the remainder are only likely to utilise it for foraging. Species that may use the study area and their likely status are listed in Table 18.

Table 18
Threatened Fauna Species that may Utilise the Study Area

Scientific Name	Common Name	Likely Status
<i>Hiraaetus morphnoides</i>	Little Eagle	Potential breeding and/or foraging
<i>Glossopsitta pusilla</i>	Little Lorikeet	Potential breeding and/or foraging
<i>Lathamus discolor</i>	Swift Parrot	Foraging visitor – flowering eucalypts
<i>Polytelis swainsonii</i>	Superb Parrot	Potential breeding and/or foraging
<i>Ninox connivens</i>	Barking Owl	Potential breeding and/or foraging
<i>Anthochaera phrygia</i>	Regent Honeyeater	Foraging visitor – flowering eucalypts
<i>Daphoenositta chrysoptera</i>	Varied Sitella	Foraging visitor
<i>Petroica boodang</i>	Scarlet Robin	Foraging visitor
<i>Petroica phoenicea</i>	Flame Robin	Foraging visitor
<i>Phascolarctos cinereus</i>	Koala	Vagrant – Ribbon Gums
<i>Petaurus norfolcensis</i>	Squirrel Glider	Potential resident breeding population
<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox	Foraging visitor – flowering eucalypts
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail Bat	Potential breeding and/or foraging

The impact of potential development on parts of the study area on these species is considered in the assessment sections of this report.

AREAS IMPORTANT FOR BIODIVERSITY

The most important biodiversity elements on the CSU Orange campus are the old growth eucalypts. Biodiversity value also exists in the native tree and shrub plantings in the shelterbelt, roadside plantings and windbreaks. The native grassland dominated areas of some paddocks have potential to contribute to biodiversity conservation, but are not currently doing so. The farm dams also offer refuge to a variety of water birds. Each of these aspects is discussed below.

Old Growth Eucalypts

Several hundred remnant eucalypt trees occur across the CSU Orange property. Some of these pre-date European occupation and others represent regeneration following episodes of clearing. Fifty nine trees have hollow limbs, trunks or spouts suitable for denning and nesting by a wide variety of birds, bats and arboreal mammals. The canopies of these trees also provide habitat, nesting sites and food, both insects and nectar, for a further large suite of bird species.

Among the old growth trees, the most important are the Ribbon Gums (*Eucalyptus viminalis*) and Apple Boxes that are important food trees for Koalas, Sugar Gliders and possibly Squirrel Gliders. Although Koalas have long been absent from areas close to Orange, there is evidence of the continued presence of glider populations. Of the 59 habitat trees with hollows, 19 are Ribbon Gums and 18 are Apple Box (Table 12).

An important focus of biodiversity enhancement should be the protection of habitat trees and the restoration of the woodlands in which they occur to something approaching the original habitat condition. It is also important to protect the mature woodland trees that have not yet developed hollows, since these trees will develop into replacement habitat trees as the existing ones slowly decline over time. Similarly, new trees need to be established to have an ongoing stock of habitat trees 100 years from now.

Existing Plantings

A considerable effort has been made over the last thirty or so years to re-establish native vegetation on the CSU campus. This has resulted in shelterbelts and windbreaks that have allowed forest and woodland dependent bird species to recolonise parts of the campus. It will be valuable to extend and link these plantings in a wider network across the property.

Grasslands

Some quite substantial areas of native grasslands exist on the College Farm (Figure 4). However, they have lost most of their original diversity; native trees, shrubs and forbs have mostly been removed by past land management practices. In some ways it is remarkable these native grasslands have persisted. In most parts of the Central Tablelands native grasses have given way to vigorous exotic grass species such as Phalaris, Cocksfoot, Prairie Grass, Yorkshire Fog and many others. Once the exotic grasses have taken over it is very difficult to reclaim the land for native vegetation. The grassland areas on the College Farm provide perhaps the best places to attempt Box-Gum Woodland re-establishment. At present the grasslands are being utilised for grazing by sheep and cattle and are not providing habitat for grassland wildlife such as finches, quails etc. The principle reasons for this are the lack of tree and shrub cover, absence of fallen timber and the intensive grazing regime which keeps the grass short.

Farm Dams

The farm dams already support a wide range of water birds (Appendices 1 and 3). Their contribution to water bird conservation could be greatly enhanced if the two larger dams were managed for wildlife as well as water supply. By restricting stock access to much or most of their perimeters, it would be possible to plant riparian tree species and encourage the growth of emergent water plants. This may make the dams attractive to threatened species such as the Blue-billed and Freckled Ducks, as well as species that depend on rushes and reeds.

ENVIRONMENTAL ISSUES

From a land management perspective, the College Farm has been well managed, as would be expected for an institution that has been a leader in rural management education for over forty years. There are no major soil stability problems, the pastures are not over grazed and noxious weeds are generally well controlled. Consequently, most of the issues raised below are peripheral to general farm management and are desirable rather than imperative from a farm management viewpoint. In

addition, some of the issues have already begun to be addressed and are included here to emphasise the need to continue the efforts.

The main environmental issues are;

- Soil erosion in Mendhams Creek
- Environmental weeds
- Harvesting of fire wood
- Noxious animal control
- Noxious weeds in the Brick Kilns paddocks

These are discussed below.

Soil Erosion in Mendhams Creek

Mendhams Creek is very deeply incised through most of its length on CSU land. This is a product of land clearing, probably in excess of 150 years ago. There is little doubt that Mendhams Creek would originally have been a shallow drainage line with a 'chain-of-ponds' structure prior to clearing. Soil erosion within the deep gully appears to be progressing only slowly at present. However, it is desirable to both halt the erosion and begin a process of remediation to restore as much of the original structure of the creek as possible. This is unlikely to be a simple process and would require the advice of a soil conservation expert.

Environmental Weeds

Weeds are generally very well controlled within the farming paddocks as would be expected. However, problems of environmental weeds are evident in the shelterbelt and along Summer Hill Creek. The shelterbelt has areas of blackberry infestation, which is both a Noxious Weed and Weed of National Significance, as does Summer Hill Creek where it traverses between the Banjo's and Risky paddocks (Plate 13). Summer Hill Creek also has a very dense infestation of Crack Willow, also a Weed of National Significance (Plate 13).



Plate 13. Heavy infestation of Crack Willow and Blackberry on Summer Hill Creek in Banjo's Paddock.

Ideally, the willows should be removed and replaced by suitable native trees, which might include Black Gum, Black Sally, Snow Gum, Ribbon Gum and Apple Box. However, while it would be desirable to rehabilitate this section of Summer Hill Creek, it is unlikely to be successful unless landholders upstream undertake similar actions. Reinfestation by Willows is likely to occur as long as large populations remain in the catchment above. Consequently, it is recommended that the university investigates the feasibility of a coordinated willow removal campaign with other landholders on Summer Hill Creek. Such a program may attract funding from the Central West CMA.

Another species considered to be an environmental weed is Hawthorn (*Crataegus monogyna*), which is common throughout Orange district. Hawthorn was found on four quadrat sites and four spot sample sites. It tends to be more common in woodland areas where it thrives in the shade of eucalypts. Unless controlled, it can form very dense thickets which overshadow all other shrub and ground cover species. CSU has undertaken control of Hawthorn in parts of the Brick Kiln paddocks, but more work is needed elsewhere on the property.

Exotic berry producing species including Blackberry, Hawthorn, Cotoneaster and Firethorn, may encourage Pied Currawongs onto CSU land. Currawongs prey on smaller birds. Hence it is desirable to eradicate all exotic berry producers.

Firewood harvesting

Evidence of the felling of dead eucalypt stags was observed at a couple of sites on the College Farm (Plate 12). From an environmental point of view this is an undesirable practice since stags provide habitat for wildlife, both for roosting and nesting, if hollows are present (Plate 10).

Noxious Animal Control

Red Foxes were commonly observed on CSU land during the survey. They were readily seen during daylight hours moving freely through the paddocks. The Red Fox is not only a threat to young lambs, but a major threat to wildlife. It is likely that foxes are having a significant impact on birds and other fauna attracted to the native shelterbelts and windbreaks. Conversely, foxes are also likely to be controlling rabbits, rats and mice. Nevertheless, it is recommended that the university participates in fox control programs organised by the Rural Lands Protection Board, if it is not already doing so.

Noxious Weed Control

Most noxious weeds are under excellent control on the College Farm. An exception is St Johns Wort in the Brick Kilns paddocks, where there are large infestations. These can be seen from the Ophir Road and are not a 'good look' for the university.

RECOMMENDATIONS FOR BIODIVERSITY ENHANCEMENT

Existing Plan

A draft 'College Farm Property Plan' was developed in 1996. The plan included a concept plan for revegetation which, with some revision, has guided the placement of native vegetation plantings since then. The guiding objectives of the plan were;

- Reduction in surface wind speeds, to benefit livestock and plants,
- increased water use, reducing areas subject to waterlogging, and reducing the rate of soil salinisation and acidification,

- reduction in soil movement,
- increased diversity of native wildlife species,
- provision of habitat for beneficial animals such as pest controllers,
- reduction in the abundance of introduced pest species, and
- the movement of wildlife through the property from nearby bush remnants.

The plan also included a set of revegetation policies;

- Ecological and biophysical outcomes take precedence over tradition and appearance,
- all plantings should be of native species, local species used wherever possible,
- shrubs and ground cover should be introduced, in addition to trees,
- regeneration should be encouraged by fencing off good stands of existing native vegetation,
- direct seeding should be used, where possible, using seeds gathered locally,
- revegetation objectives should be included in the monitoring system for the College Farm, and
- establishment and maintenance should be consistent with the requirements of native vegetation (e.g. no fertiliser).

The objectives and strategies in the plan remain relevant and desirable. However, all but two of the objectives are focussed on agricultural outcomes and only two relate directly to biodiversity enhancement. The locations of proposed plantings in the plan reflect the priority for physical outcomes related to agricultural sustainability. For example, major plantings are focussed on the water courses, Mendhams Creek, its northern tributary and Lens Gully, to enhance soil stability. Other plantings follow the outer fence lines of the property to act as windbreaks.

Biodiversity Recommendations

The following recommendations are intended to facilitate modification of the existing plan to strengthen the biodiversity outcomes.

Habitat trees

It is recommended that concentrations of habitat trees be the focus of ecosystem restoration plantings whose aims are to;

- protect the habitat trees,
- restore the ecosystem context of habitat trees to make them more attractive to native wildlife, and
- provide young trees of the same species that will ultimately replace the function of existing habitat trees as they decline.

Grasslands

This report has identified significant areas of native grasslands in some College Farm paddocks. These have value as areas where ecosystem restoration may potentially be easier and more successful than in areas dominated by vigorous introduced grasses. It is recommended that;

- where practicable, areas dominated by native grasses be used preferentially for re-establishment of native trees and shrubs.

Restoration of the original vegetation communities

This report has identified the kinds of vegetation that originally occurred on the study area and their likely distributions within it. It is recommended that;

- revegetation of the study area aims to restore, as far as practicable, plant associations with the same composition and distribution as originally occurred.
- Revegetation should include a suite of native tall shrubs and low shrubs characteristic of the original community.

Appendix 4 presents a list of flora species that are likely to have occurred on the CSU Orange property prior to white settlement. They are listed according to the vegetation associations in which they are most likely to have occurred.

Farm dams

The two largest dams on Lens Gully have potential to be important water bird refuge and breeding sites. To accomplish this, it is recommended that;

- stock access to the two largest dams be restricted, and
- plantings of suitable trees be undertaken around their backwaters and that emergent rushes and reeds be allowed to grow in the shallows.

Other Recommendations

Noxious and environmental weed and animal recommendations

It is recommended that;

- A control program for the Red Fox should be implemented in cooperation with the Rural lands Protection Board and adjoining landholders.
- Eradication of blackberry should be undertaken along Summer Hill Creek in Banjo's Paddock and in the shelterbelt.
- A program to eradicate St Johns Wort should be implemented in the Brick Kilns paddocks.
- Food sources for Pied Currawongs including Blackberry, Hawthorn, Cotoneaster and Firethorn should be eradicated.

Restoration of Mendhams Creek

It is recommended that;

- Works be undertaken with the advice of a Soil Conservationist to halt erosion in Mendhams Creek.
- The existing revegetation works on Mendhams Creek be extended to include the full suite of tree and shrub species characteristic of the original community.

Firewood harvesting

It is recommended that the university adopts a policy of stag protection and bans firewood harvesting on the College Farm.

IMPACT ASSESSMENT – Seven Part Tests

This section provides an assessment of the impacts of potential future development of the CSU Orange campus on flora and fauna based on the preceding survey findings and analysis. The assessment meets the requirements of Section 5A of the NSW *Environmental Planning and Assessment Act (1979)* (EP&A Act), NSW *State Environmental Planning Policy No. 44* (SEPP 44) and the Commonwealth *Environmental Protection and Biodiversity Conservation Act (1995)* (EPBC Act).

The likelihood of development significantly affecting the five flora species in Table 14 and the 13 fauna species in Table 17 or their habitats is assessed below in accordance with the seven factors of assessment (Seven Part Tests of Significance) set out in the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC, 2007) which are:

- (a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*
- (b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*
- (c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
 - (i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or*
 - (ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*
- (d) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*
- (e) *In relation to the habitat of a threatened species, population or ecological community:*
 - (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed;*
 - (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and*
 - (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*
- (f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*
- (g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

ASSESSMENTS OF SIGNIFICANCE

FLORA

Narrow-leaved Black Peppermint (*Eucalyptus nicholii*), Wallangara White Gum (*Eucalyptus scoparia*) and Paddys River Box (*Eucalyptus macarthurii*)

Factors of Assessment

- (a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.***

All Narrow-leaved Black Peppermint, Wallangara White Gum and Paddys River Box on the study area are cultivated trees up to approximately 30 or more years old. In total there are 58 trees of the three species (Table 14). Some 18 individuals of Narrow-leaved Black Peppermint and two Wallangara White Gums have been planted in the gardens around the built areas of the campus. Thirty eight trees, including the only Paddys River Box, are planted away from built areas and are unlikely to be affected by future development. Accordingly, Paddys River Box is not considered further in this assessment.

Narrow-leaved Black Peppermint is native to the Northern Tablelands of NSW, mainly in the Walcha to Glen Innes area (Brooker and Kleinig, 1999). Similarly, Wallangara White Gum is native in NSW only to the Tenterfield area of the Northern Tablelands. Neither species occurs naturally in the Orange area or in the South Eastern Highlands Bioregion. The planted populations on the study area are not self-sustaining; no juvenile trees derived from the plantings are present. Nor are the 'populations' part of specific conservation program for these species. Consequently, future development projects on CSU land would not threaten a viable local population of the species.

- (b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.***

Not applicable. As at March 2012, no Endangered Populations have been declared for this species in the Central West CMA area or elsewhere (NSW Scientific Committee, 2012).

- (c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***
- (i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***
 - (ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,***

Not applicable.

- (d) *In relation to the habitat of a threatened species, population or ecological community:***
- (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***
 - (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

As indicated above, future developments would not remove or fragment any natural habitat of the Narrow-leaved Black Peppermint or Wallangarra White Gum. All trees on the study area have been planted and have not established a viable, self-maintaining population of the species. The study area is not the natural habitat of the species and has no importance for the long term survival of the species in their natural habitats on the NSW Northern Tablelands. However, plantings such as those on the CSU Orange campus have potential importance as sources of material for recovery programs for the species should the wild population decline to dangerously low levels.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Critical habitat, as defined by the TSC Act or the EPBC Act, has not been declared for the Narrow-leaved Black Peppermint or the Wallangarra White Gum on the NSW Critical Habitat register (OEH, 2012b) or the Commonwealth Register of Critical Habitat (SEWPaC, 2012d) in the Project area or surrounds.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There are no recovery plans for the Narrow-leaved Black Peppermint or Wallangarra White Gum. The following recovery actions are listed in the NSW Threatened Species Profiles (OEH, 2012a):

Narrow-leaved Black Peppermint

- Only buy seed from appropriately licensed dealers.
- Only buy plants from appropriately licensed nurseries.
- Support local Landcare groups.
- Manage fire to promote regeneration.
- Practice sustainable grazing in areas of habitat and protect regenerating trees from grazing stock.
- Limit firewood collection in areas of habitat.
- Identify roadside populations and protect during road-works.
- Protect dry grassy woodland from clearing and fragmentation.

Wallangarra White Gum

- Support local Landcare groups
- Stay on established tracks when visiting national parks.
- Protect known populations and areas of potential habitat from clearing and timber collection.
- Rehabilitate disturbed areas of habitat.
- Notify OEH of any new records in NSW.

The following recovery actions are listed for both species in the Commonwealth Approved Conservation Advices (SEWPaC, 2012c,e):

Regional Priority Actions

Habitat Loss, Disturbance and Modification

- *Monitor known populations to identify key threats.*
- *Monitor the progress of recovery,*
- *Identify populations of high conservation priority.*

- *Manage threats to areas of vegetation that contain populations/occurrences/remnants of Narrow-leaved Peppermint.*
- *Ensure road widening and maintenance activities (and other infrastructure or development activities involving substrate or vegetation disturbance) in areas where Narrow-leaved Peppermint occurs do not adversely impact on known populations.*
- *Monitor collection of Narrow-leaved Peppermint seed from wild populations to ensure legal and sustainable collection is being undertaken.*

Trampling, Browsing or Grazing

- *Develop and implement a stock management plan for roadside verges and travelling stock routes.*

Fire

- *Develop and implement a suitable fire management strategy for Narrow-leaved Peppermint.*
- *Provide maps of known occurrences to local and state rural fire services and seek inclusion of mitigative measures in bush fire risk management plans, risk register and/or operation maps.*

Conservation Information

- *Raise awareness of Narrow-leaved Peppermint within the local community, particularly among land-holders with this species on their properties.*

Local Priority Actions

Habitat Loss, Disturbance and Modification

- *Minimise adverse impacts from land use at known sites.*
- *Control fire wood collection in the known habitat.*
- *Protect populations of the listed species through the development of conservation agreements and/or covenants.*

Trampling, Browsing or Grazing

- *Prevent grazing pressure at known sites on leased crown land through exclusion fencing or other barriers.*
- *Manage known sites on private property to ensure appropriate stock grazing regimes are conducted, including the protection of seedlings to ensure regeneration.*

Fire

- *Implement an appropriate fire management regime for local populations.*

These recovery actions all refer to natural populations in northern NSW. The Project would not affect the implementation of these actions. No recovery actions have been proposed for cultivated populations of the species. Any development on CSU land that affected the Narrow-leaved Black Peppermint or Wallangara White Gum would not be inconsistent with recovery actions currently listed for the species.

(g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The following threats to the Narrow-leaved Black Peppermint and Wallangara White Gum are listed in the Commonwealth Approved Conservation Advices (SEWPaC, 2012c, e). The relevant NSW listed Key Threatening Processes are given in brackets:

1. Clearing and fragmentation of habitat for agriculture and grazing (*Clearing of native vegetation*).
2. Destruction and disturbance of habitat for road construction and maintenance (*Clearing of native vegetation*).

3. Inappropriate fire regimes (*High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition*).
4. Firewood collection (*Removal of dead wood and dead trees*).
5. Seed collection for horticulture.

These threats and Key Threatening Processes refer to natural populations in northern NSW. Any development on the CSU Orange campus would not affect the operation of these threats on natural populations.

Conclusion.

It is concluded that future developments on the CSU Orange campus that adversely affected trees of the Narrow-leaved Black Peppermint or Wallangara White Gum would have no impact on natural populations on the NSW Northern Tablelands. However, the trees planted in the university woodlots are part of large cultivated populations, scattered over many parts of south eastern Australia, that guarantee the survival of these species should they decline further in the wild. It is therefore desirable that harm to these trees is avoided wherever feasible.

EPBC Act

The Narrow-leaved Black Peppermint and the Wallangara White Gum are listed as Vulnerable under the EPBC Act. The above analysis indicates that any future development projects on the CSU Orange campus would have no impacts on natural populations of these species. Consequently, there is no requirement to refer such projects to SEWPaC on account of the Narrow-leaved Black Peppermint or Wallangara White Gum.

Other Threatened Flora

***Swainsona sericea* (Silky Swainson-pea), *Thesium australe* (Austral Toadflax)**

The above two threatened flora species that are likely to have occurred on the study area prior to European settlement are considered together here. Both are small herbaceous species (Table 15) and neither was observed during the survey. Both are highly intolerant of disturbance to the natural communities in which they occur. Austral Toadflax is hemiparasitic, that is, it obtains some nutrition from the roots of other plants. Consequently, it depends on the presence of suitable hosts to survive. Austral Toadflax is largely dependent on Kangaroo Grass, *Themeda australis*, which is rare on the study area.

The above species are likely to succumb to competition from exotic grasses. Both species are also likely to be intolerant of grazing by introduced herbivores, especially sheep and rabbits. The apparent absence of these species from the study area and the wider region is attributable to a long history of habitat disturbance and grazing by introduced mammals.

Factors of Assessment

- (a) ***In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.***

Future developments on the CSU Orange campus would involve removal of vegetation and earth works for new buildings, roads and car parks. Such activities would result in the death and permanent

loss of individual plants of Silky Swainson-pea and Austral Toadflax, if they were present on the site, and would have the potential to place local populations at risk of extinction. However, no populations were found by the survey and it is considered highly unlikely that these species occur anywhere on CSU land owing to the long history of agriculture and grazing on the site.

(b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*

Not applicable. As at March 2012, no Endangered Populations have been declared for either of these species in the Central West CMA area (NSW Scientific Committee, 2012).

(c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

(ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable.

(d) *In relation to the habitat of a threatened species, population or ecological community:*

(i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

(ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

(iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

As indicated above, future development projects on the CSU Orange campus would have potential to remove, modify, fragment and isolate habitat for Silky Swainson-pea and Austral Toadflax, if they were present on the site. However, it is clear that considerable habitat modification has occurred in the past on the built parts of the campus such that habitat for these species has already been eliminated over those areas. The remainder of the study area has been affected by pasture improvement, weed invasion and heavy grazing. There is no indication that these species could have survived on CSU land. Consequently, it is considered highly unlikely that future developments on the Orange campus would result in the loss, modification, fragmentation or isolation of habitat of the Silky Swainson-pea or Austral Toadflax.

(e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

Critical habitat, as defined by the TSC Act or the EPBC Act, has not been declared for Silky Swainson-pea or Austral Toadflax on the NSW Critical Habitat register (OEH, 2012b) or the Commonwealth Register of Critical Habitat (SEWPaC, 2012d) in the study area or surrounds.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plans exist for the Silky Swainson-pea or the Austral Toadflax. Recovery actions are listed in their profiles on the threatened species pages of the NSW OEH website (OEH, 2012a).

All recovery actions in the profiles refer to the protection and management of known populations of the species. Since no populations of Silky Swainson-pea or Austral Toadflax are known or likely to occur on the CSU Orange campus, the recovery actions are not relevant to any future developments on the campus.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key Threatening Processes that may be relevant to future developments on the CSU Orange campus include:

- Clearing of native vegetation, and
- Invasion of native plant communities by exotic perennial grasses

However, these actions would not threaten Silky Swainson-pea or Austral Toadflax, since no populations of these species are known or likely to occur on these areas.

Conclusion.

It is concluded that future developments on the CSU Orange campus would not adversely affect populations of Silky Swainson-pea or Austral Toadflax, as suitable habitat for these species is absent, and no populations are known or likely to occur on CSU land.

EPBC Act

One of the above species, Austral Toadflax, is listed as threatened under the EPBC Act. The above analysis indicates that any future development projects on the CSU Orange campus would have no impacts on natural populations of this species. Consequently, there is no requirement to refer such projects to SEWPaC on account of the Austral Toadflax.

FAUNA

In this section 13 species of threatened fauna (Table 17) that may have resident populations or temporarily utilise food sources on the study area are subjected to a Seven Part Test of Significance. The previous analysis of the value for fauna of the habitats on the study area concluded that six of the threatened fauna species have potential to breed in the study area; Little Eagle, Little Lorikeet, Superb Parrot, Barking Owl, Squirrel Glider and Yellow-bellied Sheathtail Bat. The Little Eagle and Barking Owl may potentially hunt for prey over the grazing paddocks and other open spaces. Several species may potentially utilise the remnant paddock eucalypt trees for food including leaves, sap, nectar or insects; Little Lorikeet, Swift Parrot, Varied Sitella, Regent Honeyeater, Koala, Squirrel Glider and Grey-headed Flying Fox. Superb Parrots, Scarlet and Flame Robins may forage for seeds or insects on the ground. The Yellow-bellied Sheathtail Bat may forage aerially for insects over the tree canopy.

Factors of Assessment

- (a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

Six of the threatened fauna species are considered to have some potential to breed on the study area. All but one of these, the Little Eagle, are dependent on hollows in habitat trees for breeding. The Little Eagle builds its nest high in tall eucalypts, usually in locations remote from human activity. It is unlikely to nest close to existing infrastructure or in areas likely to be affected by future development on the campus. Apart from two trees close to the Dentistry School car park, all other trees with hollows, 55 in all, are located away from the main campus. Accordingly, any new developments close to the existing infrastructure are unlikely to significantly affect populations of hollow nesting threatened species, should any occur on CSU land.

Eight other threatened fauna species have potential to forage on CSU land, but are unlikely to breed there. The main potential impact of a future building project on such visiting threatened fauna may be a reduction in available food resources. The main potential food resources that may be affected are nectar from flowering eucalypts, prey such as mice and rabbits from open space or grazing paddocks, seeds from native grasses, and foliage from Ribbon Gums.

Since none of the migratory or nomadic species is known or likely to depend on the study area for maintaining an existing viable population, it is highly unlikely that a future development could put such a population at risk. Rather, the study area would most likely function as a minor occasional supplementary source of food. While this is obviously useful, it is not likely to be critical to the survival of populations of these species, which depend on the availability of food over a wide area. Local populations of such migratory and nomadic species may encompass very large areas. Their success is often more dependent on climatic conditions than the availability of resources at a point source.

- (b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.**

Not applicable. As at March 2012, no Endangered Populations have been declared for any of these species in the Central West CMA area (NSW Scientific Committee, 2012).

- (c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
 - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

Not applicable.

- (d) In relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Areas potentially available for development at CSU Orange are confined to the vicinity of the existing infrastructure in the south west corner of the study area. This area lacks high quality native bushland or prime breeding habitat for the 13 threatened fauna species. The best habitat on the study area for threatened fauna species is the remnant Box-Gum Woodland located in the central parts of the College Farm and this is unlikely to be targeted for development.

Consequently, future development near the existing infrastructure would not remove, modify, fragment or isolate any habitat important to the long term survival of the subject species.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Critical habitat, as defined by the TSC Act or the EPBC Act, has not been declared for any of the subject species on the NSW Critical Habitat register (OEH, 2012b) or the Commonwealth Register of Critical Habitat (SEWPaC, 2012d) in the study area or surrounds.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Recovery plans have been prepared only for the Swift Parrot (Swift Parrot Recovery Team, 2001) and Regent Honeyeater (Menkhorst *et al.*, 1999). On ground recovery actions are listed for the most species in their profiles on the threatened species pages of the NSW OEH website (OEH, 2012a) summarised as follows;

Action	Little Eagle	Little Lorikeet ¹	Swift Parrot	Superb Parrot	Barking Owl	Regent Honeyeater	Varied Sitella ¹	Scarlet Robin ¹	Flame Robin ¹	Koala	Squirrel Glider	GH Flying Fox	Yellow-bellied Sheathtail Bat
Protect areas of habitat from overgrazing					✓						✓		
Protect known populations and areas of potential habitat from clearing, fragmentation or disturbance, including grazing	✓				✓			✓			✓		
Retain and protect nesting, roosting and foraging habitat, including standing dead trees, hollow bearing trees, feeding trees	✓				✓	✓		✓		✓	✓	✓	✓
Buffer or fence habitat areas from the impacts of other activities	✓				✓			✓					
Rehabilitate known and potential habitat, increase remnant size	✓					✓		✓					
Identify and map the extent and quality of foraging and roosting habitat on private and public land.			✓	✓							✓		
Protect, manage and restore habitat on private land through conservation agreements, management agreements and incentive payments.			✓	✓							✓		✓
Reduce collisions in areas where birds are foraging by closing window blinds etc.			✓										
Retain stands of preferred feed-trees, particularly large mature individuals and mistletoe			✓			✓				✓		✓	
Revegetate with preferred feeding tree species			✓							✓			
Participate in surveys to locate the winter foraging areas			✓										
Local Councils must give consideration to nesting and foraging habitat within their LEPs				✓									
Ensure that forestry prescriptions and harvesting plans provided effective protection from direct and indirect impacts to nest sites, including buffers for all nest trees and protection from planned burns				✓									
Encourage landholders/managers to remove or reduce grazing in known Box-Gum Woodland foraging habitat using incentives				✓							✓		
Apply mosaic pattern hazard reduction techniques					✓					✓			

Action	Little Eagle	Little Lorikeet ¹	Swift Parrot	Superb Parrot	Barking Owl	Regent Honeyeater	Varied Sitella ¹	Scarlet Robin ¹	Flame Robin ¹	Koala	Squirrel Glider	GH Flying Fox	Yellow-bellied Sheath-tail Bat
Retain and enhance vegetation along watercourses and surrounds, remove stock					✓	✓							
Maintain a captive population						✓							
Use incentives on private land to encourage landholders to manage key areas						✓							
No further loss of woodland and forest habitat from development				✓		✓							
Conduct research into non-breeding habitat and long distance movements			✓	✓		✓							
Investigate impacts of interspecific competition and nest predation						✓							
Retain dead timber on the ground in open forests and woodlands				✓				✓					
Avoid exotic berry-producing shrubs to minimise predation by Currawongs								✓					
Control domestic cats near habitat								✓					
Link remnant populations via corridors in the landscape										✓			
Control feral predators and reduce attacks by domestic dogs										✓			
Signage on roads to minimise road kills										✓			
Manage and enforce licensed shooting and investigate non-lethal crop protection measures												✓	
Research roost tree fidelity, foraging range, attributes of roost trees, effective of logging prescriptions, burning regimes, effects of pesticides													✓

1. No recovery actions are currently listed for this species.

Potential future developments on CSU Orange land may be counter to some of the above 29 recovery actions, particularly those related to habitat clearing or loss. However, potential habitat clearing would be confined to the planted shelterbelt and/or a small number of remnant eucalypt trees. The impacts of such clearing would be slight, given that none of the threatened fauna species under consideration has a permanent local population on the study area, with the possible exception of the Squirrel Glider. Any populations of the latter that may occur are likely to be confined to the larger remnant woodlots on the College Farm, rather than around the built parts of the campus. Accordingly, the only likely impact of clearing vegetation near the existing infrastructure would be a slight reduction in potential foraging habitat for migratory or nomadic species, for which abundant similar habitat occurs elsewhere in the surrounding region.

(g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

Key Threatening Processes that may be relevant to future developments on the CSU Orange campus include:

- Clearing of native vegetation, and
- Invasion of native plant communities by exotic perennial grasses

Depending on where developments take place, some clearing of the planted shelterbelt or other plantings may occur. All naturally occurring vegetation on CSU Orange land is in poor condition relative to pristine habitat, owing to past land uses, including all remnants that once formed parts of threatened ecological communities. The most important extant elements of the original biodiversity are scattered old growth and regenerated natural trees, particularly those with hollows suitable for wildlife. However, few such trees exist in areas potentially suitable for future development and would be avoided wherever possible. In addition, many such trees occur in woodlots on other parts of the College Farm that are not intended for development and would continue to sustain wildlife.

Soil disturbed by earth works for building projects is likely to be colonised by introduced grass species. However, except for some parts of the College Farm dominated by a few native grasses (Figure 4), all areas likely to be considered for development are already dominated by introduced perennial grasses.

Consequently, future developments are unlikely to significantly increase the impact of these key threatening processes.

Conclusion.

It is concluded that future developments on the CSU Orange campus would not significantly affect populations of the 13 threatened fauna species under consideration here, as no suitable exists in areas likely to be considered for development around the existing built areas of the campus. In addition, no populations of the 13 species are known to occur on CSU land. However, future developments that affect food resources for these species may result in a slight decrease in the foraging habitat available.

EPBC Act

Four of the above fauna species, the Swift Parrot, Superb Parrot, Regent Honeyeater and the Grey-headed Flying Fox are listed as threatened under the EPBC Act. The above analysis indicates that any future development projects on the CSU Orange campus would have no significant impacts on the survival of natural populations of these species. Consequently, there is no requirement to refer such projects to SEWPaC on account of the Swift Parrot, Superb Parrot, Regent Honeyeater and the Grey-headed Flying Fox.

SEPP 44

NSW SEPP 44 aims to protect habitat utilised by the Koala, *Phascolarctos cinereus*, which is known to occur in the areas surrounding Orange. Ribbon Gum, *Eucalyptus viminalis*, is a favoured Koala food tree listed in Schedule 2 of SEPP 44. Remnant mature Ribbon Gum trees occur across the higher parts of the study area. SEPP 44 requires consideration of the study area as potential Koala habitat.

Since the vegetated parts of CSU land exceed one hectare in size and patches may have 15 percent or more coverage by Ribbon Gums, those patches are considered to be potential Koala habitat. However, the area does not have an extant Koala population, and none is known to occur close by (BioNet, 2012a). Accordingly, the study area does not include 'core' Koala habitat and a SEPP 44 plan of management is not required.

EPBC Act

Only one matter would require referral to the Commonwealth Department of Sustainability Environment Water Population and Communities relating to Commonwealth listed threatened species and ecological communities, migratory species or wetlands of international importance. A referral to the Commonwealth would be needed if there was a proposal to adversely impact on either of the two Box-Gum Woodland remnants identified in this report as qualifying for protection under the EPBC Act (p. 57-59). However, these remnants occur on parts of the CSU Farm that are unlikely to be developed.

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APPENDIX 1.
FAUNA OF CSU ORANGE (As at 31 January 2007)
COMPILED BY DR. CILLA KINROSS

BIRDS

Order and FAMILY	Common Name	Scientific name	Habitats	Status
Galliformes				
PHASIANIDAE	Brown Quail	<i>Coturnix ypsilophora</i>	WB, OG	N
Gruiformes				
TURNICIDAE	Little Button Quail	<i>Turnix velox</i>	GD	R (1)
RALLIDAE	Eurasian Coot	<i>Fulica atra</i>	WE	A
Pelecaniformes				
PHALACROCORACIDAE	Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	WE	U
Ardeiformes				
ARDEIDAE	White-faced Heron	<i>Ardea novaehollandiae</i>	RV, WE, OG	C
	White-necked Heron	<i>Ardea pacifica</i>	WE	R
PLATALEIDAE	Royal Spoonbill	<i>Platalea regia</i>	WE	R
	Yellow-billed Spoonbill	<i>Platalea flavipes</i>	WE	R
Anseriformes				
ANATIDAE	Australian Wood Duck	<i>Chenonetta jubata</i>	WE, RV	A
	Pacific Black Duck	<i>Anas superciliosa</i>	WE	A
	Grey Teal	<i>Anas gracilis</i>	WE	C
	Hardhead	<i>Aythya australis</i>	WE	C
	Black Swan	<i>Cygnus atratus</i>	WE	R, B
Podicipediformes				
PODICIPEDIDAE	Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	WE	U, B
Ciconiiformes				
THRESKIORNITHIDAE	Straw-necked Ibis	<i>Threskiornis spinicollis</i>	OG	U
	White Ibis	<i>Threskiornis mulucca</i>	OG	C
Falconiformes				
ACCIPITRIDAE	Wedge-tail Eagle	<i>Aquila audax</i>	OW	U
	Little Eagle	<i>Hieraetus morphnoides</i>	OW	R
	Black-shouldered Kite	<i>Elanus notatus</i>	OW	C
	Brown Goshawk	<i>Accipiter fasciatus</i>	OW	R
FALCONIDAE	Nankeen Kestrel	<i>Falco cenchroides</i>	OW	UI
	Brown Falcon	<i>Falco berigora</i>	OW	R
	Peregrine Falcon	<i>Falco peregrinus</i>	OW	R
	Australian Hobby	<i>Falco longipennis</i>	RV	R
Gruiformes				
RALLIDAE	Dusky Moorhen	<i>Gallinula tenebrosa</i>	WE	A
Charadriiformes				
CHARADRIIDAE	Masked Lapwing	<i>Vanellus miles</i>	WE	U, B
	Black-fronted Dotterel	<i>Charadrius melanops</i>	WE	U
LARIDAE	Silver Gull	<i>Larus novaehollandiae</i>	WE, FE	U
Columbiformes				
COLUMBIDAE	Crested Pigeon	<i>Ocyphaps lophotes</i>	OW, WB	A, I
	Common Bronzewing	<i>Phaps chalcoptera</i>	OW	R, D
Psittaciformes				

Order and FAMILY	Common Name	Scientific name	Habitats	Status
CACATUIDAE	Galah	<i>Cacatua roseicapilla</i>	FE, OW	A, I
PSITTACIDAE	Australian King-Parrot	<i>Alisterus scapularis</i>	OF	R
	Eastern Rosella	<i>Platycercus eximius</i>	OW, WB	C, B
	Crimson Rosella	<i>Platycercus elegans</i>	OW, WB	C
	Superb Parrot	<i>Polytelis swainsonii</i>	OW	R, V
	Red-rumped Parrot	<i>Psephotus haematonotus</i>	FE, OW, WB	A, I
Cuculiformes				
CUCULIDAE	Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	OW	R
	Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>	OW, WB	U
	Shining Bronze-Cuckoo	<i>Chrysococcyx lucidis</i>	OW	R
	Pallid Cuckoo	<i>Cuculus pallidus</i>	OW	U
Strigiformes				
STRIGIDAE	Southern Boobook	<i>Ninox novaeseelandiae</i>	GD, WB	R
Caprimulgiformes				
PODARGIDAE	Tawny Frogmouth	<i>Podargus strigoides</i>	OW, WB	R
Coraciiformes				
HALCYONIDAE	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	FE, OW, WB	B
	Sacred Kingfisher	<i>Todiramphus sanctus</i>	OF, WB	U
Passeriformes				
CLIMACTERIDAE	White-throated Treecreeper	<i>Cormobates leucophaeus</i>	OF, WB	U
MALURIDAE	Superb Fairy-wren	<i>Malurus cyaneus</i>	WB, GD	A, B
PARDALOTIDAE	Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	OF, RW	U
	Brown Thornbill	<i>Acanthiza pusilla</i>	GD, WB	C, B
	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	OW, WB	C, I, B
	Striated Thornbill	<i>Acanthiza lineata</i>	WB	C
	Yellow Thornbill	<i>Acanthiza nana</i>	OF, WB	C
	Speckled Warbler	<i>Chthonicola sagittata</i>	OF, WB ¹	R, D, V
	White-throated Gerygone	<i>Gerygone olivacea</i>	OF, WB	U
	Spotted Pardalote	<i>Pardalotus punctatus</i>	OF, FE, WB	C, B
	Striated Pardalote	<i>Pardalotus striatus</i>	OF, FE, WB	C, B
	White-browed Scrubwren	<i>Sericornis frontalis</i>	OF, WB, GD	C, B
MELIPHAGIDAE	Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	FE, GD, WB	C, B
	Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	GD, WB, OF	C, B
	Fuscous Honeyeater	<i>Lichenostomus fuscus</i>	OW	R
	Yellow-tufted Honeyeater	<i>Lichenostomus melanops</i>	GD	R (1)
	White-eared Honeyeater	<i>Lichenostomus leucotis</i>	FE, OF	U
	White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	OF, FE, GD, WB	A, I, B
	Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>	WB, OW	R, D
	Noisy Friarbird	<i>Philemon corniculatus</i>	OW, WB, VY	C
	Red Wattlebird	<i>Anthochaera carunculata</i>	OF, FE, VY	C, B
	Noisy Miner	<i>Manorina melanocephala</i>	WB, OW	U, I
PETROICIDAE	Eastern Yellow Robin	<i>Eopsaltria australis</i>	OF	U, D
	Red-capped Robin	<i>Petroica goodenovii</i>	WB, OW	R, D, B
	Scarlet Robin	<i>Petroica multicolor</i>	OW	R
	Flame Robin	<i>Petroica phoenicea</i>	OW	R

Order and FAMILY	Common Name	Scientific name	Habitats	Status
NEOSITTIDAE	Varied Sittella	<i>Daphoenositta chrysoptera</i>	OW, WB	R
PACHYCEPHALIDAE	Grey Shrike-thrush	<i>Colluricincla harmonica</i>	OF, FE, WB	C, B
	Crested Shrike-tit	<i>Falcunculus frontatus</i>	WB	R, D
	Golden Whistler	<i>Pachycephala pectoralis</i>	WB, OF	U, D
	Rufous Whistler	<i>Pachycephala rufiventris</i>	OF, WB	C, D, B
DICRURIDAE	Magpie-lark	<i>Grallina cyanoleuca</i>	UB	A, I, B
	Restless Flycatcher	<i>Myiagra inquieta</i>	OW	R, D
	Grey Fantail	<i>Rhipidura fuliginosa</i>	OF, FE, WB	C, B
	Willie Wagtail	<i>Rhipidura leucophrys</i>	OW, WB, GD	A, I, B
CAMPEPHAGIDAE	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	OW, HS, VY	U, I, B
	White-winged Triller	<i>Lalage sueurii</i>	OW	R, D
ORIOOLIDAE	Olive-backed Oriole	<i>Oriolus sagittatus</i>	WB	R
ARTAMIDAE	Dusky Woodswallow	<i>Artamus cyanopterus</i>	OW	U, D, B
	Grey Butcherbird	<i>Cracticus torquatus</i>	OW	C
	Pied Butcherbird	<i>Cracticus nigrogularis</i>	OW	U, I
	Australian Magpie	<i>Gymnorhina tibicen</i>	UB	A, I, B
	Pied Currawong	<i>Strepera graculina</i>	UB	C, I, B
CORVIDAE	Australian Raven	<i>Corvus coronoides</i>	OW, WB	A, I, B
CORCORACIDAE	White-winged Chough	<i>Corcorax melanorhamphos</i>	OW, WB	U, I, B
MOTACILLIDAE	Richard's Pipit	<i>Anthus novaeseelandiae</i>	OG	R
PASSERIDAE	House Sparrow*	<i>Passer domesticus</i>	GD, WB	A, I, B
	Red-browed Finch	<i>Neochmia temporalis</i>	OF, WB	A, B
	Double-barred Finch	<i>Poephila bichenovii</i>	OW, WB	R
FRINGILLIDAE?	European Goldfinch*	<i>Carduelis carduelis</i>	OW, WB	C
DICAEIDAE	Mistletoebird	<i>Dicaeum hirundinaceum</i>	OW	U
HIRUNDINIDAE	Tree Martin	<i>Hirundo nigricans</i>	OW, WE	U
	Welcome Swallow	<i>Hirundo neoxena</i>	OW, OG, WE	A, I, B
SYLVIIDAE	Clamorous Reed-Warbler	<i>Acrocephalus stentoreus</i>	WE	C, B
	Rufous Songlark	<i>Cinclorhamphus mathewsi</i>	OW, OG	U, B
	Golden-headed Cisticola	<i>Cisticola exilis</i> ¹	OG	R
ZOSTEROPIDAE	Silvereye	<i>Zosterops lateralis</i>	UB	A, B
STURNIDAE	Common Starling*	<i>Sturnus vulgaris</i>	UB	C, I, B
CHECK	Common Blackbird*	<i>Turdus merula</i>	WB, GD	C, I, B

¹ Last seen c1990s – now locally extinct

ADD: collared sparrowhawk, buff-banded rail (peregrine prey, so may be off-campus), long-billed corella (probably aviary escapes), sulphur-crested cockatoo, channel-billed cuckoo (rare), brush cuckoo (uncommon).

Habitats/location

CODE	Habitat and/or location
OF	forest or woodland (grazed)
OW	open woodland (pasture with scattered trees)
FE	forest edge
WE	wetlands/wet grasslands/dam
CK	creek
RI	riparian (stream banks and adjacent)

OG	grassland
GD	garden
WB	windbreak or shelterbelt (planted)
UB	ubiquitous

Status

R – rare: fewer than 1-4 birds or one flock observed per annum

U – uncommon: 5-10 birds OR up to 20 birds observe, but in a single flock pa

C – fairly common: 11-30 birds, more than one flock

A – abundant/very common: more than 30 birds observed – seen regularly

B – evidence of breeding

D – decreasing in the landscape according to Reid (1999)

I – increasing in the landscape according to Reid (1999)

V – listed on Schedule 2 of Threatened Species Conservation Act 1995 as ‘vulnerable’

FROGS

Common name	Scientific Name	Call or comment
Southern Frogs	Family MYOBATRACHIDAE	Normal toes, no discs
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>	Pobblebonk - "plonk"
Spotted Grass Frog	<i>L. tasmaniensis</i>	very rapid uk-uk-uk: tommy-gun (often in reeds)
Froglet	<i>Crinia parinsignifera</i>	harsh high pitched squelshy squeak (dam)
Common Eastern Froglet	<i>C. signifera</i>	crick-crick-crick (dam)
Tree Frogs	Family HYLIDAE	adhesive toe discs
Peron's Tree Frog	<i>L. peronii</i>	loud rattle (buildings)
Whistling Tree Frog ¹¹	<i>L. verreauxi</i>	‘weep...weep...weep’ (grasslands)

REPTILES

Common Name	Scientific name	Comment
TORTOISES		
Long-necked Tortoise	<i>Chelodina longicollis</i>	Farm dams
SNAKES		
Eastern Brown Snake	<i>Pseudonaja textilis</i>	Ubiquitous
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	Usually near water
Copperhead	<i>Austrelaps superbus</i>	May come in building
Diamond Python	<i>Morelia spilota</i>	One only near visitor flats
LIZARDS		
Eastern Blue-tongue	<i>Tiliqua scincoides</i>	Ubiquitous
Shingleback	<i>Trachydosaurus rugosus</i>	Uncommon
Cunningham's Skink	<i>Egernia cunninghami</i>	Uncommon

MAMMALS (excludes stock)

Common Name	Scientific name	Comment
BATS		
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	Caught in mist net
RODENTS		
Rat	<i>Rattus sp.</i>	
House Mouse	<i>Mus musculus</i>	
MARSUPIALS		
Black Wallaby	<i>Wallabia bicolor</i>	Rare
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	Uncommon?
OTHER MAMMALS		
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	Rarish
European Rabbit	<i>Oryctolagus cuniculus</i>	
Brown Hare	<i>Lepus capensis</i>	
Red Fox	<i>Vulpes vulpes</i>	
House Cat	<i>Felis catus</i>	

Scientific Name	Common Name	Quadrat										Spot Sample									Opp.	Planted	A	B	C						
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9											
<i>*Hypericum perforatum</i>	St. Johns Wort			1								•	•	•																	
Dilleniaceae																															
<i>Hibbertia obtusifolia</i>	Hoary Guinea Flower													•																	
Euphorbiaceae																															
<i>Chamaesyce</i> sp.	A Spurge																														
Fabaceae: Faboideae																															
<i>*Medicago arabica</i>	Spotted Burr Medic						1	2	3																						
<i>*Medicago polymorpha</i>	Burr Medic																														
<i>Pultenaea subternata</i>	Egg and Bacon Pea													•																	
<i>*Trifolium pratense</i>	Red Clover									1																					
<i>*Trifolium repens</i>	White Clover			4	2	5	5	3	3			•	•		•		•														
<i>*Trifolium subterraneum</i>	Subterranean Clover			2			1		3																						
<i>*Vicia sativa</i>	Vetch	3	1									•																			
Fabaceae: Mimosoideae																															
† <i>Acacia baileyana</i>	Cootamundra Wattle																														
<i>Acacia dealbata</i>	Silver Wattle			1										•																	
† <i>Acacia decurrens</i>	Sydney Green Wattle																														
† <i>Acacia implexa</i>	Hickory Wattle																														
† <i>Acacia mearnsii</i>	Black Wattle																														
† <i>Acacia melanoxylon</i>	Blackwood																														
† <i>Acacia</i> sp.																															
† <i>Acacia vestita</i>	Weeping Boree																														
Fumariaceae																															
<i>*Fumaria capreolata</i>	Climbing Fumitory																														
Geraniaceae																															
<i>*Geranium molle</i>	Dove's Foot																														
<i>Geranium retrorsum</i>	Grassland Cranesbill							2																							
<i>Geranium solanderi</i>	Austral Crane's Bill	2	3	2		2	1								•																
Lamiaceae																															
<i>*Marrubium vulgare</i>	White Horehound				1				2						•																
† <i>Westringia fruticosa</i>	Coastal Rosemary																														
Loranthaceae																															

APPENDIX 3 - Bird Species List

Scientific Name	Common Name	FloraSearch		This Survey (2012)				
		2007	2008	11 July	16 July	17 July	18 July	Opp.
AVES								
ANSERIFORMES								
Anatidae								
<i>Anas gracilis</i>	Grey Teal			2		1	4	
<i>Anas superciliosa</i>	Pacific Black Duck					6	11	
<i>Aythya australis</i>	White-eyed Duck			3	2	3	3	
<i>Chenonetta jubata</i>	Australian Wood Duck			9	2	2	1	•
CHARADRIIFORMES								
Charadriidae								
<i>Vanellus miles</i>	Masked Plover				1		2	
Laridae								
<i>Larus canus</i>	Seagull			24	15	70	100	
CICONIIFORMES								
Ardeidae								
<i>Ardea pacifica</i>	Pacific Heron					1	1	
<i>Egretta novaehollandiae</i>	White-faced Heron					1		
Threskiornithidae								
<i>Threskiornis molucca</i>	Australian White Ibis				109	101	40	
<i>Threskiornis spinicollis</i>	Straw-necked Ibis				1			
COLUMBIFORMES								
Columbidae								
<i>Ocyphaps lophotes</i>	Crested Pigeon						5	•
FALCONIFORMES								
Accipitridae								
<i>Elanus axillaris</i>	Black-shouldered Kite				1			
Falconidae								
<i>Falco cenchroides</i>	Nankeen Kestrel			1				
<i>Falco peregrinus</i>	Peregrine Falcon			3		2	1	•
GALLIFORMES								
Phasianidae								
<i>Coturnix pectoralis</i>	Stubble Quail							•

Scientific Name	Common Name	FloraSearch		This Survey (2012)				
		2007	2008	11 July	16 July	17 July	18 July	Opp.
GRUIFORMES								
Rallidae								
<i>Fulica atra</i>	Eurasian Coot			4	5	6	4	
PASSERIFORMES								
Acanthizidae								
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				4			
<i>Acanthiza lineata</i>	Striated Thornbill	•			4	2	3	
<i>Acanthiza pusilla</i>	Brown Thornbill							•
<i>Sericornis frontalis</i>	White-browed Scrubwren					2	4	•
<i>Smicrornis brevirostris</i>	Weebill	•						
Artamidae								
<i>Cracticus nigrogularis</i>	Pied Butcher Bird				1		2	•
<i>Cracticus torquatus</i>	Grey Butcher Bird		•			1		
<i>Gymnorhina tibicen</i>	Australian Magpie	•	•	10	6	7	4	•
<i>Strepera graculina</i>	Pied Currawong	•						
Campephagidae								
<i>Coracina novaehollandiea</i>	Black-faced Cuckoo-shrike	•						•
Climacteridae								
<i>Cormobates leucophaeus</i>	White-throated Treecreeper				1			
Corvidae								
<i>Corvus coronoides</i>	Australian Raven		•		4	3		•
Estrildidae								
<i>Neochmia temporalis</i>	Red-browed Finch				30			
Hirundinidae								
<i>Hirundo neoxena</i>	Welcome Swallow	•		40		13		•
Maluridae								
<i>Malurus cyaneus</i>	Superb Fairy-wren	•	•	5	7	8	3	
Meliphagidae								
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill							•
<i>Anthochaera carunculata</i>	Red Wattlebird	•	•	1	2	3	3	•
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater							•
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater	•		1		1	1	

Scientific Name	Common Name	FloraSearch		This Survey (2012)				
		2007	2008	11 July	16 July	17 July	18 July	Opp.
<i>Manorina melanocephala</i>	Noisy Minor			17	7	7	5	•
Monarchidae								
<i>Grallina cyanoleuca</i>	PeeWee				1	1	2	•
<i>Rhipidura albiscapa</i>	Grey Fantail	•		2		1	1	
<i>Rhipidura leucophrys</i>	Willie Wagtail	•						
Pachycephalidae								
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		•	1		1		
<i>Pachycephala pectoralis</i>	Golden Whistler	•			1		1	
Pardalotidae								
<i>Pardalotus punctatus</i>	Spotted Pardalote						2	
<i>Paradlotus striatus</i>	Striated Pardalote		•	1	2			•
Petroicidae								
<i>Petroica phoenicea</i>	Flame Robin							•
Sturnidae								
* <i>Sturnus vulgaris</i>	Common Starling	•		5	3	4	5	
Turdidae								
* <i>Turdus merula</i>	Eurasian Blackbird							•
Zosteropidae								
<i>Zosterops lateralis</i>	Silvereye	•						•
PELECANIFORMES								
Phalacrocoracidae								
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant			1	1		1	
PODICIPEDIFORMES								
Podicipedidae								
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe			9	5	2	8	
PSITTACIFORMES								
Cacatuidae								
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo				1		2	•
<i>Cacatua roseicapilla</i>	Galah	•	•	2	11	2	6	•
Psittacidae								
<i>Psephotus haematonotus</i>	Red-rumped Parrot	•			2			•
<i>Platycercus elegans</i>	Crimson Rosella	•	•	1	3	2	11	•
<i>Platycercus eximius</i>	Eastern Rosella	•	•	13	3	7	17	•

Scientific Name	Common Name	FloraSearch		This Survey (2012)				
		2007	2008	11 July	16 July	17 July	18 July	Opp.
Total counts				155	235	260	253	
Total species	54	18	10	22	29	28	30	25

* Introduced species; Opp. = Opportunistically observed species.

DRAFT

**APPENDIX 4 - Suggested Plant Species for Rehabilitation Plantings
(Plant associations as per Figure 5)**

Common Name	Scientific Name	Plant Association					Comments
		1	2	3	4	5	
Trees							
Silver Wattle	<i>Acacia dealbata</i>	✓	✓	✓			
Hickory	<i>Acacia implexa</i>			✓		✓	
Green Wattle	<i>Acacia mearnsii</i>			✓		✓	
Black Wattle	<i>Acacia melanoxylon</i>	✓	✓				
Kurrajong	<i>Brachychiton populneus</i>			✓		✓	Steep slopes and gullies, frost-free
Black Gum	<i>Eucalyptus aggregata</i>		✓				
White Box	<i>Eucalyptus albens</i>					✓	
Blakely's Red Gum	<i>Eucalyptus blakelyi</i>				✓		
Apple Box	<i>Eucalyptus bridgesiana</i>	✓	✓	✓	✓		
Broad-leaved Peppermint	<i>Eucalyptus dives</i>	✓	✓				
Yellow Box	<i>Eucalyptus melliodora</i>			✓	✓		
Snow Gum	<i>Eucalyptus pauciflora</i>	✓	✓				
Candlebark	<i>Eucalyptus rubida</i>	✓	✓				
Black Sally	<i>Eucalyptus stellulata</i>		✓				
Ribbon Gum	<i>Eucalyptus viminalis</i>	✓	✓				
Shrubs							
Box-leaf Wattle	<i>Acacia buxifolia</i>			✓		✓	
Dawson's Wattle	<i>Acacia dawsonii</i>			✓			
Western Silver Wattle	<i>Acacia decora</i>			✓			
Early Wattle	<i>Acacia genistifolia</i>			✓		✓	
Varnish Wattle	<i>Acacia verniciflua</i>			✓		✓	
Honeypots	<i>Acrotriche serrulata</i>	✓				✓	
Native Cranberry	<i>Astroloma humifusum</i>					✓	
	<i>Astrotricha ledifolia</i>	✓		✓			
Silver Banksia	<i>Banksia marginata</i>	✓		✓			
	<i>Bossiaea buxifolia</i>	✓	✓	✓			
	<i>Bossiaea prostrata</i>	✓	✓	✓			
Daphne Heath	<i>Brachyloma daphnoides</i>	✓	✓	✓		✓	
Kangaroo Thorn	<i>Bursaria spinosa</i>	✓	✓	✓		✓	
Common Fringe-myrtle	<i>Calytrix tetragona</i>	✓		✓		✓	
	<i>Cassinia longifolia</i>	✓	✓	✓	✓	✓	
	<i>Cassinia quinquefaria</i>			✓		✓	
	<i>Cryptandra amara</i>			✓		✓	
	<i>Daviesia genistifolia</i>			✓		✓	
	<i>Daviesia latifolia</i>	✓	✓				
	<i>Daviesia leptophylla</i>			✓		✓	
Wattle-leaf Bitter-pea	<i>Daviesia mimosoides</i> subsp. <i>mimosoides</i>	✓					

Common Name	Scientific Name	Plant Association					Comments
		1	2	3	4	5	
Blueberry Lily	<i>Dianella longifolia</i>	✓				✓	
Blue Flax-lily	<i>Dianella revoluta</i>	✓		✓		✓	
	<i>Dillwynia phyllicoides</i>	✓		✓		✓	
	<i>Discaria pubescens</i>	✓		✓		✓	
	<i>Dodonaea viscosa subsp. cuneata</i>			✓		✓	
	<i>Dodonaea viscosa subsp. angustissima</i>			✓		✓	
	<i>Gompholobium huegelii</i>			✓		✓	
	<i>Grevillea ramosissima</i>			✓		✓	
	<i>Hakea microcarpa</i>	✓	✓	✓			
False Sarsparilla	<i>Hardenbergia violacea</i>	✓		✓			
	<i>Hibbertia obtusifolia</i>		✓	✓	✓	✓	
	<i>Hibbertia riparia</i>			✓		✓	
Shrub Violet	<i>Hymenanthera dentata</i>		✓				
	<i>Indigofera adesmiifolia</i>	✓	✓	✓		✓	
Austral Indigo	<i>Indigofera australis</i>	✓	✓	✓		✓	
	<i>Leptospermum myrtifolium</i>	✓	✓	✓			
	<i>Leucopogon fletcheri</i>	✓		✓			
	<i>Leucopogon virgatus</i>			✓		✓	
Peach Heath	<i>Lissanthe strigosa</i>			✓		✓	
Eastern Cotton-bush	<i>Maireana microphylla</i>			✓		✓	
Urn Heath	<i>Melichrus urceolatus</i>	✓		✓		✓	
Mountain Mirbelia	<i>Mirbelia oxylobioides</i>	✓	✓				
Sago Bush	<i>Ozothamnus diosmifolius</i>			✓		✓	
	<i>Pimelea curviflora curviflora var. sericea</i>	✓	✓				
Smooth Rice Flower	<i>Pimelea glauca</i>	✓	✓	✓			
	<i>Platylobium formosum</i>	✓	✓	✓		✓	
Spreading Bush-pea	<i>Pultenaea microphylla</i>			✓		✓	
	<i>Pultenaea setulosa</i>	✓	✓	✓			
Grey Bush-pea	<i>Pultenaea spinosa</i>			✓		✓	
	<i>Pultenaea subternata</i>	✓		✓		✓	
	<i>Rubus parvifolius</i>	✓	✓	✓			
Five Corners	<i>Styphelia triflora</i>			✓		✓	
Leafy Templetonia	<i>Templetonia stenophylla</i>			✓		✓	