North Silverdale:
Flora and Fauna Assessment

FINAL REPORT

Prepared for SitePlus Pty Ltd

04 June 2014

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- Ben Coddington for assistance in the Field
- Ashleigh Pritchard for mapping
- Nathan Garvey for review

Summary

Biosis Pty Ltd was commissioned by SitePlus to undertake a flora and fauna assessment of an area of land proposed for rezoning in North Silverdale. The study area is located approximately 1.2 kilometres east of Warragamba and approximately 53 kilometres west of the Sydney CBD.

A general terrestrial flora and fauna assessment of the study area was undertaken by a qualified ecologist and botanist between January and April 2014.

Ecological values

Key ecological values identified within the Study Area include:

- Approximately 26.8 hectares of native vegetation in low to good condition. This includes 20.32 hectares of Shale Sandstone Transition Forest, an endangered ecological community, and 5.61 hectares of Western Sandstone Gully Forest, which provide significant habitat features for a number of threatened flora and fauna species. Known habitat for two threatened fauna species and potential habitat for one threatened flora species and nineteen threatened fauna species.
- Contribution to a linear habitat corridor connecting the Blue Mountains National Park to the north and Bents Basin State Conservation Area to the south.
- Areas assessed as being sensitive land in accordance with the vegetation categories outlined in Table 1, section 2.5.2 of the Wollondilly Development Control Plan (WDCP, 2011).

The Study Area has a combined total area of 68.06 hectares, of which 25.94 hectares (38%) supports remnant and regrowth native vegetation. Of this vegetated area, 14.4 hectares (54%) will be retained in the proposed E4 Environment Living Zone.

Vegetation within each zone is summarised below.

Row Labels	B2	B4	R2	R3	E4	Total
Shale Sandstone Transition Forest		0.01	3.76	2.38	8.27	14.42
Shale Sandstone Transition Forest (Low Condition)	0.14		2.57	2.62	0.58	5.91
Western Sandstone Gully Forest			0.01		5.60	5.61
Total	0.14	0.01	6.34	5.00	14.45	25.94

The E4 zone has been designed to incorporate the majority of good condition native vegetation, including good condition Shale Sandstone Forest EEC, on the site. The design of the proposed zoning has also included consideration of retaining a high degree of connectivity with large areas of native vegetation to the east and the ecological values of the Nepean River corridor.

The B2 and B4 zones support a total of 0.15 hectares of native vegetation of which 0.14 hectares is Shale Sandstone Transition Forest in low condition. The R2 and R3 zones support a total of 11.34 hectares of native vegetation, of which 5.19 hectares is Shale Sandstone Transition Forest in low condition.

Government legislation and policy

An assessment of the project against key biodiversity legislation and policy is provided and summarised below.

Legislation / Policy	Relevant ecological feature on site	Permit / Approval required	Notes
Environment Protection and Biodiversity Conservation Act 1999	Threatened species and endangered ecological communities.	Future development may effect threatened species and endangered ecological communities. Referral of the project to the Australian Government Minister for the Environment is not required at this stage.	Consider measures to avoid and minimise impacts to known and potential locations of MNES.
Threatened Species Conservation Act 1995	Threatened species and endangered ecological communities.	Future development may effect threatened species, populations or ecological communities. A Species Impact Statement is not required at this stage.	The Planning Proposal has been designed to minimise impacts to threatened species and communities. Residual impacts can be offset through retention and protection of native vegetation in an E4 zone. Future development in R2 and R3 zones should consider measures to avoid and minimise impacts to known and potential locations of TSC listed species, populations and communities.
Environmental Planning & Assessment Act 1979	Threatened species and endangered ecological communities.	Future development may effect threatened species, populations or ecological communities.	
Native Vegetation Act 2003	Native vegetation.	Approval is required for removal of native vegetation under the NV Act, unless exempt from the provisions. Proposed zones indicate NV Act will not be relevant.	
Noxious Weeds Act 1993	One class four noxious weeds was recorded within the subject site.	No Permit or approval is required under the NW Act for the proposed works at this stage of the planning proposal.	Reasonable steps to eradicate state prohibited weeds and comply with the requirements in the NW Act for a notifiable weed is required.
State Environmental Planning Policy 44	Koala habitat.	The subject site supports potential Koala habitat. No evidence of occupation	Targeted surveys may be required at the development application

Legislation / Policy	Relevant ecological feature on site	Permit / Approval required	Notes
		recorded. No management plan required at this stage.	stage to determine whether core habitat is present.
Sydney Regional Environmental Plan No.20 – Hawkesbury Nepean River (No2 – 1997).	Threatened species and endangered ecological communities.	Future development may effect threatened species, populations or ecological communities.	

Note: Guidance provided in this report does not constitute legal advice.

Recommendations

The results of this flora and fauna assessment have been used to inform the concept plan (Figure 2) for a proposed rezoning and future development of the subject site. The principal means to reduce impacts on biodiversity values within the study area is to avoid and minimise removal of native vegetation and habitat. A key recommendation of the current assessment was the protection of native vegetation in the eastern section. This recommendation has been incorporated into the current design in an E4 zone which has been adjusted to accommodate significant vegetation. Other recommendations are outlined in Table 9.

Further consideration of biodiversity values should be considered in the detailed design phase with the objective of long term sustained improved outcome. In addition to designing out impacts and designing in improved outcomes for biodiversity values, further assessments of terrestrial biodiversity values will be required once detailed design is close to finalisation. It is at this stage that all potential impacts can be thoroughly assessed and minor amendments made or additional actions proposed to minimises or mitigate impacts to terrestrial biodiversity values.

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1. Introduction

1.1 Project background

Biosis Pty Ltd has been commissioned by the Site Plus Pty Ltd to undertake a terrestrial flora and fauna assessment of the study area for planning proposal for the proposed rezoning of ten lots fronting Silverdale Road, North Silverdale, NSW (Figure 1).

The North Silverdale land owners group proposes to undertake residential subdivision and an expansion of the existing shopping centre. The land subject to the proposal is currently zoned RU2 Rural Landscape and B1 Neighbourhood Centre under Wollondilly Local Environmental Plan 2011 (LEP; WSC 2011a). Proposed re-zoning will include:

- R2 Low Density Residential
- R3 Medium Density Residential
- B2 Local Centre
- B4 Mixed Use
- E4 Environmental Living

Proposed zonings are shown in Figure 2.

The Department of Planning and Infrastructure (DP&I; now Department of Planning and Environment , DP&E) has issued a Gateway Determination for the proposal. In support of the planning proposal Wollondilly Shire Council (WSC) has recommended the DP&I consider the preparation of a number of studies as part of a Gateway Assessment, including the preparation of a flora and fauna assessment. The requirement for the preparation of a flora and fauna assessment for the planning proposal is also specified in the DP&I Planning Team Report (DP&I 2013) and endorsed in the Gateway Determination (DP&I 2013).

This assessment and report address the requirements of the project brief in the context of the requirements of the Gateway Determination (DP&I 2013).

1.2 Scope of assessment

The objectives of this investigation are to:

- Describe the vascular flora (ferns, conifers, flowering plants), vertebrate fauna (birds, mammals, reptiles, frogs.
- Map native vegetation and other habitat features.
- Review the implications of relevant biodiversity legislation and policy with particular reference to the requirements of the Gateway Determination (DP&I, 2013c), *Wollondilly Local Environmental Plan 2011* (WLEP) and *Wollondilly Development Control Plan 2011* (WDCP).
- Identify potential implications of the proposed rezoning and future development and provide a constraints analysis and recommendations to inform concept planning and design.

1.3 Location of the study area

The subject site is located within the suburb of Silverdale, Wollondilly Local Government Area (LGA), Parish of Wilton and County of Camden (Figure 1).

The subject site covers approximately 68 hectares of privately owned land, and includes the following seven properties located to the north of Silverdale township (Figure 2):

- Lot 6 DP1086326
- Lot A DP 161634
- Lot 7 DP 38123
- Lot 2 DP519533
- Lot 199 and 200 DP1092447
- Lot 10 and 11 DP38123
- Lot 121 and 122 DP747833

The majority of the subject site has been extensively used for residential, light industrial and agricultural purposes and has been extensively modified. The only unmodified and undisturbed areas are present within the easternmost sections of the subject site which are covered with remnant native vegetation. The proposed zoning for this portion of the site has been designed to protect this remnant vegetation and associated biodiversity values.

The study area is within the:

- Sydney Basin Bioregion.
- Hawkesbury - Nepean River catchment via Scotcheys Creek and the Nepean River.

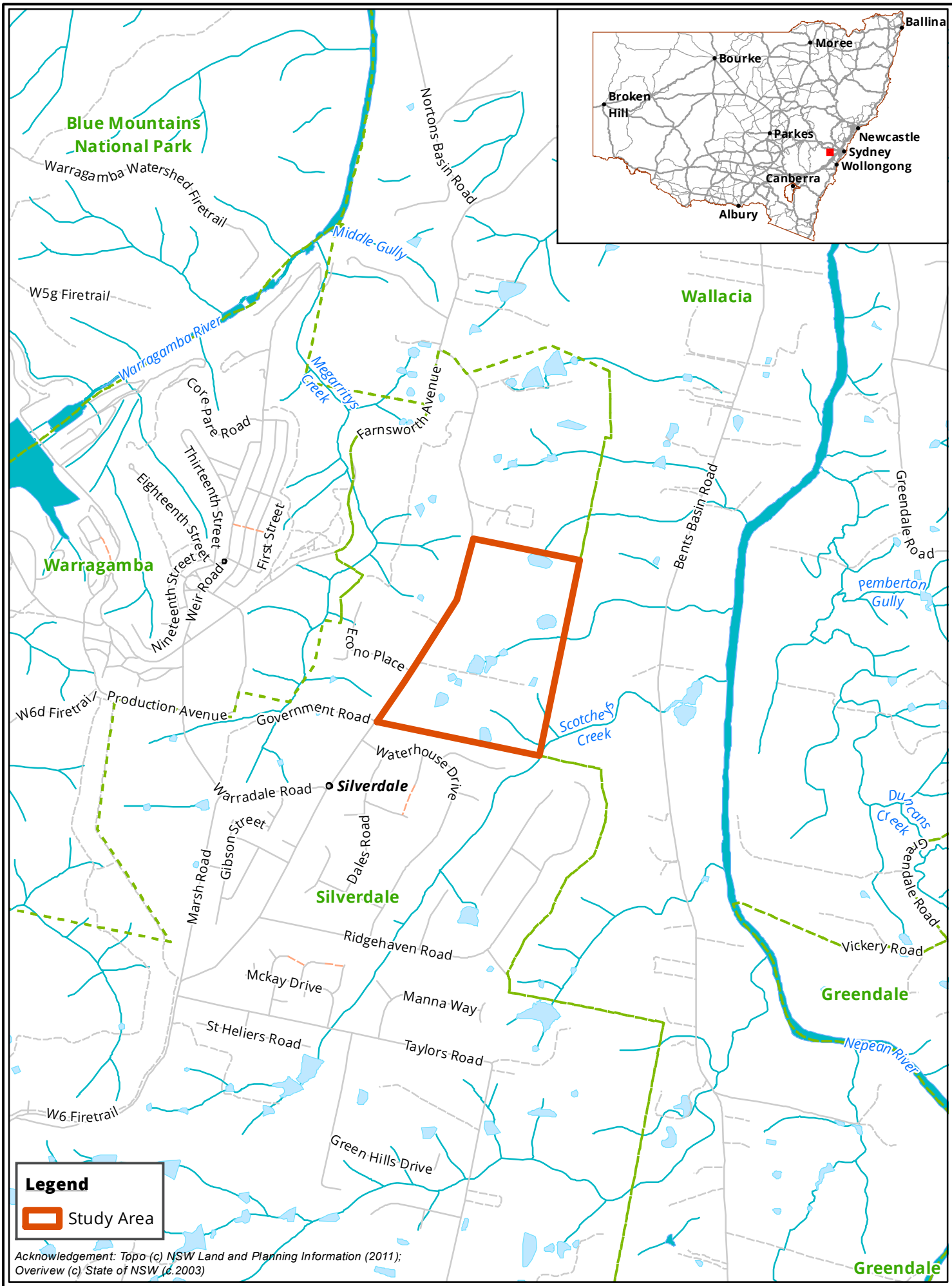

Figure 1: Location of the study area, North Silverdale, NSW

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Scale 1:25,000@A4, GDA 1994 MGA Zone 55

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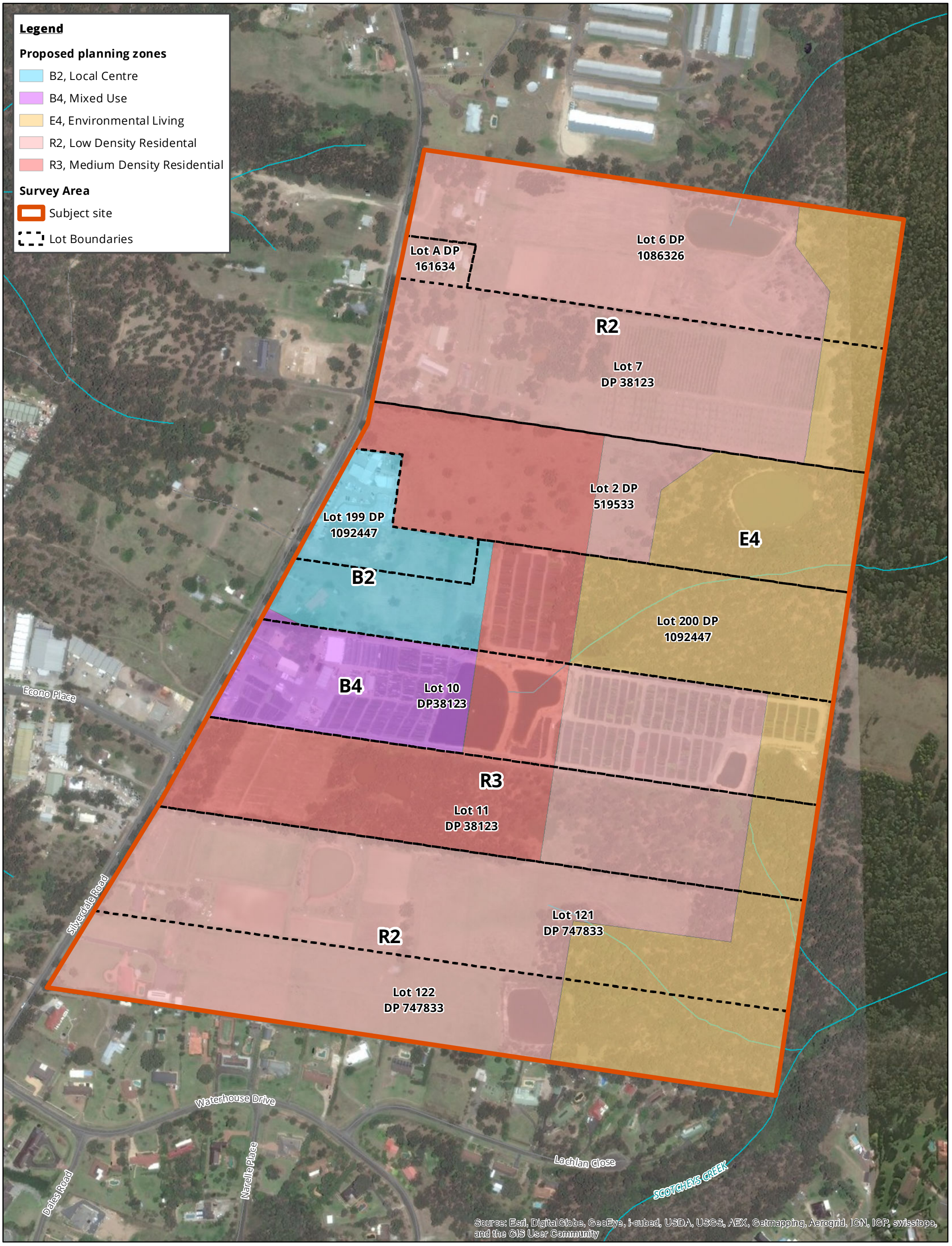

Figure 2: Subject site overview, including proposed zonings

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Acknowledgements: Imagery (c) Nearmap 2012
Topo (c) NSW Land and Planning Information (2012)

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16916_F2_Overview

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Scale 1:3,900 @ A3
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2. Methods

2.1 Literature and database review

In order to provide a context for the subject site, information about flora and fauna from within 10 kilometres of the subject site was obtained from relevant public databases. Records from the following databases were collated and reviewed:

- Office of Environment and Heritage Atlas of NSW Wildlife. © The State of New South Wales, Office of Environment and Heritage (OEH).
- PlantNET (The Royal Botanic Gardens and Domain Trust, 2014).
- BirdLife Australia, the New Atlas of Australian Birds, 1998-2012 (BA).
- Protected Matters Search Tool of the Australian Government Department of the Environment for matters protected by the EPBC Act.

Other sources of biodiversity information:

- Relevant vegetation mapping and interpretation guidelines, including:
  - The *Native Vegetation of the Cumberland Plain, Western Sydney. NSW National Parks and Wildlife Service 1:25 000 Map Series* (NPWS 2002).
  - *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands* (Tozer et al. 2010).

The following reports and information sources were also reviewed:

- *Planning Proposal to amend Wollondilly Local Environmental Plan* 2011 to *enable the Residential Development of North Silverdale and the Expansion of an Existing Shopping Centre. Silverdale Road, Silverdale* (SitePlus 2012).
- *Draft Flora and Fauna Assessment, Lot 19 and 20 in DP 1015250, Silverdale Road, Silverdale, Shire of Wollondilly* (Mills 2011).
- Relevant Department of Planning and Infrastructure reports for the subject site (DP&I 2013).
- NSW Scientific Committee final determinations for threatened biodiversity.
- Recovery Plans for relevant threatened biodiversity.
- OEH threatened biodiversity profiles.

2.2 Site investigation

2.2.1 Flora assessment

The flora assessment was undertaken on January 21, 2014. The flora assessment included a combination of random meanders, transects and spot locations recording dominant species to determine the plant communities present within the study area.

A list of dominant flora species was compiled for each plant community. The general condition of native vegetation was assessed as well as the effects of current seasonal conditions. Notes were made on specific issues such as degree of weed infestation, evidence of management works, current land use, impacts and the regeneration capacity of the vegetation (resilience).

An additional survey undertaken on April 10, 2014 to confirm vegetation communities and inform a preliminary BioBanking Assessment. Vegetation communities were mapped using a GPS enabled Tablet computer.

The subject site and study area are incorporated in the *Native Vegetation of the Cumberland Plain, Western Sydney. NSW National Parks and Wildlife Service 1:25 000 Map Series* (NPWS 2002) and SCIVI mapping (Tozer et al. 2010) with the NPWS (2002) mapping scheme the key reference for the current assessment.

2.2.2 Fauna assessment

The study area was investigated on January 21, 2014 to determine its values for fauna. These were assessed primarily on the basis of the types and qualities of habitats present. All species of fauna observed during the assessment were noted and active searching for fauna was undertaken. This included direct observation, searching under rocks and logs, examination of tracks and scats and identifying calls. Particular attention was given to searching for significant species and their habitats. Fauna species were recorded with a view to characterising the values of the site and the investigation was not intended to provide a comprehensive survey of all fauna that has potential to utilise the site over time.

2.2.3 Permits and Licences

The flora and fauna assessment was conducted by experienced and qualified ecologists under the terms of Biosis' Scientific Licence issued by the Office of Environment and Heritage under the *National Parks and Wildlife Act 1974* (SL100758, expiry date March 31, 2015). Fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee.

2.3 BioBanking Assessment

A preliminary BioBanking assessment was undertaken to determine whether retention of vegetation within the proposed E4 zone would offset losses of native vegetation elsewhere on-site. The preliminary BioBanking assessment was undertaken by Nathan Garvey, an accredited BioBanking assessor, using the BioBanking credit calculator and according to the BioBanking assessment methodology (DECC 2009).

As the assessment was preliminary in nature to advise whether potential loss of native vegetation can be offset by retention of native vegetation in the E4 zone, and targeted surveys were beyond the scope of the current assessment, assessments of threatened species credits and contribution of threatened species to ecosystem credits were not included. This level of assessment was deemed suitable for a Planning Proposal.

Vegetation types were stratified according to their condition (moderate/good versus low) and then by weed invasion. Vegetation types are consistent with vegetation mapping shown in Figure 3.

The BioBanking assessment assumes that all native vegetation within proposed B2, B4, R2 and R3 zones will be removed.

Management zones for the E4 zone were consistent with the vegetation zones, excepting areas where soil translocation may occur. These were classed as low condition Shale Sandstone Transition Forest and given a score of zero for current condition. Default site improvements scores were used.

The proposed rezoning will result in the potential removal of 0.01 hectares of Western Sandstone Gully Forest. This area is below that considered by the BioBanking assessment methodology, and was therefore excluded from the assessment.

2.4 Qualifications

Ecological surveys provide a sample of flora and fauna at a given time and season. There are a number of reasons why not all species will be detected at a site during survey, such as species dormancy, seasonal conditions, ephemeral status of waterbodies and migration and breeding behaviours of some fauna. In many cases these factors do not present a significant limitation to assessing the overall biodiversity values of a site.

The current flora and fauna assessment was conducted in summer and given the scope of works, there are no seasonal or other external factors which limit the results.

Flora and fauna surveys and habitat assessments including characterisation of ecological features focused on the subject site. The investigation considers flora and fauna habitats and ecological features of the study area but in less detail than the subject site. No surveys or assessments were carried out in constructed aquatic habitats such as farm dams and ephemeral drainage lines.

Database searches, and associated conclusions on the likelihood of species to occur within the study area, are reliant upon external data sources and information managed by third parties.

The BioBanking assessment presented herein is preliminary and used to determine whether retention of native vegetation within the proposed E4 zone will offset losses throughout the remainder of the siteFurther work is likely to be required for a BioBanking site or BioBanking agreement.

2.5 Legislation and policy

The implications for the Planning Proposal are assessed in relation to key biodiversity legislation and policy including:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- *Environmental Planning and Assessment Act 1979* (EP&A Act), including;
  - State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44).
  - Sydney Regional Environmental Plan (SREP) No 20—Hawkesbury-Nepean River (No 2—1997)
- *Threatened Species Conservation Act 1995* (TSC Act).
- *Water Management Act 2000* (WM Act).
- *Native Vegetation Act 2003* (NV Act).
- Wollondilly local Environment Plan (WSC 2011a).
- Wollondilly Development Control Plan (WSC 2011b).

2.6 Mapping

The client supplied aerial photography and site plans as well as proposed zone boundaries. Mapping was conducted using hand-held (uncorrected) GPS units and GPS enabled tablet computer (WGS84) and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 7 metres) and dependent on the limitations of aerial photo rectification and registration.

Mapping has been produced using a Geographic Information System (GIS).

Electronic GIS files which contained our flora and fauna spatial data were provided to SitePlus who adjusted the zone boundaries throughout the study area to accommodate the findings of the flora and fauna assessment in an iterative process.

Further mapping may be required for detailed design purposes.

3. Results

The key ecological features of the study area, focusing on native plant communities, are described in the following tables and mapped in Figure 3 and Figure 4. The remaining derived plant communities that represent highly modified and cleared landscapes with a long history of disturbance are not described or discussed in detail in any of the following sections.

Species recorded during the flora and fauna assessment are listed in Appendix 1 (flora) and Appendix 2 (fauna). Unless of particular note, these species are not discussed further in detail.

A list of threatened species recorded or predicted to occur in the local area is also provided in those appendices, along with an assessment of the likelihood of the species occurring within the study area.

3.1 Vegetation & fauna habitat

Table 1: Shale Sandstone Transition Forest

Shale Sandstone Transition Forest	
Extent within study area	20.32 hectares (0.15 hectares in B2, B4, of which 0.14 hectares is in low condition, 11.34 hectares in R2 and R3 zones, of which 5.19 hectares is in low condition, and a further 8.85 hectares in E4 zone, of which 0.58 hectares is in low condition)
Fauna habitat type	Open Forest /Woodland/Open Woodland/Low Open Woodland
Description	Shale Sandstone Transition Forest is present in several patches throughout the study area. The canopy in the western and central areas of the community is dominated by Narrow-leaved Ironbark *Eucalyptus crebra*, Red Ironbark *Eucalyptus fibrosa* and Grey Gum *Eucalyptus punctata* with Thin-leaved Stringybark *Eucalyptus eugenioides* and White Stringybark *Eucalyptus globoidea* also present. There are uncommon occurrences of Blackbutt *Eucalyptus pilularis*. The eastern stands of the community are dominated by Grey Gum *Eucalyptus punctata* and Stringybarks with occasional Yellow Bloodwood *Corymbia eximia* and Red Bloodwood *Corymbia gummifera,* and Blackbutt *Eucalyptus pilularis*, Sydney Red Gum *Angophora costata* and Turpentine *Syncarpia glomulifera* also present. Regenerating canopy species, including Black She-Oak *Allocasuarina littoralis* and *Acacia* spp., form a midstorey in some stands. In other stands the midstorey and understorey are absent due to ongoing maintenance by slashing and mowing. Where present the understory is characterised by either good cover of native shrubs, mixed patches of native shrubs and woody weeds or dense infestations of woody weeds. Common native shrubs in the western and central stands of the community include Three-veined Wattle *Acacia trinervata*, Native Blackthorn *Bursaria spinosa* subsp. *spinosa*, Gorse Bitter Pea *Daviesia ulicifolia*, Large-leaf Hop-bush *Dodonaea triquetra*, White Dogwood *Ozothamnus diosmifolius* and Tick Bush *Kunzea ambigua.* The better quality and more structurally intact eastern and north

	eastern stands of the community include Gorse Bitter Pea *Daviesia ulicifolia,* Wedge Guinea Flower *Hibbertia diffusa,* Tick Bush *Kunzea ambigua, Micrantheum ericoides,* Narrow-leaved Geebung *Persoonia linearis* and Prickly Shaggy Pea *Podolobium ilicifolium* in the understorey. The groundcover in the more intact or higher quality stands of the community throughout the study area, including some areas that are being mown or slashed, include a high percent cover of native grasses, herbs, twiners, sedges and sub shrubs. Common species include Threeawn Speargrass *Aristida vagans,* Purple Burr-Daisy *Calotis cuneifolia,* Rock Fern *Cheilanthes sieberi,* Barbed Wire Grass *Cymbopogon refractus,* Wiry Panic *Entolasia stricta,* Brown's Lovegrass *Eragrostis brownii,* Variable Glycine *Glycine tabacina,* Blue Bottle-daisy *Lagenifera stipitata,* Variable Sword-sedge *Lepidosperma laterale,* Many-flowered Mat-rush *Lomandra multiflora,* Thyme Spurge *Phyllanthus hirtellus,* Pomax *Pomax umbellata* and Kangaroo Grass *Themeda australis.* Lantana *Lantana camara* is the most common woody weed in Shale Sandstone Transition Forest occurring as light infestations around the edges of some stands in the southern area to dense thickets in the central low condition stand. Other woody weeds such as Large-leaved Privet *Ligustrum lucidum* and Small-leaved Privet *Ligustrum sinense* and the vine weed Japanese Honeysuckle *Lonicera japonica* have established in places. Lower quality Shale Sandstone Transition Forest also supports higher percent cover of introduced grasses and herbs with common species invading from adjoining cleared and disturbed areas. Commonly occurring species include Narrow-leafed Carpet Grass *Axonopus fissifolius,* Cobbler's Pegs *Bidens pilosa,* Spear Thistle *Cirsium vulgare,* African Lovegrass *Eragrostis curvula,* Paspalum *Paspalum dilatatum,* Catsear *Hypochaeris radicata* and Purpletop *Verbena bonariensis.* This community supports a variety of habitat features for fauna species, including tree hollows and fissures, a dense and complex understorey, abundant coarse woody debris and dense leaf litter. Although hollows are present, they are limited in size with all identified hollows being less than 200 millimetres. This community also provides abundant nectar resources for nectarivorous animals.
Condition	The condition of Shale Sandstone Transition Forest is variable. Figure 3 shows two conditions: • Shale Sandstone Transition Forest, characterized by remnant and regrowth canopy with good structure and floristic composition in the lower strata and / or remnant and regrowth canopy with the middle strata absent but high percent cover of native groundcovers including patches with continuous canopy to scattered trees. • Shale Sandstone Transition Forest (Low Condition), characterized by remnant and regrowth canopy with moderate to poor structure and floristic composition in the lower strata, including areas dominated by woody weeds or large swards of exotic perennial grasses and /or scattered trees with good structure and floristic composition in the lower strata.
Threatened ecological	Yes. Shale Sandstone Transition Forest is listed as an endangered ecological community under the TSC and EPBC Acts. All areas of Shale Sandstone

community	Transition Forest are consistent with multiple clauses of the NSW Scientific Committee (1998) final determination for the community including areas mapped as low condition. Stands of this community in low condition may not meet thresholds for listing under the EPBC Act.
Threatened species habitat	Red-crowned Toadlet and Cumberland Plain Land Snail have been recorded within this vegetation community in the Study Area (Mills 2011). This vegetation community provides a wide variety of habitat features for threatened species, including habitat for *Epacris purpurascens* var. *purpurascens* and breeding, roosting, nesting and foraging habitat for a suite of threatened fauna species (Table 3).
Plate 1: Shale Sandstone Transition Forest	

Table 2: Western Sandstone Gully Forest

Western Sandstone Gully Forest	
Extent within subject site	5.61 hectares (0.01 hectares in R2 zone and 5.60 hectares in E4 zone)
Fauna habitat type	Open Forest
Description	Western Sandstone Gully Forest is present in two locations in the eastern portion of the study area. Canopy is dominated by remnant and regrowth Blackbutt and Sydney Peppermint with occasional Grey Gum and Turpentine, whilst Red Bloodwood and Sydney Red Gum are uncommon. Regenerating canopy species and Hickory Wattle, Black She-Oak and Blueberry Ash are present in the midstorey with understorey dominated by native dominated by native shrubs such as White Sally, Coffee Bush, White Dogwood, *Pultenaea flexilis* and Sandfly Zieria. There are moderately dense stands of Grey Myrtle in

	the lowest sections of some of the drainage lines. The groundcover is mainly in good condition and varied from sparse under dense canopy to patches of moderate cover. Common native grasses, herbs, twiners and ferns present throughout are Kidney Weed, Prickly Rasp Fern, Forest Hedgehog Grass, Harsh Ground Fern, Blady Grass, Spiny-headed Mat-rush, Weeping Grass, Wonga Wonga Vine *Pandorea pandorana,* Whiteroot and Wiry Ricegrass. Weed percent cover is low throughout and mainly limited to scattered occurrences of woody weeds such as Large-leaved Privet and Small-leaved Privet *Ligustrum sinense* with Crofton Weed present in places on the drainage line channels. This vegetation community supports a number of fauna habitat features, including hollows, a dense midstorey and abundant coarse woody debris and leaf litter. Tree hollows present provide shelter and nesting habitat for a range of hollow dependent fauna such as microbats and birds; however few are large enough to support nesting and roosting habitat for owls and arboreal mammals. The presence of leaf litter and fallen branches, limbs and bark provide foraging, perching and nesting resources for some species of birds. This community also provides abundant nectar resources for nectarivorous animals.
Condition	Highly resilient and well structured native vegetation including large remnant trees, long established regrowth canopy and mid canopy in places with small trees and shrubs in the midstorey and open understorey. The groundcover is dominated by a suite of native grasses, herbs ferns and twiners. Weed percent cover is low and mainly limited to annual and perennial grasses and herbs confined to disturbed open edges and other disturbances such as tracks and drainage lines.
Threatened ecological community	No.
Threatened species habitat	This vegetation community provides a wide variety of habitat features for threatened species, including habitat for breeding, roosting, nesting and foraging habitat for threatened fauna species (Table 3).

Plate 2: Western Sandstone Gully Forest	

3.2 Threatened species

A list of significant species recorded or predicted to occur within 10 kilometres of the Study area are provided in Appendix 1 (flora) and Appendix 2 (fauna). An assessment of the likelihood of these species occurring in the Study Area and an indication of where within the Study Area (i.e. which habitats or features of relevance to the species) is included. A summary of those species recorded or with a medium or higher likelihood of occurring in the Study area is provided in Table 3 with reference to Figure 5 and Figure 6.

Table 3: Summary of significant species most likely to occur in the study area.

Species name	Area of value within the Study area
EPBC Act listed species	
Large-eared Pied-bat *Chalinolobus dwyeri*	Non-limiting foraging habitat is present throughout the study area particularly within the Woodland, Open Forest and Low Open Forest habitats. This species is likely to forage within the study area due to the ecotone between breeding / roosting habitat in sandstone areas to the east and west. The study area does not support suitable breeding / roosting habitat.
Spotted-tailed Quoll *Dasyurus maculatus maculatus*	Predicted to use drainage lines and the vegetated corridor to the east of the study area on occasion for foraging and dispersal through the landscape.
Brush-tailed Rock Wallaby *Petrogale penicillata*	Although this species is rare in the landscape and declining, the Open Forest habitat and adjacent areas, particularly in the south-eastern corner support key habitat components including steep slopes, rocky ledges and

Species name	Area of value within the Study area
	grassy areas. There is a record of the species to the west of the study area from 1994.
Koala *Phascolarctos cinereus*	The study area supports Grey Gum and Sydney Red Gum, and is considered to be potential Koala habitat under State Environmental Planning Policy 44 (SEPP44). It also falls within the Koala Linkage Corridor as identified in the *Priority Fauna Habitats for Species of Conservation Concern in the Greater Southern Sydney Region* (DECC 2007) as shown in Figure 8.
Grey-headed Flying-fox *Pteropus poliocephalus*	The study area provides non-limiting foraging habitat for this species throughout the study area. No flying-fox camps are present within or adjacent to the study area, and the closest known camp is located at Brownlow Hill approximately 14.5km from the study area (DECCW 2010b).
TSC Act	
Epacris purpurascens var. *purpurascens*	Higher quality stands of Shale Sandstone Transition Forest support optimal habitat for this flora species. This species has been recorded to the southwest of the study in similar habitat.
Red-crowned Toadlet *Pseudophryne australis*	Recorded within the study area previously (Mills 2011). A record of the species and identified potential breeding habitat found within the Open Forest and Woodland habitats is provided in Figure 4.
Gang-gang Cockatoo *Callocephalon fimbriatum*	The study area supports suitable foraging habitat for this species, particularly within the Woodland and Open Forest habitats. Suitable breeding hollows are highly restricted to the eastern section of the study area, as mapped in Figure 4.
Glossy Black-Cockatoo *Calyptorhynchus lathami*	The study area supports abundant food resources throughout the eastern portion of the site, with Allocasuarina species abundant within the Open Forest habitats mapped in Figure 4. The study area does not support suitable breeding resources.
Speckled Warbler *Chthonicola sagittatus*	Good quality key habitat components, including foraging and breeding resources, can be found within the Woodland and Open Forest habitats in the eastern section of the study area.
Varied Sittella *Daphoenositta chrysoptera*	Although there are recent records of this species from the locality, the study area has a lower prevalence of rough-barked trees, a known key habitat component for this species. The species may still use the Woodland and Open Forest habitats as opportunistic foraging resources.
Little Lorikeet *Glossopsitta pusilla*	The study area supports suitable foraging habitat for this species particularly within the Open Woodland, Woodland and Open Forest habitats. Suitable breeding hollows are highly restricted to the eastern section of the study area, as mapped in Figure 4.
Barking Owl *Ninox connivens*	This species may utilize Grassland, Woodland and Open Forest habitats within the Study area through opportunistic foraging and/or dispersal through the landscape. The study area does not support any suitable breeding habitat for the species.

Species name	Area of value within the Study area
Flame Robin *Petroica phoenicea*	Non-limiting foraging habitat is present throughout the study area with key habitat features including open habitat and suitable perching structures for this species are particularly prevalent within the Woodland and Open Woodland habitats.
Masked Owl *Tyto novaehollandiae*	This species may utilize Grassland, Woodland and Open Forest habitats within the Study area through opportunistic foraging and/or dispersal through the landscape. The study area does not support any suitable breeding habitat for the species.
Little Bentwing-bat *Miniopterus australis*	The study area provides foraging habitat for the species within the Open Woodland, Woodland, Open Forest and Low Open Forest habitats. The study area does not support any suitable breeding habitat for the species.
Eastern Bentwing-bat *Miniopterus schreibersii*	Non-limiting foraging resources throughout the Study area. Suitable breeding hollows are highly restricted to the eastern section of the study area, as mapped in Figure 4.
Eastern Freetail-bat *Mormopterus norfolkensis*	Non-limiting foraging resources throughout the Study area. Suitable breeding hollows are highly restricted to the eastern section of the study area, as mapped in Figure 4.
Greater Broad-nosed Bat *Platyrrhinus vittatus*	Non-limiting foraging resources throughout the Study area. Suitable breeding hollows are highly restricted to the eastern section of the study area, as mapped in Figure 4. This species is relatively rare in the landscape however.
Cumberland Plain Land Snail *Meridolum corneovirens*	Recorded within the study area previously (Mills 2011). Potential habitat for the species can be found within the Woodland and Open Forest communities throughout the study area. Three known records are provided in Figure 4

Areas of greatest value for significant species within the study area are:

- High quality Shale Sandstone Transition Forest: known to support two threatened fauna species, potential habitat for an additional 17 threatened fauna species and one threatened flora species.
- Western Sandstone Gully Forest: supports potential habitat for 18 threatened fauna species.
- Creeks and streams in eastern area: known and potential breeding habitat for the Red-crowned Toadlet.

3.3 Threatened ecological communities

The TSC and EPBC Act list endangered ecological community Shale Sandstone Transition Forest is present in several locations in the study area varying from poor to good condition (Figure 3 and Table 1) as remnant trees with low per cent native groundcovers to fully structured native vegetation characterized by tree, shrub and groundcover species listed in the TSC Act final determination for the community (NSW Scientific Committee 1998). In summary all stands of the community are consistent with multiple clauses of the NSW Scientific Committee (1998) final determination including Clause 6 which states Shale Sandstone Transition Forest has an understorey which may be either grassy and herbaceous or of a shrubby nature and Clause 7

that determines species composition varies between sites depending on geographical location and local conditions (e.g., topography, relative influence of sandstone or shale).

The Cumberland Plain Recovery Plan (DECCW 2010a) addresses the threatened species, populations and ecological communities that are endemic (or primarily endemic) to Western Sydney, including Shale Sandstone Transition Forest.

Key principles on which the Recovery Plan is based are:

- The protection and management of large, intact remnants is more effective and efficient than for smaller, fragmented remnants.
- Recovery efforts need to aim to ensure that a representative sample of biodiversity is conserved.
- Active management to best practice standards is needed to prevent the degradation of bushland in a fragmented landscape.
- Where impacts on biodiversity cannot be avoided, they should be offset using appropriate means.

In summary the Recovery Plan seeks to focus recovery efforts on those lands which represent the best opportunities to secure viable, long-term conservation outcomes in the region. These lands, referred to as the priority conservation lands are mapped and generally described in the Recovery Plan. Bents Basin State Conservation Area nearby to the south of the study area is mapped in Figure 1 of the Recovery Plan as priority conservation lands. Shale Sandstone Transition Forest of the study area is mapped as occurring in the approximate 25,566 ha of priority conservation lands.

There are no published guidelines or policy statements to assess and determine the presence of EPBC Act listed Shale Sandstone Transition Forest. However the EPBC Act listing advice on Shale Sandstone Transition Forest (Threatened Species Scientific Committee, 2001) states that the determination for the EPBC listed Shale Sandstone Transition Forest includes those areas identified NSW Scientific Committee (1998) and mapping by NPWS. However, in general the EPBC Act protects areas of higher conservation value, and areas of Shale Sandstone Transition Forest (Low Condition) may not fulfill the criteria to be considered Shale Sandstone Transition Forest as defined under the EPBC Act.

3.4 Biobanking Assessment

The removal of 11.47 hectares of native vegetation will result in the requirement for 156 biodiversity credits, as outlined in Table 4.

Table 4: Credits required for removal of native vegetation in proposed B2, B4, R2 and R3 zones

Vegetation code	Vegetation type	Area (ha)	Site value score	Credits required for biodiversity
HN556	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	6.14	68.12	104
HN556	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	5.33	26.09	52

		Total	156

The retention of 14.45 hectares of native vegetation, along with potential soil translocation into disturbed areas of the E4 zone, will result in 180 credits, as shown in Table 5.

Table 5: Credits available due to retention of native vegetation in proposed E4 zone

Vegetation code	Vegetation type	Management zone	Management zone area (ha)	Number of credits
HN556	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	M4	1.75	13
HN556	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	M1	8.27	107
HN556	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	M2	0.58	5
HN564	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin	M3	5.6	55
			Total	180

The biodiversity credits available in the proposed E4 zone are sufficient to offset losses of native vegetation elsewhere across the site.

3.5 Further survey recommendations

Prior to the removal of native vegetation, further targeted surveys are recommended for the following threatened fauna species as part of a future development of the subject site to support urban development applications.

- Cumberland Plain Land Snail
- Koala

Legend

Proposed planning zones

BiosisVegetation

Vegetation Communities (Biosis 2014)

Shale Sandstone Transition Forest

Shale Sandstone Transition Forest (Low Condition)

Western Sandstone Gully Forest

Survey Area

Study Area

R2

B2

B4

R3

E4

R2

Econo Place

Silverdale Road

Waterhouse Drive

Dales Road

Narelle Place

Lachlan Close

SCOTCHEYS CREEK

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 3: Vegetation community mapping

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Acknowledgements: Imagery (c) Nearmap 2012
Topo (c) NSW Land and Planning Information (2012)

Matter: 16916
Date: 29 May 2014,
Checked by: BC, Drawn by: ANP, Last edited by: apritchard
Location:P:\16900s\16916\Mapping\
16916_F3_Vegetation

0 30 60 90 120 150

Metres
Scale 1:3,900 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

Legend

- Hollow Bearing Tree
- Red-crowned Toadlet Breeding Habitat

Terrestrial Habitat

- Low Open Forest
- Open Forest
- Open Woodland
- Woodland

Mills 2011

- Cumberland Plain Land Snail
- Hollow Bearing Tree
- Red-crowned Toadlet

Survey Area

- Study Area
- Proposed planning zones

R2

B2

B4

R3

E4

R2

Econo Place

Silverdale Road

Waterhouse Drive

Narelle Place

Dales Road

Lachlan Close

SCOTCHEYS CREEK

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 4: Fauna Constraints Mapping

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Acknowledgements: Imagery (c) Nearmap 2012
Topo (c) NSW Land and Planning Information (2012)

Matter: 16916
Date: 02 June 2014,
Checked by: BC, Drawn by: ANP, Last edited by: apritchard
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Metres
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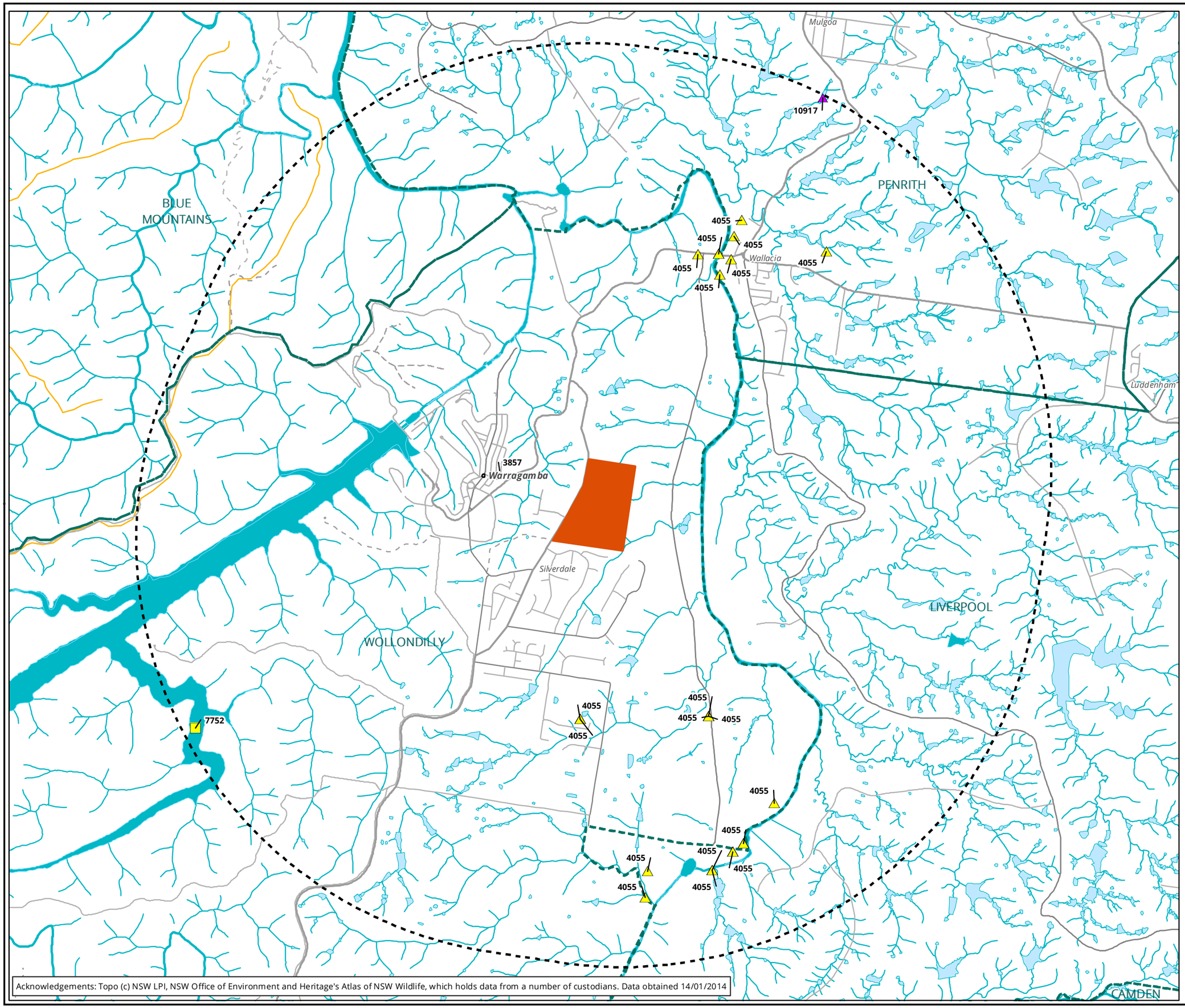
N



Legend

Threatened Flora

- 10917; Grevillea juniperina subsp. juniperina
- 4055; Eucalyptus benthamii
- 7752; Epacris purpurascens var. purpurascens

Survey Area

- Study area
- Search area

Acknowledgements: Topo (c) NSW LPI, NSW Office of Environment and Heritage's Atlas of NSW Wildlife, which holds data from a number of custodians. Data obtained 14/01/2014

Figure 5: Threatened flora records within 5km of the study area

0 0.4 0.8 1.2 1.6 2

Kilometers
Scale: 1:42,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

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Matter:
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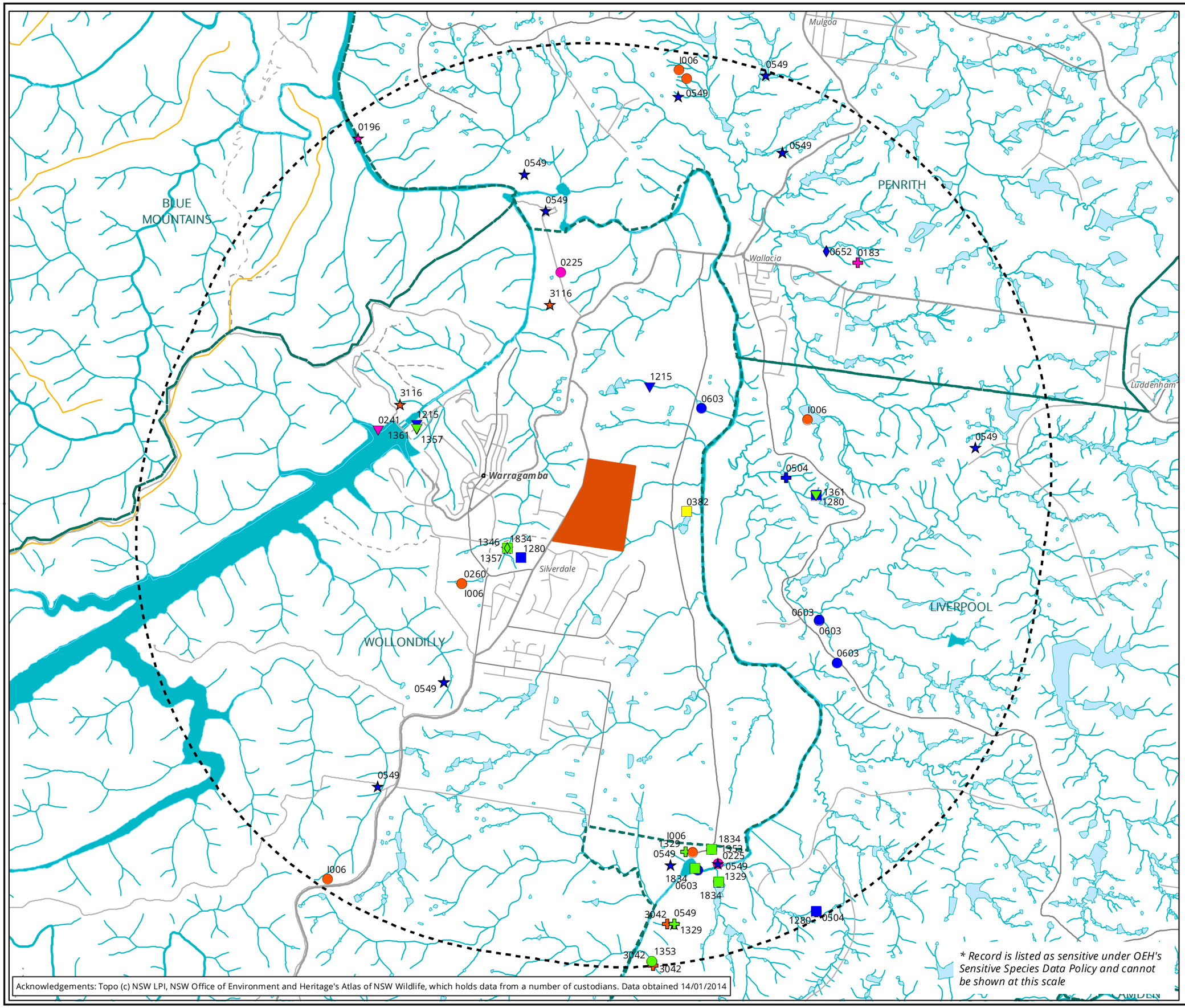
16916_F5_ThrFlora



Legend

Threatened Fauna

- 0183, Black-necked Stork
- 0196, Black Bittern
- 0225, Little Eagle
- 0230, Square-tailed Kite*
- 0241, Osprey
- 0246, Barking Owl*
- 0248, Powerful Owl*
- 0250, Masked Owl*
- 0260, Little Lorikeet
- 0265, Glossy Black-Cockatoo*
- 0268, Gang-gang Cockatoo*
- 0382, Flame Robin
- 0504, Speckled Warbler
- 0549, Varied Sittella
- 0603, Regent Honeyeater
- 0652, Diamond Firetail
- 1215, Brush-tailed Rock-wallaby
- 1280, Grey-headed Flying-fox
- 1329, Eastern Freetail-bat
- 1346, Little Bentwing-bat
- 1353, Large-eared Pied Bat
- 1357, Southern Myotis
- 1361, Greater Broad-nosed Bat
- 1834, Eastern Bentwing-bat
- 3042, Giant Burrowing Frog
- 3116, Red-crowned Toadlet
- I006, Cumberland Plain Land Snail

Survey Area

- Study area
- Search area

Figure 6: Threatened fauna records within 5km of the study area

0 0.4 0.8 1.2 1.6 2

Kilometers
Scale: 1:42,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

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Matter:
Date: 31 January 2014,
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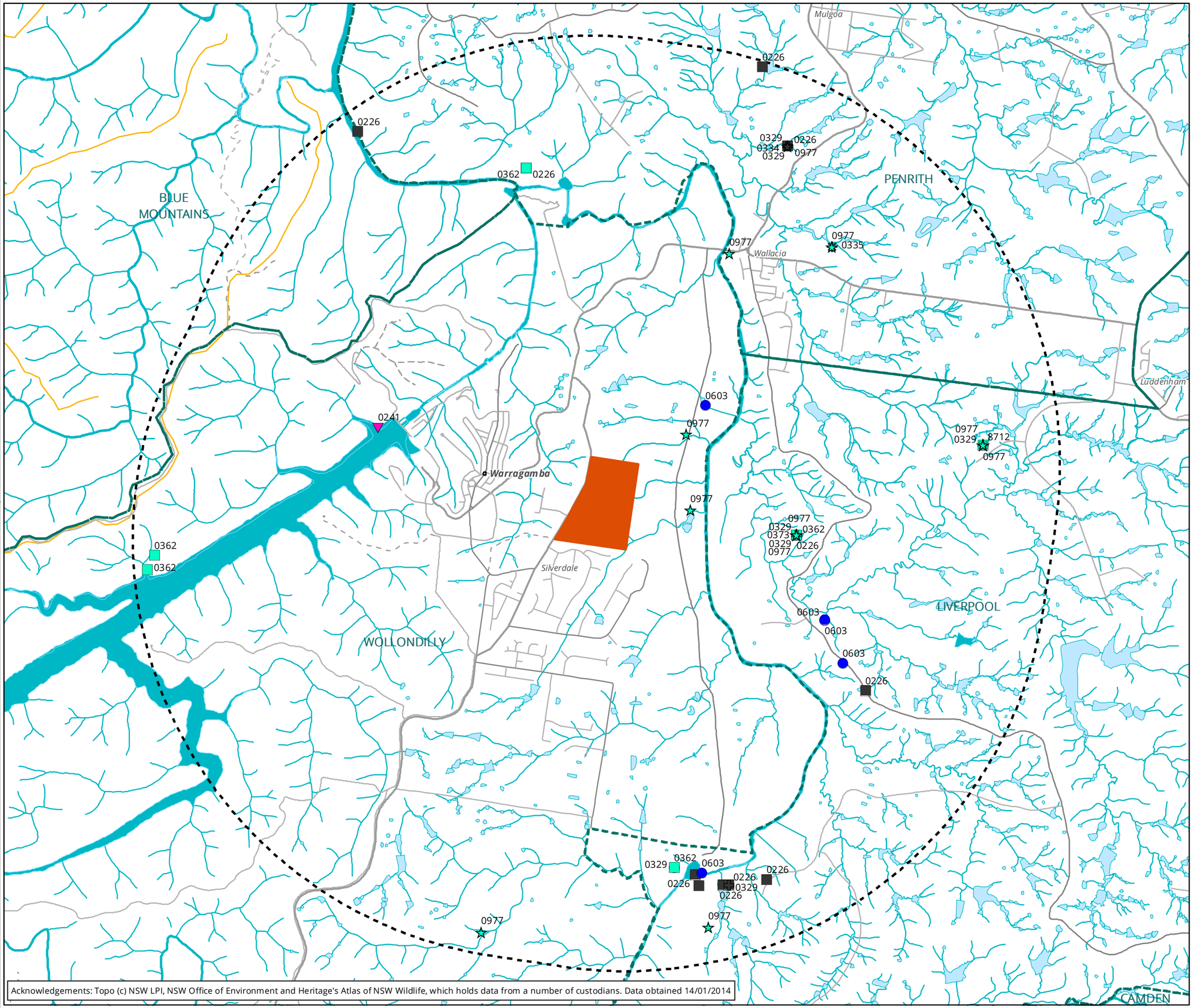
16916_F6_ThrFauna



Legend

Migratory Fauna

- 0226, White-bellied Sea-Eagle
- 0241, Osprey
- 0329, Rainbow Bee-eater
- 0334, White-throated Needletail
- 0335, Fork-tailed Swift
- 0362, Rufous Fantail
- 0373, Black-faced Monarch
- 0603, Regent Honeyeater
- 0977, Cattle Egret
- 8712, Eastern Great Egret

Survey Area

- Study area
- Search area

Acknowledgements: Topo (c) NSW LPI, NSW Office of Environment and Heritage's Atlas of NSW Wildlife, which holds data from a number of custodians. Data obtained 14/01/2014

Figure 7: Migratory Fauna within 10km of the Study Area

0 0.4 0.8 1.2 1.6 2

Kilometers
Scale: 1:42,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Matter:
Date: 19 May 2014,
Checked by: BC, Drawn by: ANP, Last edited by: apritchard
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16916_F7_MigFauna

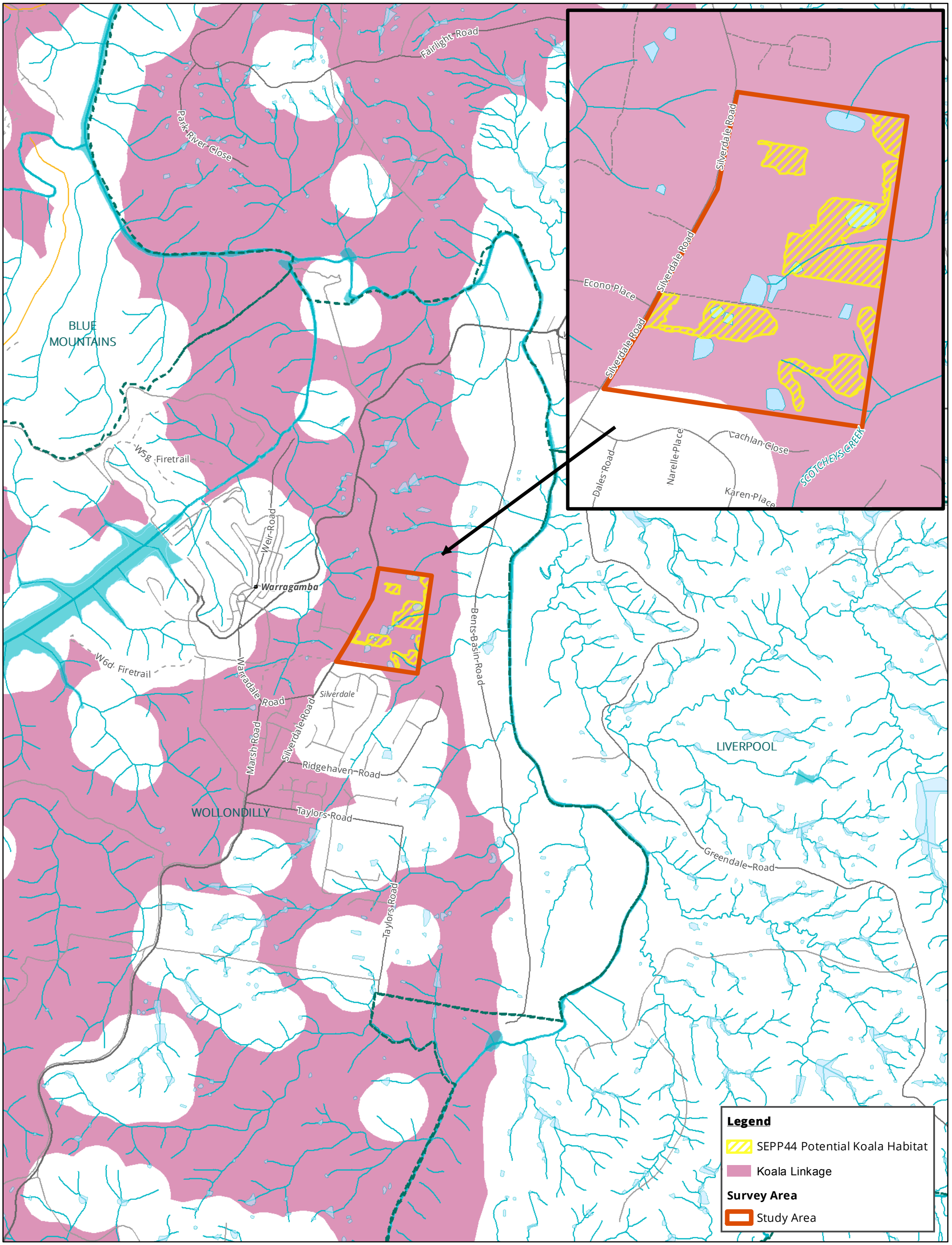

Figure 8: Koala Linkage and identified potential habitat in relation to the Study area

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Acknowledgements: Topo (c) NSW Land and Planning Information (2012), Priority Fauna Habitats for Species of Conservation Concern in the Greater Southern Sydney Region DECC

Matter: 16916
Date: 29 May 2014,
Checked by: BC, Drawn by: ANP, Last edited by: apritchard
Location:P:\16900s\16916\Mapping\
16916_F8_Koala

0 350 700 1,050 1,400 1,750

Metres
Scale 1:35,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

4. Biodiversity Legislation and Government Policy

This section provides an assessment of the Planning Proposal against key biodiversity legislation and government policy. This section does not describe the legislation and policy in detail and guidance provided here does not constitute legal advice.

4.1 Commonwealth

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act applies to developments and associated activities that have the potential to significantly impact on Matter of National Environmental Significance (MNES) protected under the Act.

MNES relevant to the Planning Proposal are summarised in Table 6. It includes an assessment against the EPBC Act policy statements published by the Australian Government which provide guidance on the practical application of EPBC Act.

Table 6: Assessment of the project against the EPBC Act

Matter of NES	Specific issues	Assessment against EPBC Act
Threatened species and ecological communities	No EPBC listed threatened flora or fauna species were recorded on subject site during the current surveys. The EPBC Act listed endangered ecological community Shale Sandstone Transition Forest is present in several locations in the study area. No EPBC listed threatened flora species medium to high likelihood of occurrence on the subject site. Five EPBC listed threatened fauna species either recorded or with potential habitat predicted in the locality are considered to a have a medium to high likelihood of occurrence within the subject site.	Significant Impact Criteria assessments would be required for each of the identified EPBC listed threatened flora and fauna species that are considered likely to occur within the study area. These assessments would need to be included with a Development Application to identify whether the proposed development actions are likely to result in a significant impact on any of the assessed flora and fauna species. No Significant Impact Criteria assessments are required at this stage.
Migratory species	No migratory fauna species were recorded on subject site during the current surveys. Excluding pelagic and marine species, the migratory bird species Cattle Egret *Ardea ibis* and Eastern Great Egret *Ardea modesta* have been recorded in the locality and are assessed to have a medium to higher likelihood to occur in or utilise the habitats	The study area does not support important habitat for any migratory species. No further consideration is required.

	of the subject site. The study area does not support important habitat for these species.	
Wetlands of international importance (Ramsar sites)	There are 12 Ramsar sites in NSW, the closest one being the Towra Point Nature Reserve on the Kurnell Peninsula in Sydney.	The subject site does not flow directly into a Ramsar site and a future development is not likely to result in a significant impact to a Ramsar site.

The likelihood of whether future development within the study area will be considered a significant impact on a MNES is unknown at this stage, and will need to be reassessed within the development application process using the criteria outlined in the relevant *Significant Impact Guidelines*.

We recommend that any proposed removal of Shale Sandstone Transition Forest consider the need for referral to the Australian Government Minister for the Environment to determine whether the action requires approval under the EPBC Act. This matter would need to be assessed when a development application is prepared.

An aquatic assessment, undertaken in conjunction with a specific development proposal, will determine whether the provisions of the relevant sections of the EPBC Act are triggered.

4.2 State

4.2.1 Threatened Species Conservation Act 1995

The TSC Act provides for the protection and conservation of biodiversity in NSW through the listing of threatened species, populations and communities; key threatening processes; and critical habitat for threatened species, populations and communities.

All areas of Shale Sandstone Transition Forest are consistent with multiple clauses of the NSW Scientific Committee (1998) final determination for the community including areas mapped as low condition (Figure 3). The remaining native vegetation within the subject site is not considered representative of any listed communities.

The threatened flora species *Epacris purpurascens* var. *purpurascens* is considered to have a medium likelihood of occurrence in the higher quality eastern stands of Shale Sandstone Transition Forest in the study area. Other than this species native and derived vegetation within the subject site is not considered to support any greater than a low likelihood of occurrence for the remaining 19 threatened flora species either previously recorded in the locality or with predicted habitat.

Of the 37 threatened fauna species either previously recorded in the locality or predicted to occur, one threatened frog, eight threatened birds, nine threatened mammals (including five threatened microbats), and one threatened mollusc are considered to have a medium or greater likelihood of occurring within the study area:

- Red-crowned Toadlet *Pseudophryne australis,*
- Gang-gang Cockatoo *Callocephalon fimbriatum,*
- Glossy Black-cockatoo *Calyptorhynchus lathami,*
- Speckled Warbler *Chthonicola sagittata.*
- Varied Sittella *Daphoenositta chrysoptera.*

- Little Lorikeet *Glossopsitta pusilla*,
- Barking Owl *Ninox connivens,*
- Flame Robin *Petroica phoenice,*
- Masked Owl *Tyto novaehollandiae*,
- Large-eared Pied Bat *Chalinolobus dwyeri*,
- Spotted-tailed Quoll *Dasyurus maculatus*
- Little Bentwing-bat *Miniopterus australis*
- Eastern Bentwing-bat *Miniopterus schreibersii oceanensis.*
- Eastern Freetail-bat *Mormopterus norfolkensis.*
- Greater Broad-nosed Bat *Platyrrhinus vittatus,*
- Brush-tailed Rock Wallaby *Petrogale penicillata*
- Koala *Phascolarctos cinereus*
- Grey-headed Flying Fox *Pteropus poliocephalus*
- Cumberland Plain Land Snail *Meridolum corneovirens*

Impacts to the threatened species, populations and communities must be assessed through the Assessment of Significance (formerly known as the "7-part test") process under Section 5A of the EP&A Act (refer to Section 4.2.2 below). Shale Sandstone Transition Forest may be affected by direct and indirect impacts according to the current concept plan (SitePlus 2014). However no Assessments of Significance have been carried out for this endangered ecological community as these cannot be fully determined at this stage. Similarly, the site provides habitat for one threatened flora species and 19 threatened fauna species. Assessments of Significance will need to be carried out as part of a Development Application for the site.

Habitat critical to the survival of an endangered or critically endangered species, populations or ecological communities can be identified under the TSC Act and listed on the Register of Critical Habitat kept by OEH. The study area does not contain declared 'critical habitat'.

A licence to harm/pick/damage habitat of a threatened species, population or community or damage critical habitat may be required for Shale Sandstone Transition Forest.

4.2.2 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the proper consideration and management of impacts of proposed development or land-use changes on the environment (both natural and built) and the community. The Act is administered by DP&E.

Sections of the EP&A Act of primary relevance to the natural environment are considered further below in relation to the current Planning Proposal.

4.2.2.1 Assessment of Significance (Section 5A)

Section 5A of the EP&A Act requires proponents and consent authorities to consider if a development will have a significant effect on threatened species, populations or communities listed under the TSC Act and FM Act. Section 5A (and Section 9A of the TSC Act) outlines seven factors that must be taken into account in an Assessment of Significance. Where any Assessment of Significance determines that a development will result

in a significant effect to a threatened species, population or community a Species Impact Statement (SIS) is required.

Assessments of Significance were not within the scope of the current assessment. Biosis recommends that Assessments of Significance be undertaken for Shale Sandstone Transition Forest and 20 listed threatened species outlined in Section 4.2.1, prior to any development on the subject site.

4.2.2.2 Local Environment Plans (Part 3 Division 4)

Local Environment Plans (LEP) apply either to the whole, or part of, a local government area and make provision for the protection or utilisation of the environment through zoning of land and issue specific clauses. Further discussion of relevant sections of the WLEP is provided in Section 4.3.

4.2.2.3 Development Control Plans (Part 3 Division 6)

Development control plans are prepared to help achieve the objectives of LEPs by providing specific, comprehensive requirements for certain types of development or locations e.g. for urban design, specific town centres and biodiversity. Further discussion of relevant sections of the WDCP is provided in Section 4.4.

4.2.2.4 State Environmental Planning Policies (Part 3 Division 2)

State Environmental Planning Policies (SEPPs) outline policy objectives relevant to state wide issues. SEPPs relevant to the current development are exclusive to:

SEPP No. 44 Koala Habitat Protection

SEPP 44 applies to areas of native vegetation greater than one hectare and applies to Councils listed in Schedule 1 that support specific Koala feed tree species listed in Schedule 2 of the SEPP. The Wollondilly LGA is included in Schedule 1 and two tree species (Grey Gum and Sydney Redgum) from Schedule 2 occur on the subject site. Under this policy the following distinction is made between 'potential' and 'core' Koala habitat:

- "Potential Koala Habitat" means areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.
- "Core Koala Habitat" means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Figure 8 outlines the areas of Shale Sandstone Transition Forest where Koala feed trees "constitutes at least 15% of the total number of trees in the upper or lower strata of the tree component", and therefore constitutes Potential Koala habitat. As such, any modification of this vegetation has potential to impact this species.

There are no known records of Koalas occurring in the Study area or in adjoining bushland areas. No Koalas were observed or heard calling during field surveys, nor were any signs of occupation, such as scats or tree scratchings, observed on or near trees within the Study area. Therefore the Study area does not constitute Core Koala Habitat. Under SEPP44 a management plan is not required.

Sydney Regional Environmental Plan No.20 – Hawkesbury Nepean River (No2 – 1997).

The *Sydney Regional Environmental Plan No 20 - Hawkesbury-Nepean River (No 2—1997)* (SREP 20) applies to the Wollondilly LGA. SREP 20 aims to 'protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context'.

The general planning considerations implemented by SREP 20 are set out in Part 2 of the plan. In summary these are:

- Clause 6 (2) Environmentally sensitive areas;
- Clause 6 (6) Flora and Fauna; and
- Clause 6 (10) Urban Development.

Clause 6 identifies key environmental issues and specific planning policies and recommended strategies for the implementation of SREP 20. Table 7 below highlights provisions of SREP 20 under Clause 6 that are of particular relevance to the conservation and management of biodiversity and natural resources relevant for the current investigations. Relevant strategies recommended under Clause 6 that are addressed by this terrestrial biodiversity assessment are highlighted with reference to specific sections of this report.

Table 7: Summary of SREP 20, Clause 6 strategies relevant to the current biodiversity investigations.

Issue	Policy	Strategies	Report section
Environmentally sensitive areas	The environmental quality of environmentally sensitive areas must be protected and enhanced through careful control of future land use changes and through management and (where necessary) remediation of existing uses. Note. Environmentally sensitive areas in the Hawkesbury-Nepean catchment are: the river, riparian land, escarpments and other scenic areas, conservation area sub-catchments, national parks and nature reserves, wetlands, other significant floral and faunal habitats and corridors, and known and potential acid sulphate soils	Minimise adverse impacts on water quality, aquatic habitats, riverine vegetation and bank stability.	Section 5 Ecological Constraints and Recommendations
Flora and fauna	Manage flora and fauna communities so that the diversity of species and genetics within the catchment is conserved and enhanced.	Conserve and, where appropriate, enhance flora and fauna communities, particularly threatened species, populations and ecological communities, aquatic habitats, wetland flora, rare flora and fauna, riverine flora, flora with heritage value, habitats for indigenous and migratory species of fauna, and existing or potential fauna corridors.	Section 5 Ecological Constraints and Recommendations

Issue	Policy	Strategies	Report section
		Locate structures where possible in areas which are already cleared or disturbed instead of clearing or disturbing further land.	Section 5 Ecological Constraints and Recommendations
		Minimise adverse environmental impacts, protect existing habitat and, where appropriate, restore habitat values by the use of management practices.	Section 5 Ecological Constraints and Recommendations
		Consider the range of flora and fauna inhabiting the site of the development concerned and the surrounding land, including threatened species and migratory species, and the impact of the proposal on the survival of threatened species, populations and ecological communities, both in the short and longer terms.	Section 5 Ecological Constraints and Recommendations
		Consider the need to provide and manage buffers, adequate fire radiation zones and building setbacks from significant flora and fauna habitat areas.	Section 5 Ecological Constraints and Recommendations
		Consider the need to control access to flora and fauna habitat areas.	Section 5 Ecological Constraints and Recommendations
		Consider the need to maintain	Section 5 Ecological Constraints and

Issue	Policy	Strategies	Report section
		corridors for fish passage, and protect spawning grounds and gravel beds.	Recommendations
Urban Development	All potential adverse environmental impacts of urban development must be assessed and controlled.	All relevant terrestrial biodiversity strategies are listed above in relation to environmentally sensitive areas, and flora and fauna.	Section 5 Ecological Constraints and Recommendations

4.2.3 Fisheries Management Act1994

The *Fisheries Management Act1994* (FM Act) includes considerations that would need to be investigated and assessed as part of any future Development Applications, as discussed below.

The FM Act provides for the protection and conservation of aquatic species and their habitat through NSW. Impacts to threatened species, populations and communities listed under the FM Act must be assessed through the Assessment of Significance process under Section 5A of the EP&A Act.

A key definition for the FM Act is 'Water land', which is land submerged by water, whether permanently or intermittently, or, whether forming an artificial or natural body of water and includes wetlands and any other land prescribed by the FM Regulations as water land. In summary, DPI (2013) state that one or more permits issued by DPI as part of integrated development consent may be required under the FM Act if works including, but not limited to, the following would potentially impact on water land or fish passage:

- Construction of bridges, culverts, causeways (both piped and un-piped) or other road-crossings of waterways (temporary or permanent).
- Channelisation, relocation or realignment of waterways.
- Installation of pipelines across a waterway (involving dredging or reclamation).
- Installation of stormwater outlets (involving reclamation of the bed or bank of a waterway).
- Stream bed or bank stabilisation works (involving dredging or reclamation to halt erosion).

In some instances, DPI assesses proposals in relation to a classification scheme that factors in the functionality of a waterway as fish habitat. This includes an assessment of habitat sensitivity 'Type' and also waterway 'Class' to identify an appropriate width of the riparian buffer (DPI, 2013). Further assessments of aquatic fauna and their habitats may be required to assist in the preparation of a future Development Application

4.2.4 Native Vegetation Act 2003

The NV Act provides for, encourages and promotes the management of native vegetation on a regional basis. Under the NV Act no clearing of native vegetation is allowed except in accordance with prior development consent from the relevant Council or under a Property Vegetation Plan (PVP) approved by the relevant Local Land Services office. Consent to clear native vegetation is required unless the clearing is exempt clearing according to Section 25 of the NV Act or is land listed in Schedule 1 that is excluded from operation of the NV Act. The types of development most likely to involve dual consent requirements from a Council and Local Land Services include dual occupancies, rural and rural residential subdivision and rural tourism ventures.

4.2.5 Noxious Weeds Act 1993

The NW Act was enacted to provide for the identification, classification and control of noxious weeds. Plants declared as noxious weeds are currently listed under Weed Control Order No. 28 Declaring Certain Plants to be Noxious Weeds published in the New South Wales Government Gazette No. 97 (Department of Premier and Cabinet 2011).

One Class 4 noxious weed Fireweed *Senecio madagascariensis* listed under the NW Act for the Wollondilly LGA was recorded in the current surveys. This species is present as minor occurrences that would not be considered as significant infestations. An occupier (other than a public authority or a local control authority) must take all reasonable steps to eradicate state prohibited weeds and comply with the requirements in the NW Act for a notifiable weed or restricted plants.

4.3 Wollondilly Local Environmental Plan 2011

The WLEP sets a number of aims including those that consider the management of biodiversity in the LGA. Specific aims of the WLEP that consider biodiversity and natural resource management are:

- To provide for the management of natural resources and the protection of the natural landscape character.
- To protect water quality in land that is situated within water supply catchments.
- The objective of Clause 7.2 Biodiversity protection is 'to maintain terrestrial and aquatic biodiversity' including:
    - Protecting native fauna and flora.
    - Protecting the ecological processes necessary for their continued existence.
    - Encouraging the recovery of native fauna and flora and their habitats.
    - Protecting water quality within drinking water catchments.

Clause 7.2 applies to land identified as 'sensitive land' on the WLEP Natural Resources - Biodiversity Map. Before determining a development application for land to which Clause 7.2 applies, the consent authority must consider any adverse impact of the proposed development on:

- Native ecological communities.
- The habitat of any threatened species, populations or ecological community.
- Regionally significant species of fauna and flora or habitat.
- Habitat elements providing connectivity.
- Water quality within drinking water catchments.

There are number of factors that must be considered including avoiding, minimising or mitigating potential environmental impacts before development consent can be granted by Council. The study area does not support land currently identified on the WLEP Natural Resources - Biodiversity Map.

The objective of Clause 7.3 Water protection of the WLEP is 'to maintain the hydrological functions of riparian land, waterways and aquifers' including protecting the following:

- Water quality.
- Natural water flows.
- The stability of the bed and banks of waterways.
- Groundwater systems.

This clause applies to land identified as "sensitive land" on the Natural Resources - Water Map. Before determining a development application for development on land to which this clause applies, the consent authority must consider any adverse impact of the proposed development on the following:

- The water quality of receiving waters.
- The natural flow regime.
- The natural flow paths of waterways.
- The stability of the bed, shore and banks of waterway.

- The flows, capacity and quality of groundwater systems.

Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

- The development is designed, sited and will be managed to avoid any adverse environmental impact.
- If that impact cannot be avoided the development is designed, sited and will be managed to minimise that impact.
- If that impact cannot be minimised the development will be managed to mitigate that impact.

The study area supports land identified on the Natural Resources - Water Map, with the creek in the southern area listed as 10m on this document. This creek will be wholly contained in the proposed E4 zone.

Clauses 7.2 and 7.3 of the WLEP 2011 are integral to the aims of this assessment and have been considered in the formulation of the constraints analysis and recommendations below.

4.4 Wollondilly Development Control Plan 2011

The WDCP provides the technical detail for the implementation of the WLEP 2011 and Volume 1 of the WDCP outlines the information and plans to be submitted with any development application.

The key section of the WDCP to the current assessment is Volume 1, 2.5 Biodiversity which focuses on the definitions of 'sensitive land' that are identified on the Natural Resources - Biodiversity Map of the WLEP. Sensitive land for the purposes of the WLEP comprises part or all of the following environmental characteristics:

- Endangered ecological communities as defined by the TSC Act.
- Core vegetation and critical habitats.
- Flora and fauna corridors.
- Habitat for threatened species according to Schedules 1 and 2 of the TSC Act.
- Key areas of biodiversity.
- Riparian corridors (including Riparian Land as described under Section 2.6 of WDCP Volume 1).

As part of the WDCP, WSC has developed a rating system that classifies 'sensitive land' and 'potentially sensitive land' into five categories. Primarily, the categories from one to five consider the quality and integrity of the vegetation and are designed to ensure that biodiversity is considered as part of the development assessment process. The rating system highlights vegetation through its location, conservation and biodiversity values, opportunities to link areas of strategic importance, the potential of the vegetation in supporting threatened species and water quality outcomes. Table 1 of the WDCP, Section 2.5.2, defines the criteria for defining each vegetation category. Actions or controls to be considered in the development application and assessment process for 'sensitive land' and 'potentially sensitive land' are clearly stated.

Sections 2.5 of the WDCP is integral to the aims of this assessment. As such, formulation of the constraints analysis in the following Table 8 and Figure 9 focuses on identifying and classifying 'sensitive lands' based on the six guiding features listed above. Future develop should be subject to the controls outlined in Table 1 of Section 2.5.2 of the WDCP for each category.

Table 8: Vegetation categories according to the WDCP (Figure 9)

WDCP Category	WDCP Category objectives	WDCP Description	WDCP Controls	Assessment of vegetation communities in the study area against Section 2.5.2 of the WDCP
5	To improve and maintain environmental outcomes and protect core areas.	Core vegetation and critical habitats – major rivers/tributaries/known flora species populations. This classification applies to land that has been identified as having Endangered Ecological Communities (EEC) or Core vegetation with habitat for threatened species, it may also border significant water courses.	Development applications must be accompanied by a comprehensive flora and fauna survey and species impact statements. Core vegetation must be retained. Biobanking or offsetting must be specified where development proposes any disturbance or removal of Class 5 vegetation.	• Areas of high quality Shale Sandstone Transition Forest, which is listed as an endangered ecological community under the EPBC and TSC Acts which is core vegetation with high degree of connectivity with other remnant vegetation and the Nepean River. • Areas of Western Sandstone Gully Forest which is core vegetation with high degree of connectivity with other remnant vegetation and the Nepean River.
4	To improve and maintain environmental outcomes and support core areas. To maintain strategic links to core areas and provide buffer zones.	Corridors and connection core vegetation – support to Core Vegetation with modified cover but intact. This classification applies to land that has been identified as having EEC and/or core	Development applications must be accompanied by a comprehensive flora and fauna survey and species impact statements. Important vegetation corridors must be identified and	• Areas of low quality Shale Sandstone Transition Forest, which is listed under listed as an endangered ecological community under the EPBC and TSC Acts, with a

WDCP Category	WDCP Category objectives	WDCP Description	WDCP Controls	Assessment of vegetation communities in the study area against Section 2.5.2 of the WDCP
		vegetation or is a support to class 5 lands. This vegetation may not be connected to a major water course but its status is valuable and supports core areas and retention should be maximised where possible.	adequate linkages maintained. Biobanking or offsetting must be specified where a development proposes removal of Class 4 vegetation.	modified understorey with low exotic cover, but which still provides a high degree of connectivity with other remnant vegetation and the Nepean River.
3	To maintain corridor links. To improve environmental outcomes. To encourage conditions which improve soil, water and vegetation outcomes.	Key areas and remnant vegetation with important linkages (creek lines steep slopes). This classification applies to land that has been identified as having Endangered Ecological Communities EEC and/or core vegetation or is a support to class 5 lands. Vegetation may not be connected to a major water courses but its status is valuable and supports core areas and retention should be maximised where possible.	Development applications involving disturbance or removal of vegetation may need to be accompanied by a comprehensive flora and fauna survey. Important vegetation corridors must be identified and adequate linkages maintained. Vegetation may be partially modified but should be retained where possible. Development assessment may specify vegetation to be retained for soil conservation and soil stability purposes. Where native vegetation is to be retained, restored or enhanced a Vegetation	• Areas of low quality Shale Sandstone Transition Forest, which is listed under listed as an endangered ecological community under the EPBC and TSC Acts, with a modified understorey and high degree of exotic cover. • Areas of high quality Shale Sandstone Transition Forest, which is listed under listed as an endangered ecological community under the EPBC and TSC Acts, but which are fragmented from core areas by clearing

WDCP Category	WDCP Category objectives	WDCP Description	WDCP Controls	Assessment of vegetation communities in the study area against Section 2.5.2 of the WDCP
			Management Plan must be prepared to the satisfaction of the Consent Authority.	or low quality vegetation with high degree of exotic cover.
2	To maintain corridor links. To improve environmental outcomes. To encourage conditions which improve soil, water and vegetation outcomes.	Disturbed vegetation with fragmented canopy/high exotic influence. This classification is for vegetation that may have some resilience but is already fragmented by development or land use.	A flora or fauna survey will only be required if the disturbance or removal of vegetation is likely to lead to landslip or soil instability and soil conservation measures could be required. Council may require measures to enhance the integrity of class 2 vegetation. Where native vegetation is to be retained, restored or enhanced a Vegetation Management Plan must be prepared to the satisfaction of the Consent Authority.	• Nil in study area
1	To maintain corridor links. To improve environmental outcomes. To encourage conditions which improve soil, water and vegetation outcomes.	Degraded linkages and opportunities - Grasslands/potential for supporting corridors. High exotic influence. This classification is where the vegetation is very degraded and there is little opportunity	Any development must specify measures to enhance the integrity of class 1 vegetation. Council may require measures to enhance the integrity of class 2 vegetation. Large developments may seek to enhance class 1 vegetation,	• Nil in study area

WDCP Category	WDCP Category objectives	WDCP Description	WDCP Controls	Assessment of vegetation communities in the study area against Section 2.5.2 of the WDCP
		for it to be a strategic link. It may however still have local significance and opportunities exist in its retention through recreational open space and this should be considered in developments. These areas may be worth retaining and complimenting with landscaping or revegetation as an offset for developments in that area.	through open space or grasslands that support core vegetation.	

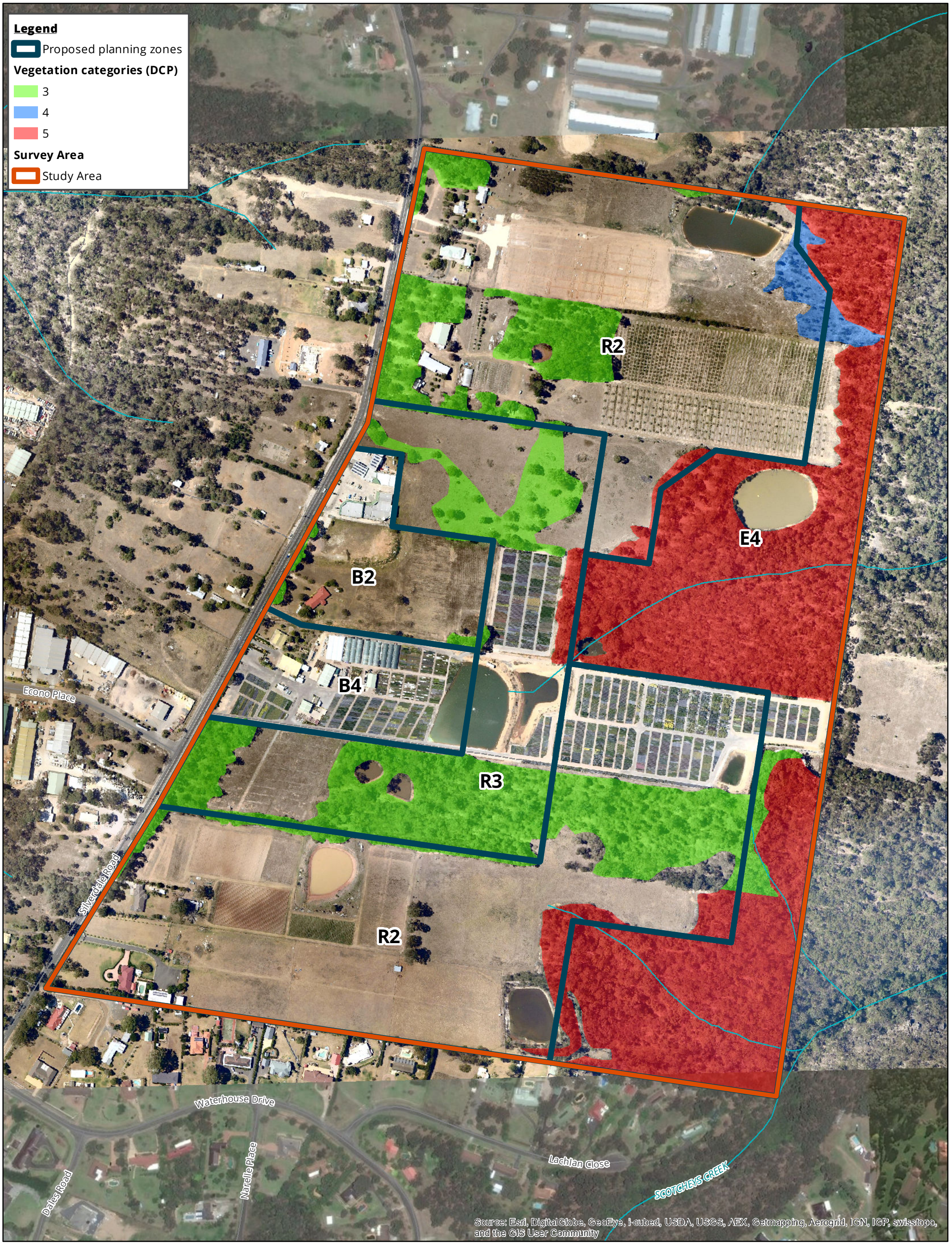

Figure 9: Vegetation categories (WDCP)

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Acknowledgements: Imagery (c) Nearmap 2012
Topo (c) NSW Land and Planning Information (2012)

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5. Ecological Constraints and Recommendations

This section identifies the potential implications of proposed rezoning on the ecological values of the study area and includes recommendations to assist in the design and development stages to minimise impacts on biodiversity.

Biosis has been advised that under the provisions of the Gateway determination conditions, the site has been identified as an Urban Release Area. Consequently, prior to any further subdivision of the site a development control plan (DCP) must be prepared. Table 9 provides a cross- reference checkpoint in the preparation of the DCP so that ecological matters raised in this assessment can be addressed.

Table 9: Potential implications of rezoning and recommendations to minimise ecological impact and long term management of biodiversity values.

Ecological feature (Figure 3 and Figure 4)	Implications of planning proposal	Recommendations for detailed design phase
Vegetation communities, including the EEC Shale Sandstone Transition Forest	Potential for removal of 11.48 hectares of Shale Sandstone Transition Forest and 0.01 hectares of Western Sandstone Gully Forest located in B2, B4, R3 and R2 zones. Protection of 8.84 hectares of Shale Sandstone Transition Forest and 5.6 hectares of Western Sandstone Gully Forest in E4 zone. Increased potential for weed invasion to retained areas.	Protect higher quality vegetation in the eastern section of the study area in an appropriate zone (this recommendation has been adopted with this area zoned E4). Retain native vegetation within any future development, where feasible to do so. Future development of the study area should be undertaken in an ecologically sustainable manner, including 'designing out' unnecessary impacts to identified features. Undertake comprehensive flora and fauna surveys for future development, including an assessment of the significance of impacts. Offset losses for all identified Class 4 and Class 5 vegetation that will be removed. Undertake soil translocation of areas of Shale Sandstone Transition Forest that will be removed into areas of the E4 zone that do not currently support native vegetation.
Known habitat for the Red-crowned Toadlet and	Protection of identified Red-crowned Toadlet habitat in E4 zone.	Retain native vegetation and natural stream structure within any future development, where feasible to do so.

Ecological feature (Figure 3 and Figure 4)	Implications of planning proposal	Recommendations for detailed design phase
Cumberland Land Snail	Potential impacts to Red-crowned Toadlet habitat from urban run-off, resulting in degradation of the waterway. Potential impacts to Red-crowned Toadlet habitat from activities permissible in E4 zone (e.g. grazing of livestock). Potential removal of Cumberland Plain Land Snail in B2, B4, R3 and R2 zones.	Future development of the study area should be undertaken in an ecologically sustainable manner, including 'designing out' unnecessary impacts to identified features, such as the control of urban run-off. Exclude stock from identified Red-crowned Toadlet breeding habitat (Figure 4). Exclude and or manage stock to ensure the retention of key habitat resources for the Cumberland Plain Land Snail, including native ground covers, leaf litter and woody debris accumulations within the mapped Shale Sandstone Transition Forest. Targeted surveys for Cumberland Plain Land Snail are recommended for any proposed development where the removal of Shale Sandstone Transition Forest can not be avoided. Any identified individuals should be relocated to adjacent suitable habitat.
Potential habitat for threatened fauna species	Potential removal of 11.49 hectares of native vegetation which provides habitat for a range of threatened species. Retention of feeding habitat for the Glossy Black-Cockatoo in E4 zone. Increased risk of impacts to threatened species from urbanization, including collision risk, mortality due to attack by domestic pets etc. Degradation of retained habitat.	Retain native vegetation and natural stream structure within any future development, where feasible to do so. Future development of the study area should be undertaken in an ecologically sustainable manner, including 'designing out' unnecessary impacts to identified features. Fences should not include barbed wire due to the risk of entanglement. Ensure use of appropriate signage to warn drivers of local fauna.
Hollow-bearing trees	Retention of identified hollow-bearing trees in E4 zone.	Retain all hollow-bearing trees within any future development, where feasible to do so.

Ecological feature (Figure 3 and Figure 4)	Implications of planning proposal	Recommendations for detailed design phase
		Exclude and or manage stock to ensure the retention and ongoing health of hollow-bearing trees. Where the removal of hollow-bearing trees can not be avoided a qualified ecologist will be required to manage fauna species during vegetation removal process.
Potential Koala habitat	Potential removal of 5.8 hectares of Potential Koala habitat in development zones B2, B4, R3 and R2 Retention of 9.71 hectares of potential Koala habitat in E4 zone. Increased risk of impacts to Koalas from urbanization, including collision risk, mortality due to attack by domestic pets etc.	Retain all mapped potential habitat and native vegetation corridors within any future development, where feasible to do so. Where the removal of mapped potential habitat and native vegetation corridors is unavoidable, targeted Koala surveys should be undertaken using the Spot Assessment Technique. Enforce that all domestic pets are excluded from native vegetation corridors, and where exclusion is impractical, disallow the provision of 'off leash' areas within these vegetated areas. Ensure use of appropriate signage to warn drivers of local fauna.
First order streams connected to Nepean River	Degradation of waterways due to urban runoff.	Avoid development and clearing through waterways as far as possible. Reduce erosion and associated sedimentation of waterways through the retention and improvement of current water storage facilities within the study area, the construction of mounds and swales to divert runoff and use of settlement ponds and silt fencing.
Fauna connectivity	Minimal decreases in east-west connectivity through the site for small mammals and invertebrates.	Habitat corridors along the eastern boundaries should be retained to provide for fauna connectivity throughout the landscape. These corridors should be as wide as possible, with a minimum width of retained vegetation of 50 m.

The results of this flora and fauna assessment have been used to inform the concept plan (Figure 2) for a proposed rezoning and future development of the subject site. The principal means to reduce impacts on biodiversity values within the study area will be to avoid and minimise removal of native vegetation and habitat. Further consideration of biodiversity values should be considered in any future Development Application with the objective of long term sustained improved outcome. In addition to designing out impacts and designing in improved outcomes for biodiversity values, further assessments of terrestrial biodiversity values will be required once detailed design is completed. It is at this stage the extent of potential impacts can be thoroughly assessed and minor amendments made or additional actions proposed to minimises or mitigate impacts to terrestrial biodiversity values.

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Appendices

Appendix 1: Flora

Flora species recorded from the subject site

EPBC Act: CR - Critically Endangered EN - Endangered VU - Vulnerable	**TSC Act:** C1 – critically endangered (Part 1, Schedule 1A) E1 – endangered (Part 1, Schedule 1) E2 – endangered (Part 1, Schedule 1) E4 – presumed extinct (Part 4, Schedule 1) V1 – vulnerable (Part 1, Schedule 2)
General status: + Characteristic species for TEC's ✓ Presence only	**Noxious weed status:** N1 State prohibited species (Class 1) N2 Regionally prohibited species (Class 2) N3 Regionally controlled species (Class 3) N4 Regionally restricted species (Class 4) N5 Restricted plant (Class 5)

Flora within this table are listed in alphabetic order and divided into Indigenous and Introduced species. Please note that the data collected by Mills (2011) on Lot 200 DP 1092447 has also been included in a separate column in Table 10 below.

Table 10: Flora species recorded from the subject site

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
Indigenous species						
	Acacia binervia	Coast Myall	✓			✓
	Acacia brownii	Heath Wattle				✓
	Acacia decurrens	Black Wattle				✓
	Acacia elongata	Swamp Wattle				✓
	Acacia falcata		+			✓
	Acacia fimbriata	Fringed Wattle	✓			
	Acacia floribunda	White Sally				✓
	Acacia implexa	Hickory Wattle	+			✓
	Acacia longifolia					✓
	Acacia parramattensis	Parramatta Wattle	+		✓	✓
	Acacia sp	Wattle	✓			
	Acacia trinervata	Three-veined Wattle	✓			✓
	Acacia ulicifolia	Prickly Moses	✓			✓
	Acianthus fornicatus	Pixie Caps				✓
	Adiantum aethiopicum	Common Maidenhair				✓
	Allocasuarina littoralis	Black She-Oak	+	✓		

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Allocasuarina torulosa	Forest Oak				✓
	Angophora costata	Sydney Red Gum	+			✓
	Anisopogon avenaceus	Oat Speargrass	✓	✓		
	Aristida vagans	Threeawn Speargrass	+		✓	✓
	Astroloma humifusum	Native Cranberry				✓
	Babingtonia virgata					✓
	Backhousia myrtifolia	Grey Myrtle		✓		
	Billardiera scandens	Hairy Apple Berry	✓			✓
	Bossiaea obcordata	Spiny Bossiaea				✓
	Bossiaea prostrata					✓
	Breynia oblongifolia	Coffee Bush	✓			✓
	Brunoniella australis	Blue Trumpet	✓			✓
	Bursaria spinosa subsp. spinosa	Native Blackthorn	+		✓	✓
	Calotis cuneifolia	Purple Burr-Daisy	+			
	Cassinia aculeata	Dolly Bush				✓
	Centella asiatica	Indian Pennywort				✓
	Cerastium fontanum					✓
	Cheilanthes sieberi	Rock Fern	+			✓

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Chloris truncata	Windmill Grass				✓
	Clerodendrum tomentosum	Hairy Clerodendrum				✓
	Corymbia eximia	Yellow Bloodwood	+	✓		
	Corymbia gummifera	Red Bloodwood	+	✓		✓
	Cymbopogon refractus	Barbed Wire Grass	+			✓
	Cynodon dactylon	Common Couch	✓			✓
	Daviesia ulicifolia	Gorse Bitter Pea	+			✓
	Desmodium rhytidophyllum					✓
	Desmodium varians	Slender Tick-trefoil	✓			
	Dianella caerulea	Blue Flax-lily	✓			✓
	Dianella revoluta	Blueberry Lily				✓
	Dichondra repens	Kidney Weed				✓
	Dillwynia phylicoides	Parrot-pea				✓
	Dodonaea triquetra	Large-leaf Hop-bush	+			
	Doodia aspera	Prickly Rasp Fern		✓		
	Echinopogon caespitosus	Bushy Hedgehog-grass				✓
	Echinopogon ovatus	Forest Hedgehog Grass	✓			
	Elaeocarpus reticulatus	Blueberry Ash				✓

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Eleocharis sphacelata	Tall Spike Rush				✓
	Entolasia marginata	Bordered Panic	✓			✓
	Entolasia stricta	Wiry Panic	+			✓
	Eragrostis brownii	Brown's Lovegrass	+			
	Eragrostis leptostachya	Paddock Lovegrass				✓
	Eucalyptus crebra	Narrow-leaved Ironbark	+			✓
	Eucalyptus eugenioides	Thin-leaved Stringybark	+			✓
	Eucalyptus fibrosa	Red Ironbark	+			
	Eucalyptus globoidea	White Stringybark	+	✓		
	Eucalyptus pilularis	Blackbutt	+			✓
	Eucalyptus piperita	Sydney Peppermint	✓			
	Eucalyptus punctata	Grey Gum	+			✓
	Eucalyptus resinifera	Red Mahogany				✓
	Eucalyptus tereticornis	Forest Red Gum	+			
	Euchiton sphaericus	Star Cudweed				✓
	Exocarpos cupressiformis	Cherry Ballart	+			✓
	Exocarpos strictus	Dwarf Cherry				✓

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Ficus rubiginosa	Port Jackson Fig		✓		
	Gahnia aspera	Rough Saw-sedge	✓		✓	
	Glochidion ferdinandi	Cheese Tree		✓		
	Glycine clandestina	Twining glycine	+			
	Glycine microphylla	Small-leaf Glycine				✓
	Glycine tabacina	Variable Glycine	✓			✓
	Gompholobium minus	Dwarf Wedge Pea				✓
	Gonocarpus teucrioides	Germander Raspwort				✓
	Goodenia hederacea	Ivy Goodenia	+			✓
	Grevillea mucronulata		+			✓
	Hardenbergia violacea	False Sarsaparilla	+			✓
	Hibbertia aspera	Rough Guinea Flower				✓
	Hibbertia diffusa	Wedge Guinea Flower	+			✓
	Hovea longifolia	Rusty Pods	✓			
	Hydrocotyle laxiflora	Stinking Pennywort				✓
	Hypericum gramineum	Small St John's Wort				✓
	Hypolepis muelleri	Harsh Ground Fern				✓
	Imperata cylindrica	Blady Grass				✓

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Isopogon anemonifolius	Broad-leaf Drumsticks	✓			
	Juncus usitatus				✓	✓
	Kennedia rubicunda	Dusky Coral Pea	✓			
	Keraudrenia corollata var. denticulata					✓
	Kunzea ambigua	Tick Bush	+			✓
	Lagenifera stipitata	Blue Bottle-daisy	✓			✓
	Laxmannia gracilis	Slender Wire Lily				✓
	Lepidosperma laterale	Variable Sword-sedge	+			✓
	Leptomeria acida	Sour Currant Bush		✓		
	Leptospermum polygalifolium	Tantoon	✓			✓
	Leptospermum trinervium	Slender Tea-tree		✓		✓
	Leucopogon muticus	Blunt Beard-heath	+	✓		✓
	Lindsaea microphylla	Lacy Wedge Fern		✓		
	Lissanthe strigosa	Peach Heath				✓
	Lomandra filiformis	Wattle Matt-rush				✓
	Lomandra longifolia	Spiny-headed Mat-rush				✓
	Lomandra multiflora	Many-flowered Mat-rush	✓			✓

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Lomandra obliqua		✓			✓
	Lomatia silaifolia	Crinkle Bush				✓
	Ludwigia peploides				✓	
	Melaleuca styphelioides	Prickly-leaved Tea Tree				✓
	Melaleuca thymifolia	Thyme Honey-myrtle				✓
	Melia azedarach	White Cedar	✓			✓
	Micrantheum ericoides		✓			
	Microlaena stipoides	Weeping Grass	+			✓
	Monotoca elliptica	Tree Broom-heath				✓
	Notelaea ovata		✓			✓
	Opercularia diphylla	Stinkweed				✓
	Ozothamnus diosmifolius	White Dogwood	+			✓
	Pandorea pandorana	Wonga Wonga Vine		✓		
	Panicum effusum	Hairy Panic				✓
	Panicum simile	Two-colour Panic	✓			
	Paspalum distichum	Water Couch				✓
	Passiflora herbertiana					✓
	Persicaria decipiens	Slender Knotweed				✓

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Persoonia linearis	Narrow-leaved Geebung	+	✓		✓
	Phyllanthus hirtellus	Thyme Spurge	+			✓
	Poa labillardierei	Tussock grass	+			
	Poa sieberiana	Snowgrass		✓		✓
	Podolobium ilicifolium	Prickly Shaggy Pea	✓			✓
	Pomaderris sp	Sublime Point Pomaderris	✓			
	Pomax umbellata	Pomax	+			✓
	Pratia purpurascens	Whiteroot	+			✓
	Pultenaea flexilis		+			
	Rytidosperma sp	Wallaby grass			✓	
	Sigesbeckia orientalis					✓
	Solanum americanum	Glossy Nightshade				✓
	Solanum brownii	Violet Nightshade	✓			
	Solanum pungetium	Eastern Nightshade				✓
	Stypandra glauca	Nodding Blue Lily		✓		✓
	Syncarpia glomulifera	Turpentine	+	✓		✓
	Tetrarrhena juncea	Wiry Ricegrass	✓			

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Themeda australis	Kangaroo Grass	+		✓	✓
	Veronica plebeia	Trailing Speedwell				✓
	Xanthorrhoea macronema		✓			
	Xanthorrhoea resinifera					✓
	Xylomelum pyriforme	Woody Pear				✓
	Zieria smithii	Sandfly Zieria		✓		
Introduced species						
	Ageratina adenophora	Crofton Weed	✓			✓
	Anagallis arvensis	Scarlet Pimpernel				✓
	Araujia hortorum					✓
	Aster subulatus	Wild Aster				✓
	Austrostipa sp					✓
	Axonopus fissifolius	Narrow-leafed Carpet Grass			✓	
	Bidens pilosa	Cobbler's Pegs				✓
	Brassica fruticulosa	Twiggy Turnip				✓
	Cirsium vulgare	Spear Thistle				✓
	Conyza sp					✓

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Eragrostis curvula	African Lovegrass	✓			✓
	Erythrina x sykesii	Coral tree				✓
	Gamochaeta sp	Cudweed				✓
	Gomphocarpus fruticosus	Narrow-leaved Cotton Bush			✓	
	Hypochaeris radicata	Catsear				✓
	Lantana camara	Lantana	✓		✓	✓
	Ligustrum lucidum	Large-leaved Privet	✓			
	Ligustrum sinense	Small-leaved Privet	✓			✓
	Lonicera japonica	Japanese Honeysuckle	✓			✓
	Myriophyllum aquaticum	Parrots Feather				✓
	Paspalum dilatatum	Paspalum	✓			✓
	Paspalum urvillei	Vasey Grass				✓
	Pennisetum clandestinum	Kikuyu Grass				✓
	Phytolacca octandra	Inkweed				✓
	Plantago lanceolata	Lamb's Tongues				✓
	Rumex crispus	Curled Dock				✓
N4	*Senecio madagascariensis*	Fireweed				✓

Status	Scientific name	Common name	Shale Sandstone Transition Forest	Western Sandstone Gully Forest	Acacia Scrub	Mills (2011)
	Setaria sp	Scrub Pigeon Grass			✓	
	Sida rhombifolia	Paddy's Lucerne				✓
	Solanum mauritianum	Wild Tobacco Bush				✓
	Sonchus asper subsp. *glaucescens*	Prickly Sowthistle				✓
	Tagetes minuta	Stinking Roger				✓
	Trifolium repens	White Clover				✓
	Verbena bonariensis	Purpletop			✓	✓

The following Table 11 includes a list of the threatened flora species that have potential to occur within the study area. The list of species is sourced from the BioNet Wildlife Atlas and the Protected Matters Search Tool (DE; accessed on 14/01/2014).

The criteria for determining the likelihood of occurrence for threatened biota are listed below.

Likelihood of occurrence	Potential criteria
High	• Species/ecological communities recorded in study area during current or previous assessment/s. • Sufficient good quality habitat is present in study area. • Study area is within species natural distributional range (if known). • Species has been recorded within 5 km or from the relevant catchment/basin.
Medium	• Records of terrestrial biota within 5 km of the study area or of aquatic species in the relevant basin/neighbouring basin. • Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	• No records within 5 km of the study area. • Marginal habitat present (low quality & extent). • Substantial loss of habitat since any previous record(s).
Negligible	• Habitat not present in study area • Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

The most recent record relates to:

species predicted to occur by the DoE database (not recorded on other databases)

species predicted to occur based on natural distributional range and suitable habitat despite lack of records in the databases searched

Year recorded on databases listed above

2014 recorded during current survey

Table 11: **Threatened flora species recorded, or predicted to occur, within 5km of the study area.**

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
Acacia bynoeana	Bynoe's Wattle	VU	E1	#	Low	Although habitat in the form of vegetation types and open sedges are present there are no records of the species in the search area.	*Acacia bynoeana* is found in central eastern NSW, in the following catchment regions – Hawkesbury/Nepean, Hunter/Central Rivers, Southern Rivers, and Sydney Metropolitan. More specifically it is found from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. It seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and recently burnt patches. It grows in sandy clay soils often containing ironstone gravels. Main vegetation types include heath or dry sclerophyll forest on sandy soils. Associated overstorey species include *Corymbia gummifera*, *Corymbia maculata*, *Eucalyptus parramattensis*, *Banksia serrata* and *Angophora bakeri*. Flowering period is mainly summer.
Allocasuarina		EN	E1	#	Low	Although habitat in	Found in the Hawkesbury/Nepean and Sydney

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
glareicola						the form of vegetation types is present the species distribution is highly restricted and there are no records of the species in the search area.	Metropolitan Catchment Authority Regions. Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil. Also found in Dry Sclerophyll forest/Woodland. Associated species include *Eucalyptus parramattensis*, *Eucalyptus fibrosa*, *Angophora bakeri*, *Eucalyptus sclerophylla* and *Melaleuca decora*. Common associated understorey species include *Melaleuca nodosa*, *Hakea dactyloides*, *Hakea sericea*, *Dillwynia tenuifolia*, *Micromyrtus minutiflora*, *Acacia elongata*, *Acacia brownei*, *Themeda australis* and *Xanthorrhoea minor*.
Asterolasia elegans		EN	E1	#	Low	Although habitat in the form of vegetation types is present the species is conspicuous and was not recorded in the surveys. Additionally there are no records of the species in the search area.	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford LGA. Known from only six populations in the catchments of the Colo and Hawkesbury Rivers, only one of which is wholly within a conservation reserve. Found in sheltered forests on mid- to lower slopes and valleys which support sheltered forest on Hawkesbury Sandstone. The canopy at known sites includes *Syncarpia glomulifera*, *Angophora costata*, *Eucalyptus piperita*, *Allocasuarina torulosa* and *Ceratopetalum gummiferum*. The species is considered to be fire sensitive and reliant on seed germination after disturbance to maintain populations. A soil seedbank appears to be established by this species,

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
							so for a number of years following fire or other disturbance the species may not be apparent, but be present only as seed in the soil. The size of the seedbank depends not only on the amount of seed contributed by mature plants each season, but on the level of dormancy of the seed which can vary from year to year. The longevity of each crop of seed in the soil is perhaps 5 - 10 years.
Cryptostylis hunteriana	Leafless Tongue Orchid	VU	V	#	Low	Although habitat in the form of vegetation types is present there are no records of the species in the search area.	This species typically grows in swamp-heath on sandy soils chiefly in coastal districts but has also been recorded on steep bare hillsides. Within the Central Coast bioregion, this species has been recorded within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland. This species does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by *Eucalyptus sclerophylla*, *E. sieberi*, *Corymbia gummifera* and *Allocasuarina littoralis*; appears to prefer open areas in the understorey of this community and is often found in association with the *Cryptostylus subulata*. It occurs in the following Catchment Management Regions Hawkesbury/Nepean, Hunter/Central Rivers, Northern Rivers and Southern Rivers. Inconsistent flowring times Dec-February; Jan-February (in Victoria)

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
Cynanchum elegans	White-flowered Wax Plant	EN	E1	#	Low	Although habitat in the form of vegetation types is present there are no records of the species in the search area.	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley. Catchment Management Regions include Hawkesbury/Nepean , Hunter/Central Rivers, Northern Rivers, Southern Rivers and Sydney Metropolitan. *Cynanchum elegans* usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; *Leptospermum laevigatum*, *Banksia integrifolia subsp. integrifolia*; *Eucalyptus tereticornis* open forest and woodland; *Eucalyptus maculata* open forest and woodland; and *Melaleuca armillaris* scrub to open scrub. Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific.
Epacris purpurascens var. purpurascens			V	1965/#	Medium	Shale Sandstone Transition Forest provides preferred habitat for this species including vegetation associations and soil types.	Located in the Hawkesbury/Nepean, Hunter/Central Rivers/and Sydney Metropolitan catchment authority region - from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South.
Eucalyptus benthamii	Camden White Gum	VU	V	2006/#	Negligible	The study area does not provide preferred	Known from two main locations: Bents Basin and Kedumba Valley. A few scattered individuals are

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
						habitat for the species.	recorded from other sites on the sandy alluvial flats of the Kedumba/Cox/Nepean River system. Occurs only in wet open forest on sandy alluvial soils along valley floors at an elevation of 140-750 m. The soils are shallow to moderately deep and are well drained alluvial sands and gravels along stream channels, small terraces and alluvial flats. Restricted but locally abundant.
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea		V	1915/#	Low	Although habitat in the form of vegetation types is present and there is one record to the north, the species mainly occurs on lower lying areas of the Cumberland Plain.	It's distribution is centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town. It is found on clay soils in open forest on the Cumberland Plain.
Haloragis exalata subsp. exalata	Square Raspwort	VU	V	#	Low	Although habitat in the form of vegetation types is present there are no records of the species in the search area.	Square Raspwort is known from a few scattered locations in south-eastern NSW including the Nepean River (near Sydney), Lake Illawarra, the Wallaga Lake - Tilba area and the Geehi Valley in Kosciuszko National Park. There are isolated records from northern NSW (Mt Kaputar National Park and Tuggolo State Forest). It also occurs in Victoria. Square Raspwort occurs in damp places near watercourses. It regenerates only from seed. The species appears to be favoured by soil disturbance.

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
Melaleuca deanei	Deane's Paperbark	VU	V	#	Low	Although habitat in the form of vegetation types is present the species is conspicuous and was not recorded in the surveys. Additionally there are no records of the species in the search area.	*Melaleuca deanei* occurs in Catchment Management Regions Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan. Distinctly it occurs in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. The species grows in wet heath on sandstone and Dry Sclerophyll Forests. Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate.
Pelargonium sp. Striatellum (G.W.Carr 10345)	Omeo Stork's Bill	EN		#	Negligible	The study area does not provide preferred habitat for the species.	*Pelargonium sp. Striatellum (G.W.Carr 10345)* is a tufted perennial herb. It has a basal leaf rosette and leafy flowering stems which grow to 15 cm tall, with fleshy and often extensively branched rhizomes giving rise to individual plants (ramets) in clonal colonies. The species is known to occur in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. *Pelargonium sp. Striatellum (G.W.Carr 10345)* occurs within the South Eastern Highlands and South East Corner IBRA Bioregions and the Hawkesbury-Nepean, Murrumbidgee, Southern Rivers and North East Natural Resource Management Regions.
Persoonia acerosa	Needle Geebung	VU	V	#	Low	Although habitat in the form of	The Needle Geebung has been recorded only on the central coast and in the Blue Mountains, from Mt

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
						vegetation types is present the species is conspicuous and was not recorded in the surveys. Additionally there are no records of the species in the search area.	Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba, Wentworth Falls, Springwood area. The Needle Geebung occurs in dry sclerophyll forest, scrubby low-woodland and heath on low fertility soils.
Pimelea curviflora var. curviflora		VU	V	#	Low	Although habitat in the form of vegetation types is present the species is restricted to the hills and plateaus to the north east of the Cumberland Plain. Additionally there are no records of the species in the search area.	Occurring in Hawkesbury/Nepean and Sydney Metropolitan Catchment Authority Areas. Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Occurs on lateritic soils and shale-sandstone transition soils on ridge tops in woodland. Associated with Dry Sclerophyll forests and Coastal valley grassy woodlands. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots. Flowers October to May.
Pimelea spicata	Spiked Rice-flower	EN	E1	#	Negligible	The study area does not provide preferred habitat for the species.	Once widespread on the Cumberland Plain, *Pimelea spicata* occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Catchment areas are Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan Catchment.

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
							In western Sydney, *P. spicata* occurs on an undulating topography of substrates derived from Wianamatta Shale in areas supporting, or that previously supported, the Cumberland Plain Woodland Vegetation Community. Associated species include: *Eucalyptus moluccana*, *E. tereticornis*, *E.crebra*, *Bursaria spinosa*, and *Themeda australis*. In the Illawarra region, *P. spicata* is found in open woodland and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include *Eucalyptus tereticornis*, *E. eugenioides*, *Themeda australis*, and *Lomandra longifolia*. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a more well developed shrub and grass understorey. *Pimelea spicata* flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for *P. spicata* vary. Rye (1990) noted flowering period as May - January; Benson and McDougall (2001) noted peak flowering period as March/ April.
Pomaderris brunnea	Brown Pomaderris	VU	V	#	Low	Although habitat in the form of vegetation types is present the species is conspicuous and was not recorded in the	*Pomaderris brunnea* is found in a very limited area around the Nepean and Hawkesbury Rivers, including the Bargo area. Occurs in the Central West, Hawkesbury/Nepean, Hunter/Central Rivers Catchments. Occurs on clay & alluvial soils. In the Hawkesbury/Nepean region, the species is known to

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
						surveys. Additionally there are no records of the species in the search area and the study area does not support the preferred habitat of alluvial flats.	be associated with Dry sclerophyll forests (Cumberland, Upper Riverina, Sydney Coastal, Sydney Hinterland, Sydney Sand Flats), Coastal Floodplain Wetlands and Coastal Valley Grassy Woodlands. Flowers appear in September and October.
Pterostylis saxicola	Sydney Plains Greenhood	EN	E1	#	Negligible	The study area does not provide preferred habitat for the species.	Restricted to western Sydney between Freemans Reach in the north and Picton in the south (Hawkesbury/Nepean and Sydney Metropolitan Catchment). Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. All species of Pterostylis are deciduous and die back to fleshy, rounded underground tuberoids. The time of emergence and withering has not been recorded for this species, however flowering occurs from October to December and may vary due to climatic conditions. The above ground parts of the plant whither and die following seed dispersal and the plant persists as a tuberoid until the next year.
Pultenaea glabra	Smooth Bush-Pea	VU	V	#	Negligible	The study area does not provide preferred	Found in dry sclerophyll forest on sandstone in the higher Blue Mountains and Glen Davis area. Grows

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
						habitat for the species. The species restricted to the Upper Blue Mountains.	above south facing escarpments of the main plateau and sometimes in forest with an open canopy and moist soil. Flowers September to November, fruit matures October to December.
Streblus pendulinus	Whalebone Tree	EN		#	Low	Although marginal habitat in the form of vegetation types is present the species is conspicuous and was not recorded in the surveys. Additionally there are no records of the species in the search area.	The species is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest).
Thelymitra kangaloonica		CE		#	Negligible	The study area does not provide preferred habitat for the species.	The Kangaloon Sun-orchid is a terrestrial orchid, with a flower stem growing to 56 cm high. The narrow fleshy leaf grows to 35 cm long, and has a purplish base. The plant produces two to 15 dark blue flowers with darker longitudinal veins. The Kangaloon Sun-orchid is endemic to New South Wales, and is known from three locations near Robertson in the Southern Highlands.

Appendix 2: Fauna

Below is a list (Table 12) of fauna species recorded from the study area during the present assessment including some common species not recorded but with a high probability to utilise the study area based on the number of database records for the locality. Table 13 is a list of threatened fauna species recorded or predicted to occur within 10km of the study area.

Notes to tables:

EPBC Act:	**TSC Act:**
EX - Extinct	C1 – critically endangered
CR - Critically Endangered	E1 – endangered (Part 1, Schedule 1)
EN - Endangered	E2 – endangered (Part 2, Schedule 1)
VU - Vulnerable	E4 – presumed extinct (Part 4, Schedule 1)
CD - Conservation dependent	V1 – vulnerable (Part 1, Schedule 2)

* - introduced species

Fauna species in these tables are listed in alphabetical order within their taxonomic group. Please note that the data collected by Mills (2011) on Lot 200 DP 1092447 has also been included in a separate column in Table 12 below.

Table 12: Vertebrate fauna species recorded from the study area

Status	Scientific Name	Common Name	Biosis survey	Observation type	Mills (2011)
Amphibians					
	Crinia signifera	Common Eastern Froglet			+
	Limnodynastes tasmaniensis	Spotted Grass Frog	+	Heard	
V1	*Pseudophryne australis*	Red-crowned Toadlet			+
Birds					
	Acanthiza lineata	Striated Thornbill			+
	Anas gracilis	Grey Teal			+
	Anas superciliosa	Pacific Black Duck			+
	Anthochaera carunculata	Red Wattlebird			+
	Aythya australis	Hardhead	+	Seen	+
	Chenonetta jubata	Australian Wood Duck	+	Seen	
	Colluricincla harmonica	Grey Shrike-thrush			+
	Cormobates leucophaea	White-throated Treecreeper			+

Status	Scientific Name	Common Name	Biosis survey	Observation type	Mills (2011)
	Corvus coronoides	Australian Raven			+
	Cracticus tibicen	Australian Magpie	+	Seen	+
	Cracticus torquatus	Grey Butcherbird			+
	Dacelo novaeguineae	Laughing Kookaburra	+	Seen	+
	Eolophus roseicapillus	Galah			+
	Eopsaltria australis	Eastern Yellow Robin			+
	Fulica atra	Eurasian Coot	+	Seen	
	Grallina cyanoleuca	Magpie-lark			+
	Hirundo neoxena	Welcome Swallow	+	Seen	+
	Lichenostomus chrysops	Yellow-faced Honeyeater			+
	Manorina melanocephala	Noisy Miner	+	Seen	+
	Manorina melanophrys	Bell Miner	+	Seen	+
	Ocyphaps lophotes	Crested Pigeon	+	Seen	
	Pardalotus punctatus	Spotted Pardalote			+
	Phalacrocorax varius	Pied Cormorant	+	Seen	
	Phaps chalcoptera	Common Bronzewing			+
	Platycercus elegans	Crimson Rosella			+
	Psophodes olivaceus	Eastern Whipbird	+	Heard	
	Rhipidura albiscapa	Grey Fantail			+
	Rhipidura leucophrys	Willie Wagtail	+	Seen	
	Strepera graculina	Pied Currawong			+
	Tachybaptus novaehollandiae	Australasian Grebe	+	Seen	+
	Threskiornis spinicollis	Straw-necked Ibis			+
	Trichoglossus haematodus	Rainbow Lorikeet			+
	Vanellus miles	Masked Lapwing	+	Seen	+
Mammals					
	*Bos Taurus**	European cattle			+
	Canis lupus dingo	Dingo	+	Seen	
	Chalinolobus morio	Chocolate Wattled Bat			+
	*Felis catus**	Cat			+

Status	Scientific Name	Common Name	Biosis survey	Observation type	Mills (2011)
	Macropus giganteus	Eastern Grey Kangaroo	+	Seen	+
	Macropus robustus	Common Wallaroo	+	Seen	+
	Petaurus breviceps	Sugar Glider			+
	Pseudocheirus peregrinus	Common Ringtail Possum			+
	Tachyglossus aculeatus	Short-beaked Echidna			+
	Vombatus ursinus	Common Wombat	+	Burrows	
	Wallabia bicolor	Swamp Wallaby	+	Seen	+
Reptiles					
	Lampropholis delicata	Dark-flecked Garden Sunskink			+
	Pseudechis porphyriacus	Red-bellied Black Snake			+
Molluscs					
E1	*Meridolum corneovirens*	Cumberland Plain Land Snail			+

Table 13 includes a list of the significant fauna species that have potential to occur within the study area. The list of species is sourced from the BioNet Wildlife Atlas, BirdLife Australia data search and the Protected Matters Search Tool (DE; accessed on 14/01/2014).

The criteria for determining the likelihood of occurrence for threatened biota are listed below.

Likelihood of occurrence	Potential criteria
High	• Species recorded on site during current or previous assessment/s. • Aquatic species recorded from connected waterbodies in close proximity to the site during current or previous assessment/s. • Sufficient good quality habitat is present on site or in connected waterbodies in close proximity to the site (aquatic species). • Site is within species natural distributional range (if known). • Species has been recorded within 5 km or from the relevant catchment/basin.
Medium	• Records of terrestrial species within 5 km of the site or of aquatic species in the relevant basin/neighbouring basin. • Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	• No records within 5 km of the site or for aquatic species, the relevant basin/neighbouring basin. • Marginal habitat present (low quality & extent). • Substantial loss of habitat since any previous record(s).
Negligible	• Habitat not present on site • Habitat for aquatic species not present in connected waterbodies in close proximity to the site. • Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

The most recent record relates to:

species predicted to occur by the DSEWPaC database (not recorded on other databases)

species predicted to occur based on natural distributional range and suitable habitat despite lack of records in the databases searched

Year recorded on databases listed above

2014 recorded during current survey

Table 13: Threatened fauna species recorded, or predicted to occur, within 5 km of the study area.

Scientific Name	Common Name	EPBC Act	TSC Act	Most Recent Record	Likelihood of Occurrence	Rationale for Likelihood	Habitat Description
Amphibian							
Heleioporus australiacus	Giant Burrowing Frog	VU	V	2006/#	Low	No suitable breeding habitat or foraging swamp habitat found on the site.	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks. Can also occur within shale outcrops within sandstone formations. Known from wet and dry forests and montane woodland in the southern part range. Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water. Spends the majority of its time in non-breeding habitat 20-250m from breeding sites.
Litoria aurea	Green and Golden Bell Frog	VU	E1	#	Negligible	Study area does not support suitable breeding or foraging habitat. Species has rarely been found in	Most existing locations for the species occur as small, coastal, or near coastal populations, with records occurring between south of Grafton and northern VIC. The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes.

						inland areas, particularly of greater Western Sydney. There are no recent records from the locality.	Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks, although the species has also been recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land. Breeding usually occurs in summer. Tadpoles, which take approximately 10-12 weeks to develop, feed on algae and other vegetative matter. Adults eat insects as well as other frogs, including juveniles of their own species.
Litoria littlejohni	Littlejohn's Tree Frog	VU	V	#	Low	The study area does not provide preferred habitat for the species as all drainage lines present on the site are ephemeral. No breeding habitat present. The species may be found to the east of the study area in more suitable habitat.	The species is distributed along the eastern slopes of the Great Dividing Range from Watagan State Forest near Wyong, south to Buchan in north-eastern VIC. It is not known from coastal habitats. Occurs in wet and dry sclerophyll forests and heath communities associated with sandstone outcrops between 280 and 1000 m. Littlejohn's Tree Frog prefers permanent and semi-permanent rock flowing streams, but individuals have also been collected from semi-permanent dams with some emergent vegetation. Forages both in the tree canopy and on the ground, and has been observed sheltering under rocks on high exposed ridges during summer. The species breeds in autumn but will also breed after heavy rainfall in spring and summer. The species has been recorded calling in all seasons with variously reported peak calling periods. Eggs are laid in loose gelatinous masses attached to submerged twigs; eggs and tadpoles are most often recorded in slow-flowing pools that receive extended exposure to sunlight.

Pseudophryne australis	Red-crowned Toadlet		V	2011	Recorded	Recorded previously on the site by Mills (2011). The study area supports suitable breeding habitat in ephemeral drainage lines adjacent to the eastern boundary of the study area, as mapped in Figure 4.	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks characterised by a series of shallow pools that feed into larger semi-perennial streams. Breeds all year round.
Birds							
Anthochaera phrygia	Regent Honeyeater	EN	E4A	2009/#	Low	Although this species may be a rare visitor through opportunistic foraging and/or dispersal through the landscape, the study area does not support key habitat components for the species.	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises: *E. microcarpa*, *E. punctata*, *E. polyanthemos*, *E. mollucana*, *Corymbia robusta*, *E. crebra*, *E. caleyi*, *C. maculata*, *E. mckieana*, *E. macrorhyncha*, *E. laevopinea* and *Angophora floribunda*. Nectar and fruit from the mistletoes *A. miquelii*, *A. pendula*, *A. cambagei* are also eaten during the breeding season. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and sheoaks. Also nest in mistletoe haustoria. An open cup-shaped nest is constructed of bark, grass, twigs and wool by the female.
Botaurus poiciloptilus	Australasian Bittern	EN	E1	#	Low	The study area provides no potential breeding habitat for species, and very limited foraging	The Australasian Bittern is distributed across south-eastern Australia. Often found in terrestrial and estuarine wetlands, generally where there is permanent water with tall, dense vegetation including *Typha spp.*

						habitat within the Study area's aquatic habitats.	and *Eleoacharis spp.* Typically this bird forages at night on frogs, fish and invertebrates, and remains inconspicuous during the day. The breeding season extends from October to January with nests being built amongst dense vegetation on a flattened platform of reeds.
Callocephalon fimbriatum	Gang-gang Cockatoo		V, E2	2007	High	The study area supports suitable foraging habitat for this species. Suitable breeding hollows are highly restricted to the eastern section of the study area, as mapped in Figure 4.	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	2005	High	The study area supports abundant food resources throughout the eastern portion of the site. Mills (2011) identified the presence *Allocasuarina* cones which had displayed evidence of foraging cockatoos. There is a high likelihood that he feeding species was the Glossy Black-Cockatoo however this could of be from feeding by other	Inhabits forest with low nutrients, characteristically with key Allocasuarina species. Tends to prefer drier forest types. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead.

						species such as the Yellow-tailed Black-Cockatoo.	
Chthonicola sagittata	Speckled Warbler		V	1993	Medium	Good quality key habitat components can be found within the woodlands habitats in the eastern section of the study area.	This species occurs in eucalypt and cypress woodlands on the hills and tablelands of the Great Dividing Range. They prefer woodlands with a grassy understorey, often on ridges or gullies. The species is sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. They forage on the ground and in the understorey for arthropods and seeds. Home ranges vary from 6-12 hectares.
Daphoenositta chrysoptera	Varied Sittella		V	2006	Medium	Although there are recent records of this species from the locality, the study area has a lower prevalence of rough-barked trees, a known key habitat component for this species.	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature Eucalypts. The Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.
Ephippiorhynchus asiaticus	Black-necked Stork		E1	1994	Low	Although this species may be a rare visitor through opportunistic foraging and/or dispersal through the landscape, the study area does not support	Found in swamps, mangroves and mudflats. Can also occur in dry floodplains and irrigated lands and occasionally forages in open grassy woodland. Nests in live or dead trees usually near water.

						key habitat components for the species.	
Glossopsitta pusilla	Little Lorikeet		V	2005	Medium	This nomadic species may visit the study area on occasion to forage when feed trees are flowering.	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.
Hieraaetus morphnoides	Little Eagle		V	BA/#	Low	This species prefers lightly wooded areas. Study area supports only marginal habitat.	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests.
Ixobrychus flavicollis	Black Bittern		V	1995	Low	The study area provides no potential breeding habitat for species, and very limited foraging habitat within the Study area's aquatic habitats.	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black Bittern typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water.
Lathamus	Swift Parrot	EN	E1	#	Low	Although this species	The Swift Parrot occurs in woodlands and forests of

discolor						may be a rare visitor through opportunistic foraging and/or dispersal through the landscape, the study area does not support key habitat components for the species.	NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis*. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.
Lophoictinia isura	Square-tailed Kite		V	2005	Low	Although this species may occur on occasion and forage within the study area, the study area does not support significant habitat for this species	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia*, *Corymbia maculata*, *E. elata*, or *E. smithii*. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.
Ninox connivens	Barking Owl		V	BA/#	Medium	This species may utilize Woodland habitats within the Study area through opportunistic foraging and/or dispersal through the landscape. The study	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country. Territories are typically 2000 ha in NSW habitats.

						area does not however support any suitable breeding habitat for the species.	
Ninox strenua	Powerful Owl		V	2006	Low	This species may utilize Woodland habitats within the Study area through opportunistic foraging and/or dispersal through the landscape. The study area does not however support any suitable breeding habitat for the species.	The Powerful Owl occupies wet and dry eucalypt forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm. It has a large home range of between 450 and 1450 ha.
Pandion cristatus	Osprey		V	BA/#	Low	The study area does not support suitable habitat. This species is largely restricted to coastal waters and large waterbodies and has recently been recorded to the west of the Study area at Warragamba Dam.	Found in coastal waters, inlets, estuaries and offshore islands. Occasionally found 100 km inland along larger rivers. It is water-dependent, hunting for fish in clear, open water. The Osprey occurs in terrestrial wetlands, coastal lands and offshore islands. It is a predominantly coastal species, generally using marine cliffs as nesting and roosting sites. Nests can also be made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.
Petroica phoenicea	Flame Robin		V	BA/#	Medium	The study area supports a number of key habitat features including open habitat and suitable	Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. The preferred habitat in summer includes moist

						perching structures for this species.	eucalyptus forests and open woodlands, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January.
Rostratula australis	Australian Painted Snipe	EN	E1	#	Negligible	The study area provides no potential breeding habitat for species, and very limited foraging habitat within the Study area's aquatic habitats.	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, ephemeral or permanent, although they have been recorded in brackish waters.
Stagonopleura guttata	Diamond Firetail		V	1990	Medium	Forages in open habitats amongst grassy woodlands. Suitable habitat restricted to open grassy woodlands on upper ridges.	Found in a range of habitat types including open eucalypt forest, mallee and acacia scrubs. Often occur in vegetation along watercourses.
Tyto novaehollandiae	Masked Owl		V	1995	Medium	This species may utilize Woodland habitats within the Study area through opportunistic foraging and/or dispersal through the landscape. The study area does not however support any suitable breeding habitat for the species.	The Masked Owl may be found across a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. It has mostly been recorded in open forests and woodlands adjacent to cleared lands. They nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. The nest hollows are usually located within dense forests or woodlands. Masked Owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet. It has a large home range of between 500 to 1000 ha.

Mammals							
Chalinolobus dwyeri	Large-eared Pied Bat	VU	V	2006/#	High	This species is likely to forage within the study area due to the ecotone between breeding / roosting habitat in sandstone areas to the east and west and more open foraging habitat within the study area. The study area does not support suitable breeding / roosting habitat.	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney Basin and Hunter Valley. Primarily found in dry sclerophyll forests and woodlands, but also found in rainforest fringes and subalpine woodlands. Forages on small, flying insects below the forest canopy. Roosts in colonies of between three and 80 in caves, Fairy Martin nests and mines, and beneath rock overhangs, but usually less than 10 individuals. Likely that it hibernates during the cooler months. The only known existing maternity roost is in a sandstone cave near Coonabarabran.
Dasyurus maculatus maculatus (SE mainland population)	Spotted-tailed Quoll	EN	V	#	Medium	This species is rarely observed, but is known to use drainage lines to move through the landscape. The study area is unlikely to support den sites, but the species may use drainage lines within the study area on occasion for foraging and disbursal.	Occurs along the east cost of Australia and the Great Diving Range. Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests. Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas. Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage. Seventy percent of the diet is medium-sized mammals, and also feeds on invertebrates, reptiles and birds. Individuals require large areas of relatively intact vegetation through which to forage. The home range of a female is between 180 and 1000 ha, while males have larger home ranges of between 2000 and 5000 ha. Breeding occurs from May to August.

Miniopterus australis	Little Bentwing-bat		V	2012	Medium	The study area provides foraging habitat for this species. No breeding habitat is present however.	Occurs from Northern Queensland to the Hawkesbury River near Sydney. Roost sites encompass a range of structures including caves, tunnels and stormwater drains. Young are raised by the females in large maternity colonies in caves in summer. Shows a preference for well timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests. The Little Bentwing bat forages for small insects (such as moths, wasps and ants) beneath the canopy of densely vegetated habitats.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		V	2012	High	The study area provides foraging habitat for this species. No breeding habitat is present however.	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways.
Mormopterus norfolkensis	Eastern Freetail-bat		V	2006	Medium	Suitable foraging and breeding habitat is present within the study area. This species is relatively rare in the landscape however.	Distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney. Most records are from dry eucalypt forests and woodland. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught foraging low over a rocky river within rainforest and wet sclerophyll forest habitats. The species generally roosts in hollow spouts of large mature eucalypts (including paddock trees), although individuals have been

							recorded roosting in the roof of a hut, in wall cavities, and under metal caps of telegraph poles. Foraging generally occurs within a few kilometres of roosting sites.
Myotis macropus	Southern Myotis		V	2012	Low	Although the species may overfly the study area suitable foraging and roosting habitat is not present within the study area.	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects.
Petrogale penicillata	Brush-tailed Rock-wallaby	VU	E1	1994/#	Medium	Although this species is rare in the landscape and declining, the study area and adjacent areas support key habitat components including steep slopes, rocky ledges and grassy areas.	Occurs along the Great Dividing Range south to the Shoalhaven, and also occurs in the Warrumbungles and Mt Kaputar. Habitats range from rainforest to open woodland. It is found in areas with numerous ledges, caves and crevices, particularly where these have a northerly aspect. Individuals defend a specific rock shelter, emerging in the evening to forage on grasses and forbs, as well as browse in drier months. Home sizes range from 2-30 ha.
Phascolarctos cinereus	Koala	VU	V	#	Medium	The study area supports *E.punctata* and is potential Koala habitat. It also falls within the Koala Linkage Corridor as identified in the *Priority Fauna Habitats for Species of Conservation Concern in the Greater Southern*	Pittwater LGA and Hawks nest: In NSW the Koala mainly occurs on the central and north coasts with some populations in the western region. Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include *Eucalyptus robusta*, *E. tereticornis*, *E. punctata*, *E. haemostoma* and *E. signata*. They are solitary with varying home ranges. In high quality habitat home ranges may be 1-2 ha and overlap, while in semi-arid country they are usually discrete and around 100 ha.

						Sydney Region (DECC 2007) which is displayed in Figure 8.	
Potorous tridactylus tridactylus	Long-nosed Potoroo	VU	V	#	Low	The study area lacks suitable high complexity habitat for this species. There are also no known records of the species within the locality,	Cobaki Lakes and Tweed Heads West population: Occurs from Queensland to Victoria, normally within 50 km of the coast. Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy. Known to eat fungi, arthropods, fleshy fruit, seeds and plant tissue. It is solitary and sedentary, buts tends to aggregate in small groups. It has two breeding seasons, one in late winter-early spring and the other in late summer. This species appears to benefit from a lack of recent disturbance.
Pseudomys novaehollandiae	New Holland Mouse	VU		#	Low	The study area lacks suitable high complexity habitat for this species. There are also no known records of the species within the locality,	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. The home range of the New Holland Mouse can range from 0.44 ha to 1.4 ha. The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals. The species is nocturnal and omnivorous, feeding on seeds, insects, leaves, flowers and fungi, and is therefore likely to play an important role in seed dispersal and fungal spore dispersal. It is likely that the species spends considerable time foraging above-ground for food, predisposing it to predation by native

							predators and introduced species. Breeding typically occurs between August and January, but can extend into autumn.
Pteropus poliocephalus	Grey-headed Flying-fox	VU	V	2005/#	Medium	The study area provides some foraging habitat for this species. No breeding habitat is present however. The closest known camp for the species is located 14.5km south of the study area at Brownlow Hill (DECCW 2010b).	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies (camps), commonly in dense riparian vegetation. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.
Scoteanax rueppellii	Greater Broad-nosed Bat		V	1995	Medium	Although no key foraging habitat is present within the study area, the species may utilize woodland and open forest habitats for opportunistic foraging and pipe hollows for potential roosting habitat.	Occurs along the Great Dividing Range, generally at 500 m but up to 1200 m, and in coastal areas. Occurs in woodland and rainforest, but prefers open habitats or natural or human-made openings in wetter forests. Often hunts along creeks or river corridors. Flies slowly and directly at a height of 30 m or so to catch beetles and other large, flying insects. Also known to eat other bats and spiders. Roosts in hollow tree trunks and branches.
Molluscs							
Meridolum corneovirens	Cumberland Plain Land Snail		E1	2006	Recorded	This species was previously recorded within the study area on Lot 200 DP 1092447 by Mills (2011). Suitable	Most likely restricted to Cumberland Plain, Castlereagh Woodlands and boundaries between River-flat Forest and Cumberland Plain Woodland. It is normally found beneath logs, debris and amongst accumulated leaf and bark particularly at the base of trees. May also use soil

						habitat is still present within the Woodland habitats of the Study area.	cracks for refuge.
Reptile							
Hoplocephalus bungaroides	Broad-headed Snake	VU	E1	#	Low	The study area does not support key habitat components for this species such as a lack of suitable shelter and basking rock platforms.	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer.

Table 14 lists EPBC Act listed migratory fauna species recorded or predicted to occur within 10 km of the study area and Includes records from the following sources:

- Atlas of NSW Wildlife.
- EPBC Act database (accessed on 14/01/14).
- BirdLife Australia data search.
- Current survey.

Bold denotes species recorded in the study area during the current assessment.

Table 14: Migratory fauna species recorded or predicted to occur within 10 km of the study area

Scientific Name	Common Name	Most Recent Record
Anthochaera phrygia	Regent Honeyeater	2009/#
Apus pacificus	Fork-tailed Swift	1987/#
Ardea ibis	Cattle Egret	2008/#
Ardea modesta	Eastern Great Egret	BA/#
Gallinago hardwickii	Latham's Snipe	#
Haliaeetus leucogaster	White-bellied Sea-Eagle	2012/#
Hirundapus caudacutus	White-throated Needletail	BA/#
Merops ornatus	Rainbow Bee-eater	2005/#
Monarcha melanopsis	Black-faced Monarch	BA/#
Monarcha trivirgatus	Spectacled Monarch	#
Myiagra cyanoleuca	Satin Flycatcher	#
Pandion cristatus	Osprey	BA/#
Rhipidura rufifrons	Rufous Fantail	2005/#