Glenlee Rezoning Proposal

Ecological Assessment

Prepared for
Michael Brown Planning Strategies

29/04/2016

DOCUMENT TRACKING

Item	Detail
Project Name	Glenlee Planning Proposal Rezoning
Project Number	13SYDPLA-0009
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Approved by	Steven Ward, Meredith Henderson (2016 update only)
Status	FINAL (Revised 2016)
Version Number	7
Last saved on	29 April 2016
Cover photo	Overview of proposed rezoning site. Photograph 1.5.2013 by Dr Steven Ward

This report should be cited as 'Eco Logical Australia 2013. *Glenlee Planning – Ecological Assessment*. Prepared for Michael Brown Planning Strategies.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Michael Brown Planning Strategies.

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Abbreviations

Abbreviation	Description
CEEC	Critically endangered ecological community
CPW	Cumberland Plain Woodland
DCP	Development Control Plan
EEC	Endangered ecological community
ELA	Eco Logical Australia Pty Ltd
EPBC Act	*Environment Protection & Biodiversity Conservation Act 1999*
ILP	Indicative Layout Plan
RFEF	River-flat Eucalypt Forest
TSC Act	NSW *Threatened Species Conservation Act 1995*

Executive summary

This report is an ecological assessment to support an application for rezoning of lands at Glenlee in south western Sydney. The site is 105 hectares, and is currently used for reject emplacement and coal storage, composting of organic materials, and a truck and storage facility.

An ecological assessment was undertaken in 2009 by Hayes Environmental for a larger study area which included additional lands to the north. This assessment provides an updated assessment for the narrower site area, based on the Ecological Constraints Analysis technique, which is an adaptation of methodology from Ian Perkins Consultancy Services and Aquila Ecological Surveys (2002).

Ecological Constraints Analysis provides a methodology for combining assessments of vegetation recovery potential, vegetation structure and threatened species habitat value to provide an indication of the overall ecological constraint. For the purposes of this assessment non-native vegetation was included as it may make some contribution to ecological connectivity.

Most of the site is disturbed, and the greater part of the site is cleared. Native vegetation is predominately confined to the riparian zone along the Nepean River, and a woodland area in the northwest of the site, which consists of 2.4 hectares of Cumberland Plain Woodland, a Critically Endangered Ecological Community (CEEC), and 6.5 hectares of River-flat Eucalypt Forest, an Endangered Ecological Community (EEC), both listed under the NSW *Threatened Species Conservation Act 1995*.

Cumberland Plain Woodland is also listed under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act) as '*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest'* but the vegetation on site does not meet the condition criteria under this legislation.

Also present on the site is African Olive dominated shrubland, exotic grassland, and exotic woodland, which covers 23.5 hectares in total.

There are three potential ecological corridors within the Glenlee site: (1) vegetation adjacent to Nepean River, (2) in the north of the site (between the Nepean River and the Australian Botanic Gardens), and (3) associated with the modified drainage line known as Caleys Creek.

The majority of the native vegetation present occurs within corridor 1 and there is potential to improve ecological connectivity for this corridor. From an ecological perspective it would be desirable to increase ecological connectivity between the Nepean River and the Australian Botanic Gardens either via corridor 2 or 3. Vegetation within corridor 2 is weed dominated and unlikely to be successfully revegetated to a Cumberland Plain vegetation community, it may be possible to provide some ecological connectivity. Corridor 3 is predominately exotic grassland, but there may be the potential for some increase in connectivity via site landscaping. The effectiveness of any works in this corridor would also be dependent on outcomes within the adjoining Menangle Park lands.

The Ecological Constraints Analysis process incorporated recovery potential, conservation significance, and the likelihood of use of vegetation by threatened species. Overall, the site contains 2.75 ha of vegetation within the high constraints class, 7.91 ha moderate, 0.1 ha low, and 21.93 ha very low.

The Indicative Layout Plan for the rezoning will retain over 83% of the sites total native vegetation. A total of 61% of areas mapped as high ecological constraint, 95% moderate, 2% low and 60% very low

will be retained. It is recommended that retained native vegetation adjacent to the Nepean River is to be rehabilitated with weed control and revegetation programs via a Vegetation Management Plan, and be considered for environmental protection zoning, or to have some form of conservation covenant.

1 Introduction

Eco Logical Australia Pty Ltd (ELA) was contracted by Michael Brown Planning Strategies to prepare an ecological assessment for proposed rezoning of lands at Glenlee in south-western Sydney (**Figure 1**).

Ecological assessment of this site and additional areas to the north was undertaken in 2008 by Hayes Environmental. Additional assessment is required to address a change in the proposed rezoning area and to address a number of factors required by the consent authorities, including:

- assessment of the conservation significance of vegetation on site; and,
- Camden Development Control Plan 2011 – Environmentally Sensitive Land.

The boundary of the proposed rezoning site has been altered since the earlier assessment was carried out with the overall area reduced. The current proposed rezoning site boundary is illustrated in **Figure 1**.

1.1 Study Area

The proposed rezoning site will be referred to herein as the study site and covers an area of approximately 105 hectares. The study site is located within both the Camden Local Government Area and the Campbelltown Local Government Area. The northern third of the site is within the Camden Local Government Area and the remaining southern section within the Campbelltown Local Government Area.

The study site is situated between the Nepean River and the Australian Botanic Gardens on the west and northeast respectively. The Spring Farm Material Resource Recovery Park operated by Sita is located to the north. The Menangle Park urban release area is located to the south and southeast of the study site with proposed rural lands immediately south and employment land to the east of the study site.

The study site is located within the Nepean River catchment, and drains in part to the east and to the south into a substantially modified drainage line (known as Caleys Creek) before entering the Nepean River. Most of the study area has been previously cleared and modified, with the following operations current:

- coal reject emplacement, coal stockpiling, truck and machinery maintenance and storage by Sada Services Pty Ltd
- composting and recycling of organic materials operated by Camden Soil Mix
- truck and machinery storage facility on a portion of the northern lands operated by TRN Group Earthmoving.

Native vegetation within the study site is confined primarily to that within the riparian zone adjacent to the Nepean River and an area of woodland regrowth in the northwest. Other vegetation within the site consists primarily of exotic grasslands used to stabilise sides of the emplacement area, dense African Olive shrubland, and two small areas of exotic woodland.

The native vegetation within the site falls into two vegetation communities, Cumberland Plain Woodland (CPW), a critically endangered ecological community (CEEC), and River-flat Eucalypt Forest (RFEF) an endangered ecological community. CPW is listed as a CEEC under both the Commonwealth

Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act) and the NSW *Threatened Species Conservation Act 1995* (TSC Act), while RFEF is listed under the TSC Act.

1.2 History of the Site

The utilisation of this site as a coal washery and emplacement area began in the 1950s, with the composting facility constructed in 1993. Prior to these activities beginning the area was used historically for dairy farming from the mid 1800s.

1.3 Compliance with Council Brief and Director General Requirements

The Director General Requirements (DGRs) for the Gateway Determination require that information regarding "flora, fauna and habitat" for the planning proposal is placed on public exhibition. This document provides the required information.

The Council brief identifies the following desired outcomes for the subject site relevant to ecological matters:

> *"Natural systems will be conserved and enhanced and provide habitat linkages between the Nepean River, Bush Corridor in Spring Farm and the Australian Botanic Gardens"*

This document identifies the areas which will be developed, and makes recommendations for the conservation of natural systems, and achievement of bush linkages where possible and feasible.

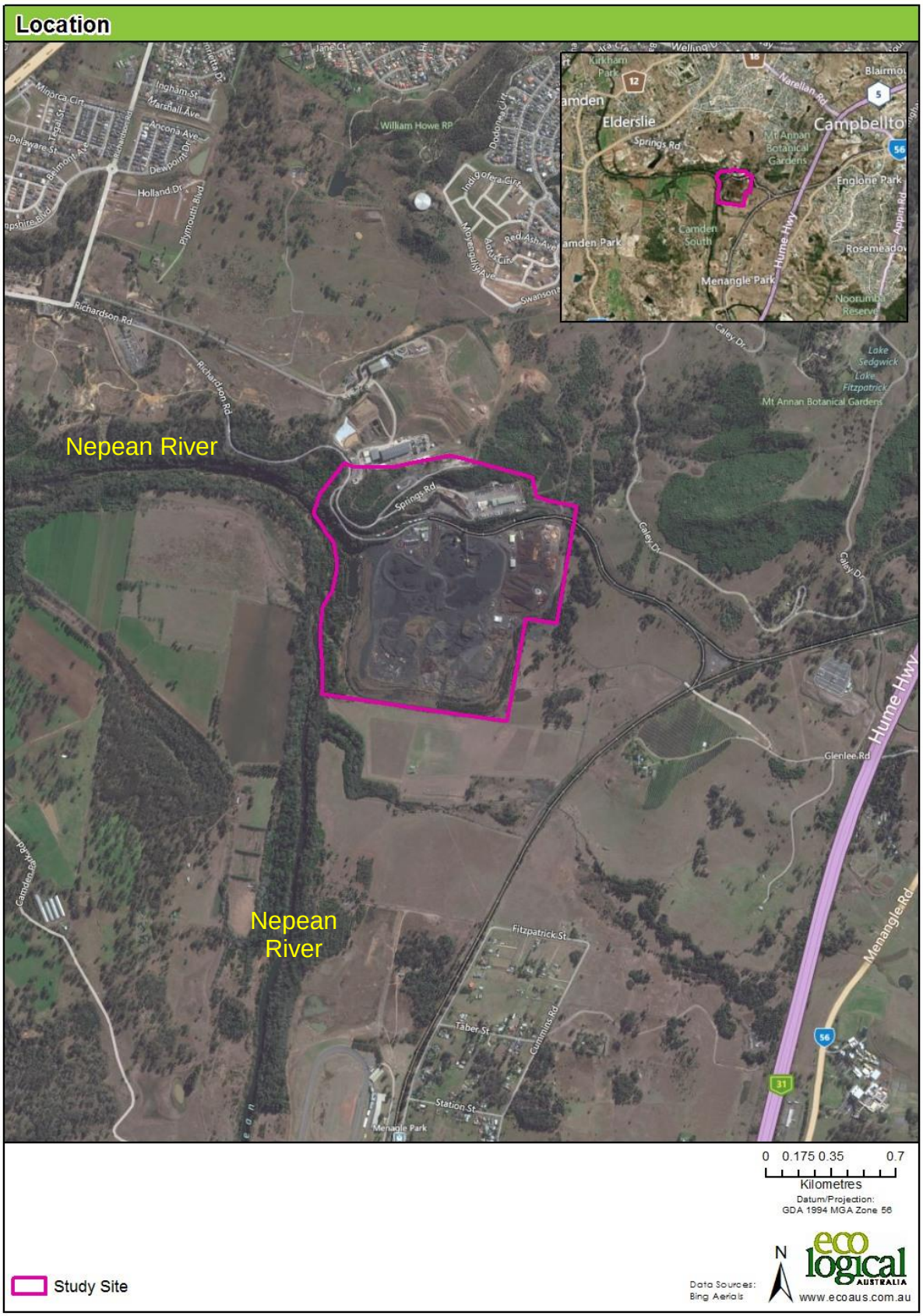

Figure 1. Glenlee Study Site and Location

2 Methods

2.1 Data and Literature Review

Database searches of the Atlas of NSW Wildlife and EPBC Act Online protected Matters Search Tool were conducted on 16th May 2013 using a 10km buffer around the study site, and updated search for the same area on 3rd March 2014.

The literature reviewed included:

- The Native Vegetation of the Cumberland Plain Western Sydney Mapping (NPWS, 2002);
- Glenlee Precinct Rezoning Industrial And Employment Lands Ecological Assessment (Hayes Environmental 2009);
- Menangle Park Flora, Fauna and Aquatic Assessments (ELA 2009);
- Significant plant species in western Sydney Urban Bushland Biodiversity Study (2007); and,
- Camden Council Development Control Plan 2011.

2.1.1 Camden Council Development Control Plan 2011

The *Camden Council Development Control Plan 2011* (DCP 2011) provides mapping of lands defined as *Environmentally Sensitive Land*.

This DCP provides a list of matters for which identification of adverse potential impacts must be addressed with any development application. These matters are:

- an endemic native vegetation community
- the existing habitat and potential habitat of any threatened species, populations or endangered ecological communities
- a regionally significant species of plant, animal or habitat
- an habitat corridor
- a wetland
- the biodiversity values within a reserve, including a road reserve or a stock route.

The DCP 2011 also has the following objectives:

1. Identify land within the Camden LGA that may be environmentally sensitive.
2. Ensure that the environmental sensitivity of such land is investigated when considering a development application.
3. Protect, manage, enhance and restore as much environmental sensitive land as possible.
4. Protect and enhance native vegetation for its aesthetic, cultural and heritage values and to retain the unique visual identity of the Camden landscape.
5. Maintain and enhance ecological processes necessary for the continued protection of environmental sensitivity land as well as encourage the recovery of threatened species, communities or populations and their habitat.
6. Ensure that all new development considers and maximises the protection of existing natural features at the site planning, design, development, construction and operation phases of the development.
7. Provide limited flexibility to achieve conservation outcomes through “green offsets”.

2.1.2 Ecological Assessment – Hayes Environmental 2008

A detailed ecological assessment was carried out by Hayes Environmental in 2008 as part of an original rezoning application. This study assessed an area which incorporated the current proposed rezoning site and an additional area to the north of the current proposal.

Of the area included in the earlier ecological assessment, Hayes (2009) described the site vegetation as

> *'Native vegetation is limited mainly to vacant lands in the northeast of the study area, and consists of poor quality regrowth woodland, with a high proportion of invasive woody weeds dominating the understorey.'*

2.1.3 Menangle Park Flora, Fauna and Aquatic Assessments - ELA 2009

This report and assessment was undertaken for Campbelltown City Council and Landcom as a technical component of a Local Environmental Study for the Menangle Park release area, which is adjacent to the southern and eastern boundaries of the Glenlee site and approximately 890 hectares in size. This Menangle Park study applied Ecological Constraint Analysis techniques, which have also been utilised in this study. The results of this study were also considered during the preparation of this report.

2.2 Conservation Significance Assessment and Ecological Constraints Analysis

ELA has conducted an Ecological Constraint Analysis, a stepped analysis of the ecological values of the site, across all vegetated areas within the study site at Glenlee. This methodology provides a total measure of the site's ecological values, and includes measurement of:

- rarity of a vegetation community;
- structural condition of the vegetation remnants;
- type and severity of disturbances;
- connectivity between remnants both on and off site;
- size of the vegetation remnant; and,
- value of the remnant as threatened species habitat.

The steps involved in this type of ecological assessment are illustrated in the flowchart in **Figure 1**. NPWS conservation significance assessment maps, threatened species assessment and field survey work are combined to determine the relative level of ecological value and constraint across the proposed rezoning site.

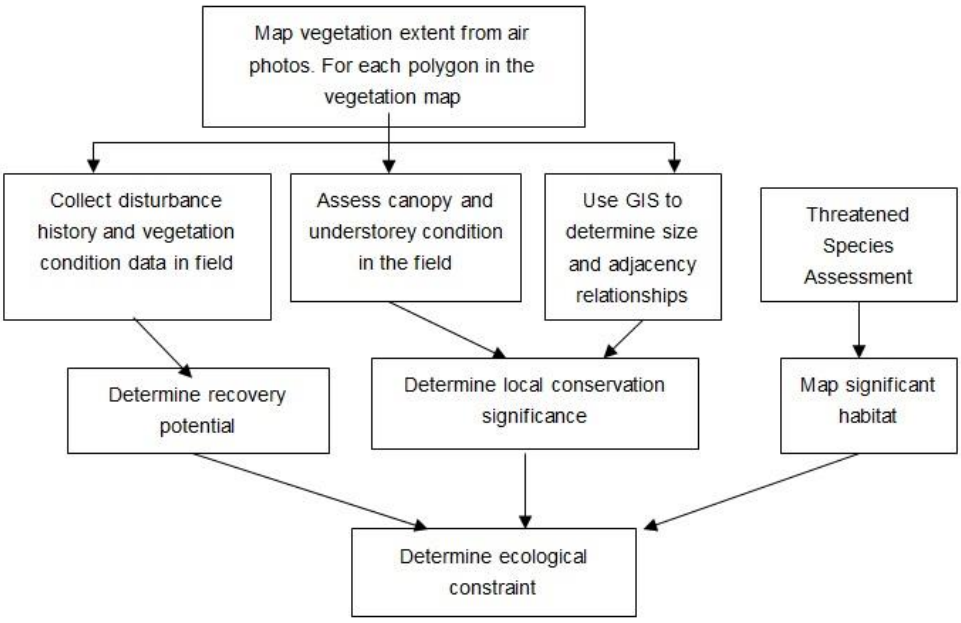

Figure 1. Ecological Constraint Assessment Flowchart (Eco Logical 2009)

This ecological assessment is based on the application of Ecological Constraint Analysis techniques developed by ELA (2009), and ELA (2003) which were an adaptation of methodology from Ian Perkins Consultancy Services and Aquila Ecological Surveys (2002).

2.2.1 Flora Survey

ELA staff conducted a field survey of all extant vegetation on site on 20 May 2013. During this survey vegetation canopy and understorey condition, site disturbance and soil condition were assessed, and boundaries for polygons clarified in the field.

Characteristics of each vegetation polygon were recorded on a pro-forma developed specifically to assess vegetation composition and condition at the Glenlee site.

The following parameters were recorded at for each polygon:

- vegetation structure including canopy and understorey condition. A canopy and condition code based on the parameters given in **Table 1** was assigned to each polygon;
- indications of recovery potential including disturbance history;
- soil condition (including compaction and presence of fill); and
- floristics including noxious weeds.

Table 1. Canopy and Condition Codes

Code	Canopy Density	Description
A	>10%	Canopy and understorey in good condition
B	5-10%	Canopy thinner, some understorey
C	>10%	Good canopy cover, extensive weed presence in understorey
TX	<10%	Scattered tree overstorey extensive weed presence in understorey

2.2.2 Fauna Habitat Survey

Suitable habitats, for any threatened species previously recorded or expected to occur in the region, were noted during the field survey. Additionally efforts were made to identify habitat features important to the life cycle of likely threatened animals. Such features included mature trees with hollows, connectivity with other woodland areas and suitable aquatic environments. Species targeted included

- threatened species in the Schedules to the TSC Act
- species listed in the Schedules to the EPBC Act
- regionally significant species listed in NPWS et al. (1997).

2.2.3 Recovery Potential

Using parameter information collected in the field each polygon's 'recovery potential' was determined. Recovery potential is defined as *"...the anticipated capacity of (an) area to recover to a state representative of its condition prior to the most recent disturbance event"* (Ian Perkins Consultancy Services and Aquila Ecological Surveys 2002, cited in Eco Logical Australia 2009). **Table 2** outlines the decision rules used in determining the recovery potential, resulting in a ranking of High, Moderate, Low or Very Low recovery potential for each vegetation polygon.

2.2.4 Conservation Significance

As part of the recovery planning process for Cumberland Plain vegetation communities, NPWS has classified remnant vegetation across the Cumberland Plain into significance categories to assist Councils and other land use planners in making decisions about land use. Remnant woodland and forest vegetation has been ranked into the following categories:

- 'Core Habitat'; defined as "areas that constitute the backbone of a viable conservation network across the landscape; or areas where the endangered ecological communities are at imminent risk of extinction";
- 'Support for Core Habitat'; "areas that provide a range of support values to the Core Habitat, including increasing remnant size, buffering from edge effects, and providing corridor connections"; and,
- 'Other Remnant Vegetation'; "all native vegetation that does not fall within the above significance categories".

The decision criteria used for classifying the vegetation into the codes is outlined in **Table 3**.

Threatened species information is then collated for the study area and used to determine significant threatened species habitat. Each remnant vegetation patch is classed as having either Known, Likely or Nil chance of supporting threatened species by considering both NPWS mapping of Conservation Significance and field survey observations.

2.2.5 Ecological Constraint

Information derived from the recovery potential, conservation significance and threatened species calculations were combined to give a ranking for the overall ecological constraint.

Table 4 and **Table 5** show the decision steps used to combine these three maps.

2.3 Study Limitations

Limitations to this study include:

- Both animals and plants can be cryptic in their habits (i.e. hard to detect), and can colonise new areas. Databases and other surveys were reviewed, and the availability of potential habitat were utilised for such species. They could, however, potentially be detected in the future.
- No trapping for fauna species was conducted.
- Assessment was based on broad-scale techniques.
- Access for detailed field survey was not possible for some limited areas due to the topography of the site (i.e. steep slopes which prohibited access).

Table 2. Recovery Potential Matrix.

Current condition and land use	Past land use and disturbance	Soil Condition	Vegetation	Recovery Potential
Cleared (no woodland canopy)	Recently cleared (<2 years)	Unmodified or largely natural. Uncultivated.	Native dominated	High
			Exotic dominated	Moderate
		Modified. Heavily cultivated and/or pasture improved. Imported material.	Either	Low
	Historically cleared (>2 years) and consistently managed as cleared.	Unmodified or largely natural. Uncultivated.	Native dominated	Moderate
			Exotic dominated	Low
		Modified. Heavily cultivated and/or pasture improved. Imported material.	Either	Very Low
Wooded/Native Canopy present or regenerating	No recent clearing of understorey	Unmodified or largely natural. Uncultivated.	Native understorey relatively intact or in advanced state of regeneration. Native dominated.	High
			Native understorey significantly structurally modified, absent or largely absent. Includes areas dominated by African Olive.	Moderate
			Exotic dominated	Low
		Moderately modified by long term grazing or mowing.	Native dominated	Low
		Modified. Heavily cultivated and/or pasture improved. Imported material.	Native understorey significantly structurally modified, absent or largely absent. Includes areas dominated by African Olive.	Very Low
			Native understorey present. Heavily weed invaded.	Low
	Understorey patchily intact	Disturbed	Native dominated	Moderate
			Exotic dominated	Low
	Recent clearing of understorey and or native understorey significantly structurally modified due to existing land use (e.g. Mowing, grazing)	Unmodified or largely natural. Uncultivated.	Native dominated. If no vegetation present, assume native dominated.	High
			Exotic dominated	Moderate
		Modified. Heavily cultivated and/or pasture improved. Imported material.	Native dominated	Low
			Exotic dominated	Very Low

Source: Eco Logical Australia (2003) cited in Eco Logical Australia (2009)

Table 3. Conservation Significance Matrix.

Community type	Condition Code*	Patch Size	Connectivity	Code	Conservation Significance
Endangered Ecological Community (Critically endangered) ("CEEC"	ABC, Tx or Txr	Any	Any	C3	Core
	Txu	Any	Any	URT	Urban remnant trees (critically endangered communities)
Endangered Ecological Community ("EEC")	ABC (with Understorey in good or moderate condition)	> 10 ha	Any	C1	Core
		< 10 ha	Adjacent to C1 or CEC	C2	Core
			Adjacent to S1	S2	Support for core
			None	O	Other remnant vegetation
	Tx or Txr, ABC (with poor Understorey condition)	Any	Adjacent to any Core	S1	Support for core
			None	O	Other remnant vegetation
	Txu	Any	Any	O	Other remnant vegetation

*Condition code as determined in the field using criteria from Table 1. Source: NSW NPWS (2002) cited in Eco Logical Australia (2009)

Table 4. Ecological Constraint Matrix Step 1
This step combines the recovery potential and conservation significance maps.

	Recovery Potential				
Conservation Significance		**High**	**Moderate**	**Low**	**Very Low**
	Core	High	High	High	High
	Support for core	High	Moderate	Moderate	Low
	Other	Moderate	Moderate	Low	Very Low

Source: Eco Logical Australia (2003) cited in Eco Logical Australia (2009)

Table 5. Ecological Constraint Matrix Step 2
This step combines results from **Table 4** with the threatened species layer to determine ecological constraint.

	Combined Recovery Potential and Conservation Significance (result of Table 4 above)				
Threatened Species Assessment		**High**	**Moderate**	**Low**	**Very Low**
	Known (High)	High	High	High	High
	Likely (Moderate)	High	Moderate	Moderate	Moderate
	Nil (Low)	High	Moderate	Low	Very Low

Source: Eco Logical Australia (2003) cited in Eco Logical Australia (2009)

3 Results

3.1 Flora

Results of the database searches as described in the **Section 2.1** are tabulated in **Appendix A**, along with the habitat requirements and assessment as to whether the species is likely to occur at the site.

Following the database searches, it was deemed that the following two threatened flora species could potentially occur within the study site.

- *Eucalyptus benthamii* (Camden White Gum)
- *Pimelea spicata* (Spiked Rice-flower).

Potential habitat for *Pimelea spicata* occurs within the sloped wooded area in the north west of the site and potential habitat for *Eucalyptus benthamii* is within the riparian zone of the Nepean River in the west of the study site.

Neither of the above species was detected within the study area during the course of survey work for the current project.

3.1.1 Field Survey and Vegetation Mapping

A complete species list, including both native and weed species, from the field survey is contained within **Appendix B**. No species listed under the TSC Act or the EPBC Act were found, nor were any flora species of regional significance encountered during the course of the field survey.

Of the weed species observed, a total of 12 species are declared as noxious weeds in the Campbelltown and/or Camden Local Government Areas, and seven species are classified as Weeds of National Significance (WoNS). These species are listed in **Appendix B** along with the required control measures associated with each species listing under the Noxious Weeds Act 1993.

A number of significant environmental weed species are also found on site and these include:

- *Olea europaea subsp. cuspidata* (African Olive);
- *Gleditsia triacanthos* (Honey Locust);
- *Celtis occidentalis* (Hackberry);
- *Privet ligustrum* (Large-leaf Privet); and
- *Eragrostis curvula* (African Lovegrass).

All site vegetation was assigned a polygon descriptor during the field survey. These polygons are mapped in **Figure 2.**

The native vegetation communities found within the study site were Shale Plains Woodland, a community classified within the broader community of the Cumberland Plain Woodlands; and Riparian Forest and Alluvial Woodland, communities fitting within the broader River-flat Eucalypt Forest classification. Vegetation mapping is given in **Figure 3**.

All native vegetation within the study site was allocated a Canopy and Condition Code, as described in **Table 1**, of ‘C’ which describes vegetation with ‘Good canopy cover, extensive weed presence in understorey’. Weed densities in the understorey varied from between 25% to 100%. **Table 7** provides areal data for native vegetation communities and exotic vegetation within the study site.

Exotic vegetation within the study site was included in this assessment and assigned appropriate parameters during the field survey. Although this methodology is generally not intended for assessment of exotic vegetation, these areas have been included due to the potential for ecological connectivity.

Table 6. Noxious Weeds and WoNS

Common name	Species Name	Noxious Weed Class*	WoNS
Asparagus Fern	*Asparagus aethiopicus*		√
African boxthorn	*Lycium ferocissimum*	4	√
African Olive	*Olea europea* subsp. *cuspidata*	4	
Balloon vine	*Cardiospermum grandiflorum*	4	
Blackberry	*Rubus fruticosus* (. spp. agg.)	4	√
Bridal Creeper	*Asparagus asparagoides*	4	√
Castor Oil Plant	*Ricinus communis*	4	
Fireweed	*Senecio madagascariensis*	4	√
Green Cestrum	*Cestrum parqui*	3	
Lantana	*Lantana camara*	4	√
Pampas Grass	*Cortaderia* sp.	3	
Prickly Pear	*Opuntia stricta*	4	√
Privet , Large-leaf	*Ligustrum lucidum*	4	
Privet , Small-leaf	*Ligustrum sinense*	4	
Weeping Willow	*Salix babylonica*	4	

***** Noxious weed classes

3 The plant must be fully and continuously suppressed and destroyed

4 The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed

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

3.1.2 Recovery Potential

Recovery potential of each vegetation polygon was determined in the field according to the criteria listed in **Table 2**. Mapping of this assessment is provided in **Figure 4**.

No areas with a high recovery potential were observed within the study site. Much of the CPW on site has an exotic understorey dominated by African Olive. The RFEF within the Nepean River riparian zone is characterised by a midstorey dominated by Honey Locust and Privet, and very limited native understorey. Those areas of CPW and RFEF without evidence of a disturbed soil profile were classified as having moderate recovery potential.

3.1.3 Conservation Significance

The results of the NPWS conservation significance mapping for the study site are displayed in **Figure 5**. This mapping is based on a broad-scale assessment of vegetation without the benefit of detailed ground truthing. The NPWS conservation significance mapping results were combined with the field survey observations to produce mapping which provides a more detailed picture of the vegetation on site including the dominance of the weed species, African Olive, in the northern sector. This information is mapped in **Figure 6**.

Non-native vegetation was also included in this assessment to provide an indication of other vegetation which may contribute to fauna habitat and potentially provide some contribution to ecological corridors.

Table 7. Areal Data for Vegetation Communities and Non-native Vegetation

Vegetation	Hectares	% of Total Area
Study Site		
Native Vegetation	9.1	8.6
Non-native vegetation	23.6	22.4
Other (i.e. Unvegetated)	72.6	68.9
Total Study Site Area	105.3	100
Native Vegetation Communities		
Cumberland Plain Woodland	2.4	2.2
River-flat Eucalypt Forest	6.5	6.2
Planted *Casuarina sp.*	0.25	0.2
Total Vegetated Area	32.7	31.1
Recovery Potential of Vegetated Areas		
Vegetation	Hectares	% of Vegetated Area
Moderate	6.7	20.4
Low	4.8	14.7
Very Low	21.2	64.9

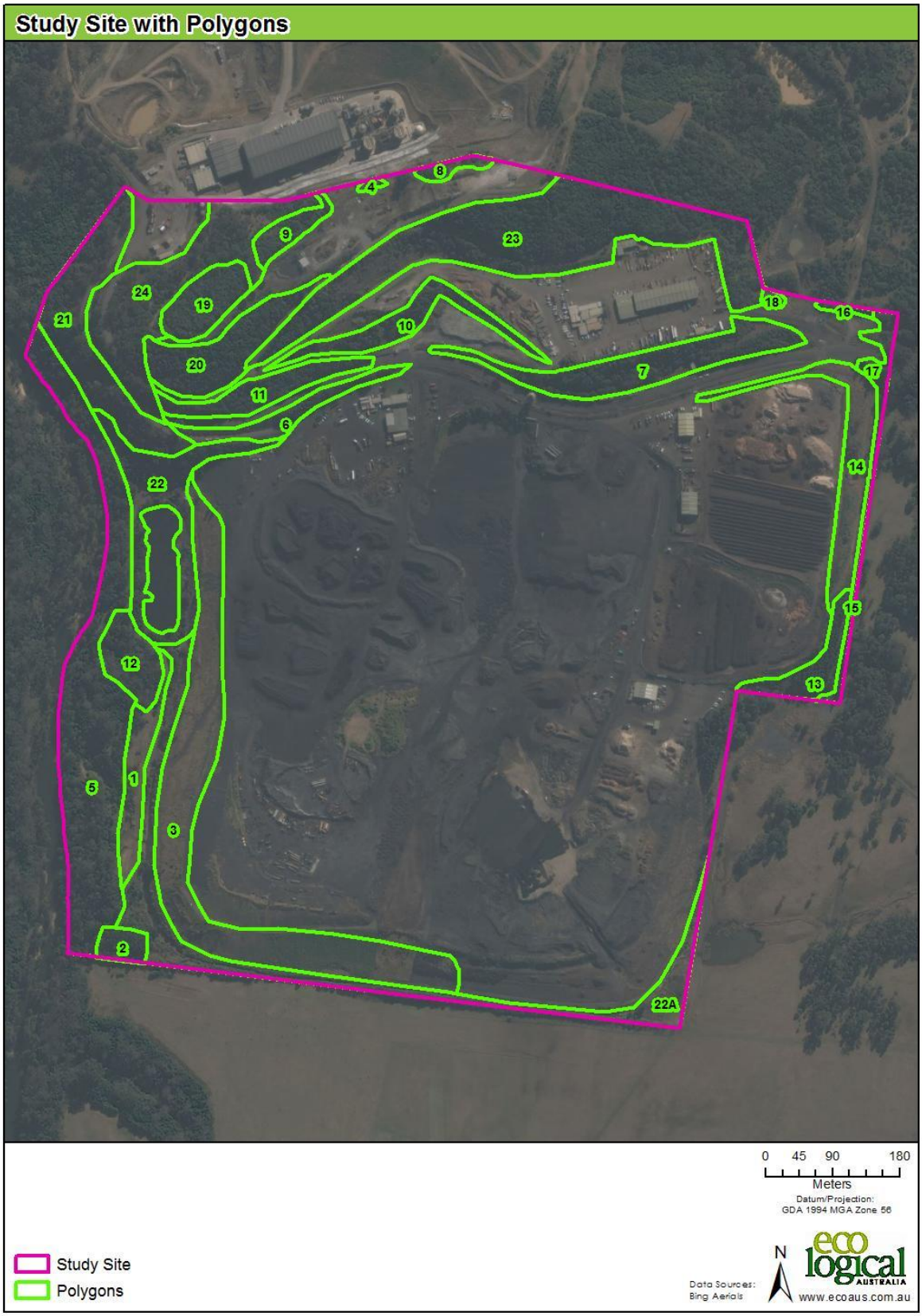

Figure 2: Mapping Polygons

Figure 3. Site Vegetation and Native Plant Communities

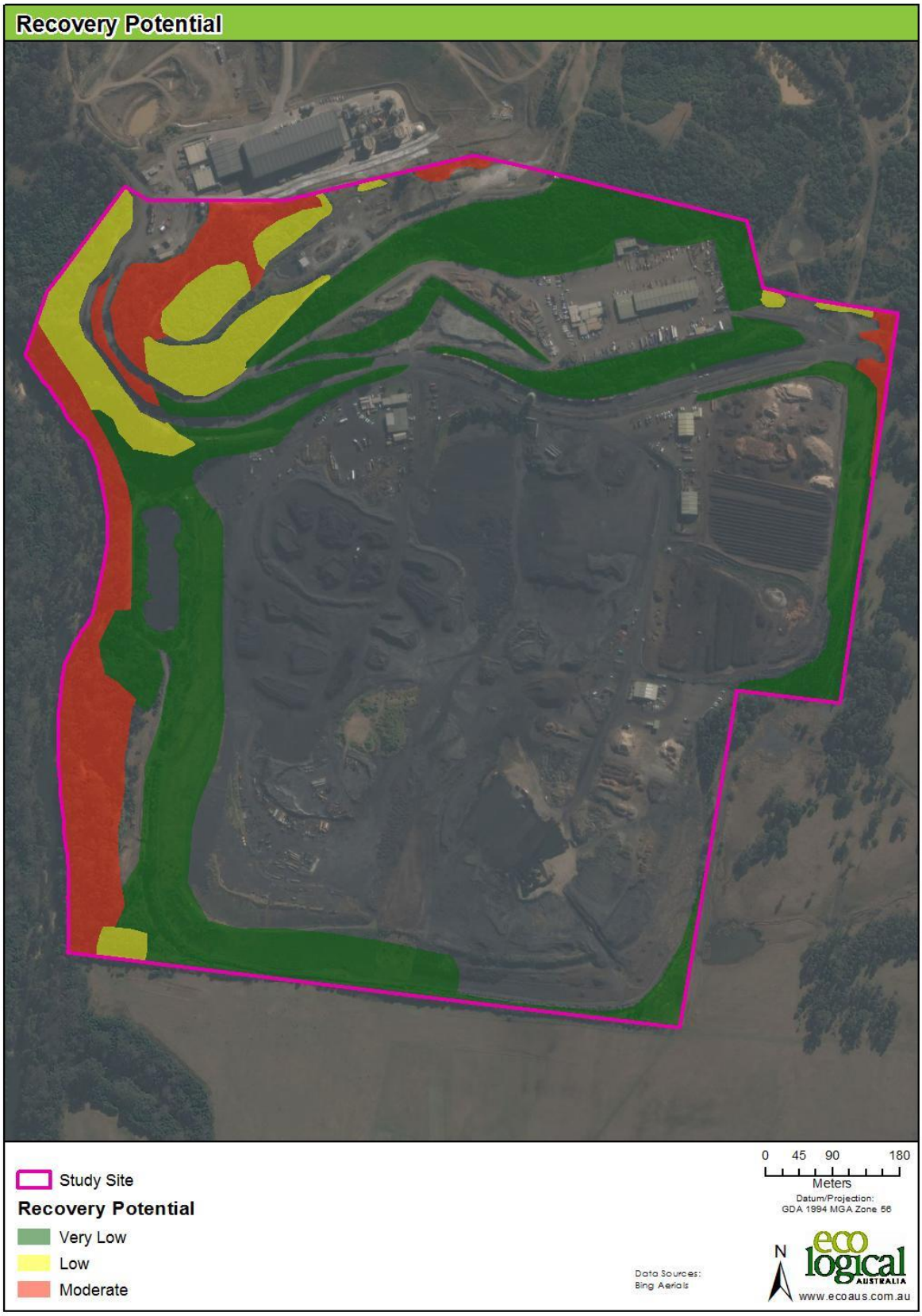

Figure 4. Recovery Potential of Vegetated Areas

Figure 5. Conservation Significance Mapping (NPWS)

Note: This mapping is from a broadscale mapping dataset, with groundtruthed outcomes shown in **Figure 6.**

Figure 6. Conservation Significance determined with field survey data

3.2 Fauna

Results of the database searches as described in **Section 2.1** is tabulated in **Appendix A**, along with the habitat requirements and an assessment as to whether the species is likely to occur within the study site.

Following the database searches, it was deemed likely that the 10 threatened species as listed in **Table 8** could potentially occur within the study site (all highly mobile species), primarily within the riparian zone along the Nepean River in the west of the study site. **Table 9** provides a list of migratory species which may visit the site intermittently.

None of the above species were detected within the study area during the course of survey work for the current project.

Table 8. Threatened Fauna which potentially may occur within the Study Site

Common Name	Scientific Name	EPBC Act	TSC Act
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	—	V
Eastern Freetail-bat	*Mormopterus norfolkensis*	—	V
Grey-headed Flying-Fox	*Pteropus poliocephalus*	V	V
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V
Large-footed Myotis	*Myotis macropus*	—	V
Powerful Owl	*Ninox strenua*	—	V
Regent Honeyeater	*Anthochaera phrygia*	E	CE
Square-tailed Kite	*Lophoictinia isura*	—	V
Swift Parrot	*Lathamus discolor*	E	E
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*		V

The listing of the species under the TSC Act and *Environment Protection &* EPBC Act is indicated by: CE = Critically Endangered, E = Endangered, V = Vulnerable

Table 9. Migratory Species Which Potentially May Occur within the study site

Common Name	Species Name
Regent honeyeater	*Xanthomyza phrygia*
Rufous fantail	*Rhipidura rufifrons*
White-throated needletail	*Hirundapus caudacutus*

A migratory species is considered to be those species listed under the EPBC Act, which includes JAMBA, CAMBA, and Bonn Convention listed species

3.3 Ecological Constraints Analysis

3.3.1 Flora and Fauna Threatened Species Habitat Assessment

The potential threatened flora and fauna habitat value for the constraints analysis was determined for each polygon, by combining both field survey observations and information relating to the known habitat conditions and foraging requirements for each species. The results of this assessment were tabulated and are included in **Table 10.**

Although exotic grasslands may provide habitat value for some fauna species these areas within the study site have not been allocated a high constraints category with regard to fauna habitat value as such grasslands are well represented in the vicinity. The grasslands within the study site are also subject to significant disturbance with regard to noise and large machinery activity, significantly reducing the value of these areas as habitat.

3.3.2 Ecological Constraints Mapping

As described in **Section 2.2.5**, information from the recovery potential, conservation significance and threatened species assessments was combined to provide an overall indication of ecological constraint. These assessments were combined using the matrices as shown in **Table 4** and **Table 5** and the resultant ecological constraints measure is given for each polygon in **Table 10.** The result of this analysis is mapped in **Figure 7**.

The ecological constraints analysis indicates that the vegetation within the study site contains:

- High ecological constraint - 2.8ha
- Moderate ecological constraint – 7.9ha
- Low ecological constraint – 0.1ha
- Very Low ecological constraint – 21.9ha.

Table 10. Ecological Constraints Matrix for Glenlee Study Site

Polygon	Vegetation (Community)	Recovery Potential	Condition Code	Conservation Significance	Ecological Constraint Matrix Step 1	Threatened Species Assessment (Flora and Fauna)	Ecological Constraint (Matrix Step 2)
1	cleared						
2	**RFEF**	Low	C	O	Low	Likely	**Moderate**
3	Exotic grassland	Very Low	TX	O	Very Low	Nil	**Very Low**
4	Olive (mostly)	Low	TX	O	Low	Nil	**Low**
5	**RFEF**	Moderate	C	S1	Moderate	Likely	**Moderate**
6	Olive (mostly)	Very Low	TX	O	Very Low	Nil	**Very Low**
7	Olive (mostly)	Very Low	TX	O	Very Low	Nil	**Very Low**
8	**CPW**	Moderate	C	C3 Core	High	Nil	**High**
9	Olive (mostly)	Low	TX	O	Very Low	Nil	**Very Low**
10	Olive (mostly)	Very Low	TX	O	Very Low	Nil	**Very Low**
11	Olive (mostly)	Very Low	TX	O	Very Low	Nil	**Very Low**
12	Constructed drainage line	Very Low	TX	O	Very Low	Nil	**Very Low**
13	Radiata pine	Very Low	TX	O	Very Low	Nil	**Very Low**
14	Exotic grassland	Very Low	TX	O	Very Low	Nil	**Very Low**
15	Planted *Casuarina cunninghamiana*	Very low	C	O	Very Low	Nil	**Very Low**
16	Olive	Low	TX	O	Very Low	Nil	**Very Low**
17	**RFEF**	Moderate	C	C2 Core	High	Likely	**High**
18	Olive (mostly)	Low	TX	O	Low	Nil	**Low**
19	Olive (mostly)	Low	TX	O	Very Low	Nil	**Very Low**
20	Olive (mostly)	Low	TX	O	Very Low	Nil	**Very Low**
21	**RFEF**	Low	C	S1	Moderate	Likely	**Moderate**
22	Exotic grassland	Very Low	TX	O	Very Low	Nil	**Very Low**
22A	Constructed drainage line	Very Low	TX	O	Very Low	Nil	**Very Low**
23	Olive (mostly)	Very Low	TX	O	Very Low	Nil	**Very Low**
24	**CPW**	Moderate	C	C3 Core	High	Likely	**High**

Figure 7. Ecological Constraints and Impact Area of the Indicative Layout Plan

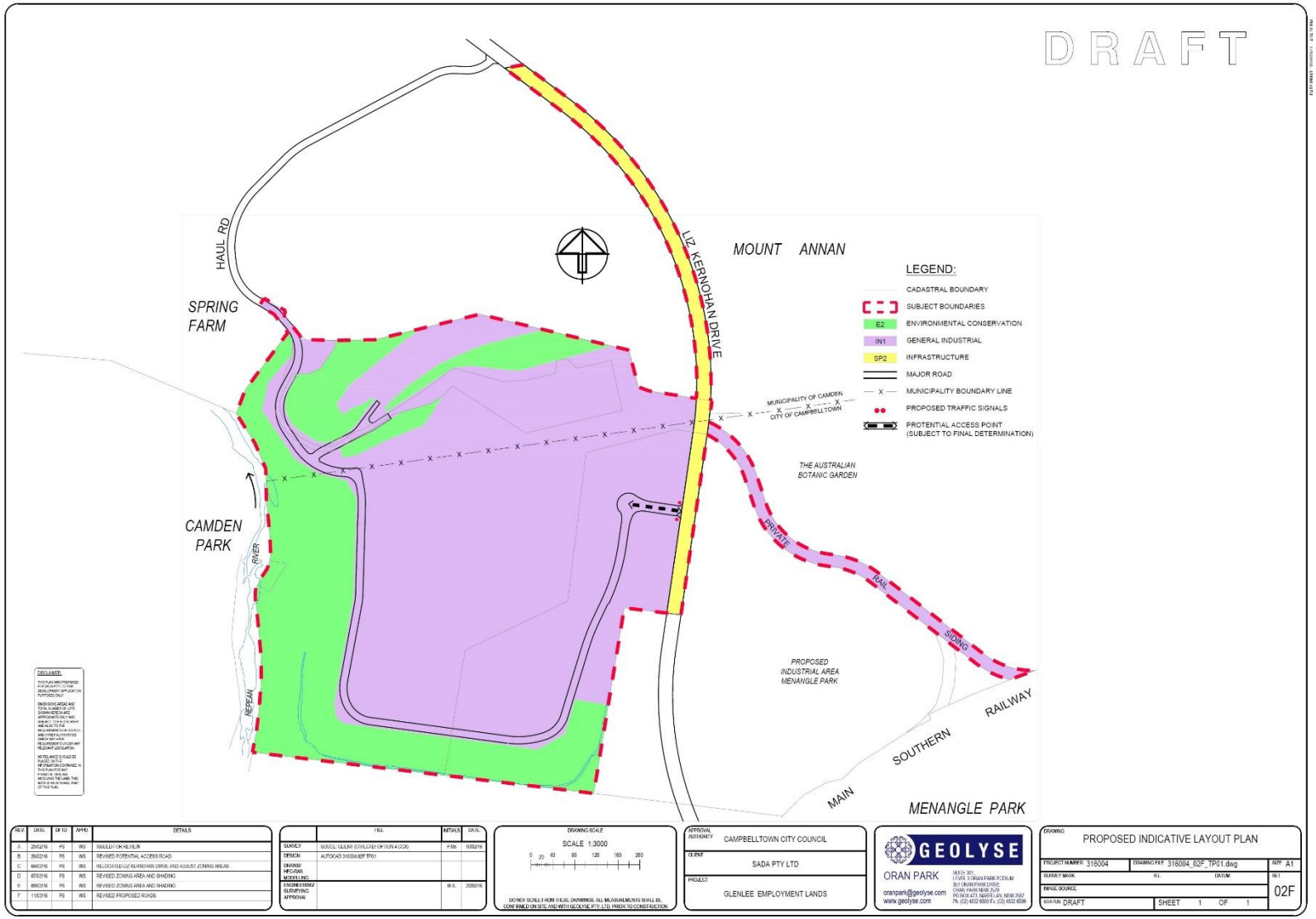

Figure 8. Detailed Proposed Indicative Layout Plan

3.4 Implications of the Indicative Layout Plan

Rezoning of the study site is proposed with an Indicative Layout Plan (ILP) as presented in **Figure 8**.

The implementation of the ILP would lead to the potential removal of 1.53 hectares of native vegetation (including planted vegetation), which is 16.77% of the native vegetation within the study site. This native vegetation impact is made up of 0.69 ha of CPW, 0.59 ha of RFEF and 0.25 ha of planted *Casuarina cunninghamiana*. The proposal will also impact on 6.28 ha of non-native vegetation, primarily exotic grassland and African Olive dominated shrubland. A detailed breakdown of potentially impacted vegetation areas by the proposed development are provided in **Table 11**.

Ecological constraints mapping of the study site has been overlayed with the impact zone of the ILP to provide a visual representation of the potential impacts of the proposed rezoning (**Figure 7**).

Table 11. Comparison of areas impacted by Indicative Layout Plan

Characteristic	Area impacted (ha)	% Total	Area retained (ha)	% Total
Recovery Potential				
Moderate	1.08	16.09	5.61	83.91
Low	1.02	21.31	3.78	78.69
Very Low	8.14	38.38	13.07	61.62
Ecological Constraints				
High	1.08	39.16	1.67	60.84
Moderate	0.36	4.60	7.55	95.40
Low	0.10	98.29	0.002	1.71
Very Low	8.70	39.66	13.23	60.34
Vegetation community				
CPW	0.69	29.13	1.67	70.87
RFEF	0.59	9.11	5.90	90.89
Total Native incl. planted	1.53	16.77	7.57	83.23

4 Discussion

4.1 Vegetation Communities

Two native vegetation communities were identified during literature review and field survey within the Glenlee study site, and may potentially be impacted by the proposed development.

One of these vegetation communities (Shale Hills Woodland) forms part of the CPW community, which as a vegetation community is listed under both state and federal legislation as a CEEC; however the area of CPW within the study site does not meet the listing criteria required under the EPBC Act.

Assessments of significance have been undertaken for the two listed vegetation communities on site. These vegetation communities are CPW, a CEEC, and RFEF, an EEC. These assessments are appended to this report in **Appendix C**. The conclusion of these assessments is that no significant impact will occur to Cumberland Plain Woodland or River-flat Eucalypt Forest as a result of the proposed development, together with the positive management proposed for retained vegetation (**Section 5**).

4.2 Flora

No flora species listed under the TSC Act or EPBC Act were found during field survey, however there is potential for two listed species to occur in remnant patches throughout the study site. No regionally significant species were recorded during survey.

The potential habitat of the two threatened flora species is outside of the impact zone of the ILP and so it is concluded that no impact will occur to the habitat of these species.

4.3 Fauna

No threatened or regionally significant fauna species were detected within the study area during the course of the field survey work.

The impact zone of the proposed development results in the retention of 83% of native vegetation across the study site such that with the rehabilitation of the retained areas of native vegetation, fauna habitat will not be impacted by the proposed development. The native vegetation which will be impacted is located along the edge of current stands and is not of significant habitat value.

4.4 Corridors

There are three potential corridors within the site:

1. Vegetation adjacent to Nepean River
2. Between the Nepean River and the Australian Botanic Gardens in the north of the site
3. Along the modified drainage line known as Caleys Creek.

The vegetation along the Nepean River provides potential biodiversity connectivity in a north/south corridor. Elderslie Banksia Scrub Forest is located to the north west of this site in the Spring Farm area, and the Menangle Park area is to the south/southwest. Currently the value of this corridor is degraded by weed infestation, and thus the value of this corridor would be improved through weed control.

The study site is located between the Nepean River and the Australian Botanic Gardens, and thus may potentially provide connectivity between these two areas. Currently the vegetation in the north of the site which appears on aerial photography as if it may provide connectivity in an east/west direction is dominated by African Olive, which predominately occurs on very steep slopes created by previous earthworks. The slope stabilising nature of the African Olive and the disturbed soil profile in this area suggest that revegetation of this area to a native woodland is unlikely to be successful. Although comprised of exotic species, this vegetation may be utilised by some native fauna species, and thus offers some limited ecological connectivity between the Nepean River and the Australian Botanic Gardens.

Portions of Caleys Creek occur outside of the study area, within Menangle Park, and the drainage line which has been redirected in the past to run to the south of the coal wash, is highly modified with little native vegetation. Thus, delivery of an ecological corridor which connects to the Australian Botanic Gardens would be dependent on outcomes within Menangle Park. However, the offset strategy for Menangle Park (GHD 2010) identifies that “precinct riparian corridors” are proposed in proximity to the eastern boundary of the Glenlee site, and adjacent to the southern boundary of the Glenlee lands are identified as “potential offset lands”.

4.5 Camden Environmentally Sensitive Land

Figure 9 shows the environmentally sensitive land as depicted in the Camden Local Biodiversity Strategy (Eco Logical Australia 2013). The objectives of DCP 2011 have been considered in this report by identifying and updating areas of environmental sensitivity, and considering adverse impacts. In this regard it is noted that over eighty eight percent of native vegetation within the study site is proposed to be retained, with management recommendations for weed control and revegetation where appropriate, increasing both the biodiversity and habitat value of these native vegetation remnants. Approximately 5.6 hectares of native vegetation with a moderate recovery potential is to be retained and managed for conservation, including riparian vegetation adjacent to the Nepean River.

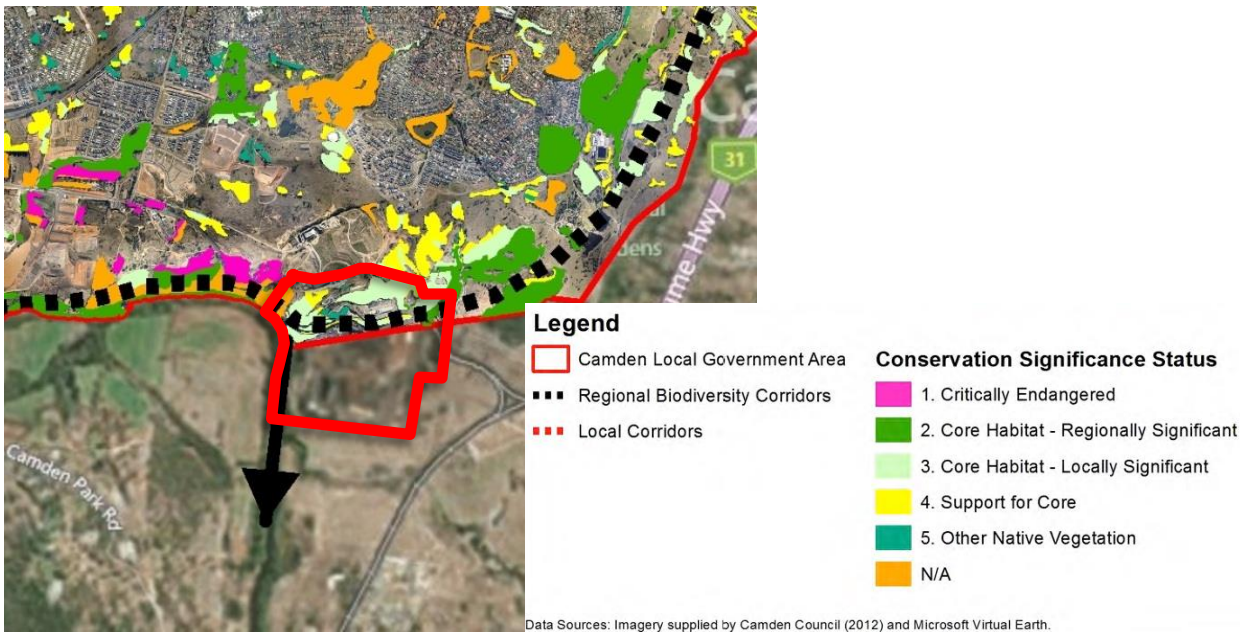

Figure 9. Camden Conservation Significance (from Camden Local Biodiversity Strategy)*

* Approximate extent of Glenlee study area shown in solid red outline over environmentally sensitive land map extracted from Camden Local Biodiversity Strategy.

The ILP shown in **Figure 7** illustrates that development of this site aims to utilise highly degraded areas within the site, with minimal impact on vegetated zones.

A regional biodiversity corridor is shown as passing through the northern portion of the Glenlee site. This report considers ecological corridors and connectivity under **section 4.4**, and maintaining and where possible enhancing ecological connectivity is considered in **section 5** of this report.

5 Conclusions and Recommendations

Overall, the ecological values of the site are highly degraded due to the coal washery activities including the emplacement of reject material, clearing, major weed incursion, fragmentation of habitat, and barriers to the movements of fauna.

The site does contain some remnant CPW and RFEF vegetation. Approximately ten percent of the existing native vegetation will be impacted by ILP, though this native vegetation is currently heavily infested with weeds.

The site has been divided into three areas (hereafter referred to as 'management units') for the provision of recommendations. These areas are:

- Zone A. Retained native vegetation (mostly adjacent to Nepean River). Includes corridor 1.
- Zone B. Exotic vegetation which comprises corridor 2
- Zone C. Caleys Creek. Includes corridor 3.

Discussion of, and recommendations for, each zone are provided below in sections 5.1 - 5.3.

5.1 Management Zone A

This management zone is made up of vegetated areas where native vegetation dominates or areas where there is the potential to revegetate towards a native vegetation community. The soil profile within this zone is generally not capped with emplacement material, and without significant disturbance.

As the native vegetation is affected by weeds, weed control and management would be required to improve the ecological value of the vegetation. Similarly, revegetating towards a native vegetation community will require rehabilitation including significant weed control and revegetation.

For this zone, it is recommended that:

1. Consider rezoning these areas to an environmental protection zoning, or to have some form of conservation covenant.
2. Asset protection zones should not be located within vegetation retained for conservation in this zone.
3. Undertake best practice soil erosion control during construction, and maintain as required, to prevent sediment flow into this zone.
4. Stormwater structures to be located outside of conservation areas.
5. A Vegetation Management Plan be prepared to direct the overall rehabilitation of the native vegetation communities. This plan will require an on-going weed control program to address the continued high density presence of weed species, specifically African Olive.

5.2 Management Zone B

This management zone contains two areas of dense African Olive with very scattered canopy trees, which form a connection between the Nepean River riparian zone and the Australian Botanic Garden. This also forms part of a proposed broader biodiversity corridor which includes Spring Farm to the west.

Due to the instability of the reject emplacement substrate, it is unlikely that these areas can be re-established as fully functioning native woodland, however it would be beneficial to increase the ecological value of these areas.

For this zone, it is recommended that:

1. Where possible, any plantings in the vicinity of this management zone be selected from the flora species representative of Cumberland Plain Woodland. It is noted that these selections will also need to consider whether these species will be able to survive on the modified soil profile, and whether they will be able to hold the soils in place and maintain the stability of any slopes.

5.3 Management Zone C

Management zone C includes areas of exotic grassland which have been established to stabilise the southern edges of the emplacement area. It also includes the constructed drainage channel where Caleys Creek was diverted on the southern boundary of the site.

For this zone, it is recommended that:

1. As part of overall site landscaping works, consideration be given to revegetation of these areas with native grasses. Revegetation with trees and shrubs may also be appropriate in sections of this management zone (mainly sections away from the embankments).

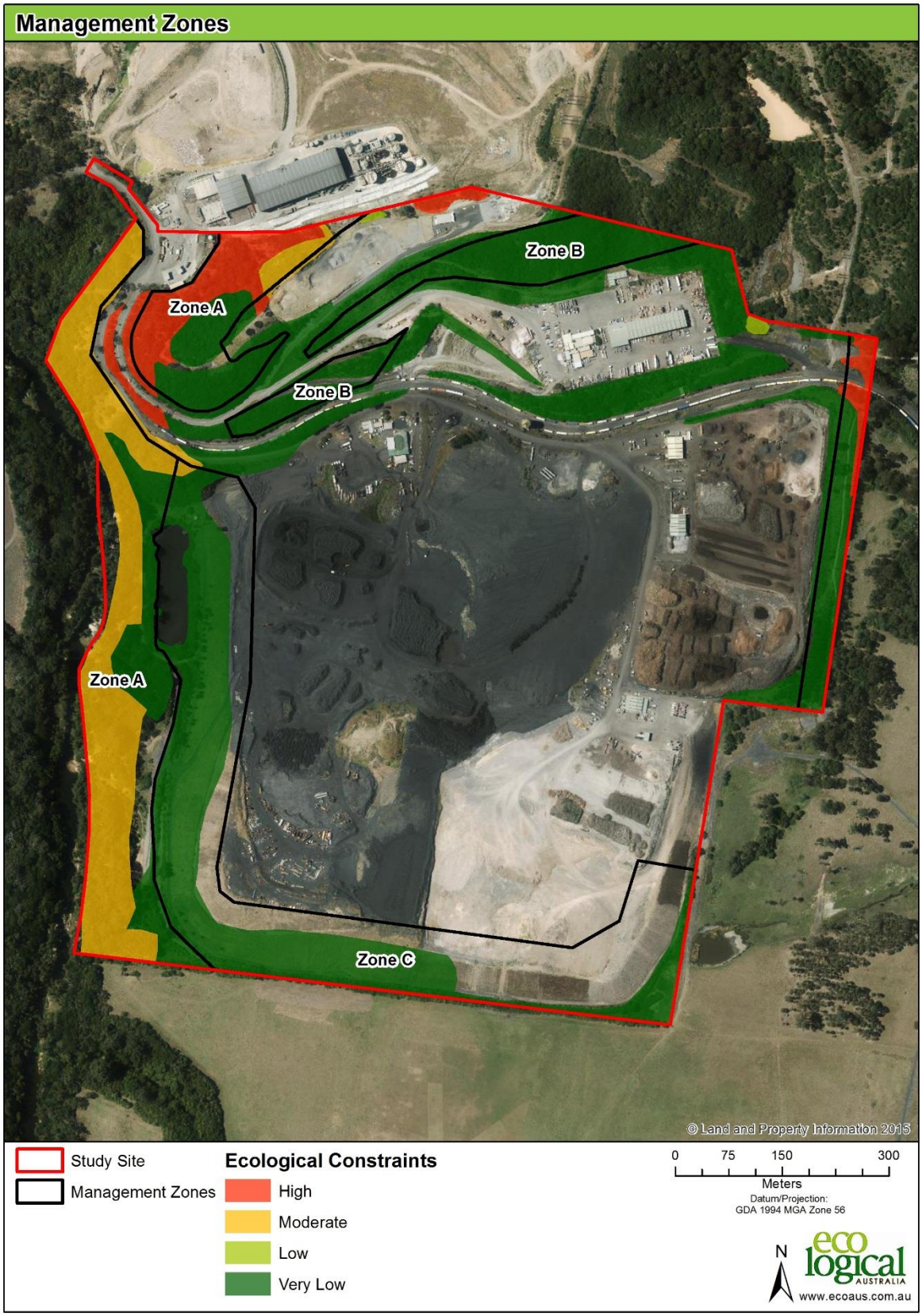

Figure 10. Proposed Management Zones

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Appendix A: Threatened Species Database Tables

Fauna Likelihood of Occurrence Table

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
Amphibians					
Heleioporus australiacus	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Garnett and Crowley 2000).	Unlikely
Litoria aurea	Green and Golden Bell Frog	V	E1	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECC 2009). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–Typha sp. and spikerushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 2004)	Unlikely
Litoria raniformis	Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog	V	E1	Relatively still or slow-flowing sites such as billabongs, ponds, lakes or farm dams, especially where bulrushes (Typha sp., Eleocharis sp. and Phragmites sp.) are present (DECC 2007; Ehmann 1997). This species is common in lignum shrublands, black box and River Red Gum woodlands, irrigation channels and at the periphery of rivers in the southern parts of NSW (DECC 2007). This species occurs in vegetation types such as open grassland, open forest and ephemeral and permanent non-saline marshes and swamps (DECC 2007). Open grassland and ephemeral permanent non-saline marshes and swamps have also been associated with this species (Ehmann 1997).	Unlikely
Mixophyes iteratus	Giant Barred Frog	E1	E1	Found on forested slopes of the escarpment and adjacent ranges in riparian vegetation, subtropical and dry rainforest, wet sclerophyll forests and swamp sclerophyll forest (DECC 2007; Ehmann 1997). This species is associated with flowing streams with high water quality, though habitats may contain weed species (Ehmann 1997). This species is not known from riparian vegetation disturbed by	Unlikely

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
				humans. During breeding eggs are kicked up onto an overhanging bank or the streams edge (DECC 2007).	
Pseudophryne australis	Red-crowned Toadlet	—	V	Red-crowned Toadlets are found in steep escarpment areas and plateaus, as well as low undulating ranges with benched outcroppings on Triassic sandstones of the Sydney Basin (DECC 2007). Within these geological formations, this species mainly occupies the upper parts of ridges, usually being restricted to within about 100 metres of the ridgetop. However they may also occur on plateaus or more level rock platforms along the ridgetop (DECC 2007).	Unlikely
Reptiles					
Hoplocephalus bungaroides	Broad-headed Snake	V	E1	Typical sites consist of exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin (DECC 2007). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998). Some of the canopy tree species found to regularly co-occur at known sites include Corymbia eximia, C. gummifera, Eucalyptus sieberi, E. punctata and E.piperita (DECC 2007).	Unlikely
Varanus rosenbergi	Heath Monitor	-	V	Associated with Sydney sandstone woodland and heath land. Rocks, hollow logs and burrows are utilised for shelter (Garnett and Crowley 2000). Terrestrial termitaria are required for reproduction (King and Green 1999).	Unlikely
Birds (Diurnal)					
Anthochaera phrygia	Regent Honeyeater	E1, Mi	CE	Regent Honeyeaters mostly occur in dry box-ironbark eucalypt woodland and dry sclerophyll forest associations, wherein they prefer the most fertile sites available, e.g. along creek flats, or in broad river valleys and foothills. In NSW, riparian forests containing Casuarina cunninghamiana (River Oak), and with Amyema cambagei (Needle-leaf Mistletoe), are also important for feeding and breeding. At times of food shortage (e.g. when flowering fails in preferred habitats), Honeyeaters also use other woodland types and wet lowland coastal forest dominated by Eucalyptus robusta (Swamp Mahogany) or E. maculata (Spotted Gum) (Franklin et al. 1989; Geering & French 1998; Webster & Menkhorst 1992). Regent Honeyeaters sometimes occur in coastal forest, especially in stands dominated by Swamp Mahogany and Spotted Gum, but also in those with Southern Mahogany E. botryoides, and in those on sandstone ranges with banksias Banksia in the understorey (Franklin et al. 1989). They have been recorded in open forest including forest edges, wooded farmland and urban areas with mature eucalypts (Garnett 1993).	Potential – occasional winter migrant

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
Botaurus poiciloptilus	Australasian Bittern	E1	E1	Terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1990. Reedbeds, swamps, streams, estuaries (Simpson & Day 1999). Favours permananent shallow waters, edges of pools and waterways, with tall, dense vegetation such as sedges, rushes and reeds on muddy or peaty substrate.	Unlikely
Burhinus grallarius	Bush Stone-curlew	—	E1	Associated with dry open woodland with grassy areas, dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland (Marchant & Higgins 1993). Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Marchant & Higgins 1993). Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed to lightly disturbed.	Unlikely
Callocephalon fimbriatum	Gang-gang Cockatoo	—	V	During summer in dense, tall, wet forests of mountains and gullies, alpine woodlands (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages. They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson & Day 2004).	Unlikely
Calyptorhynchus lathami	Glossy Black-Cockatoo	—	V	Associated with a variety of forest types containing Allocasuarina species, usually reflecting the poor nutrient status of underlying soils (NPWS 1997; DECC 2007). Intact drier forest types with less rugged landscapes are preferred (DECC 2007). Nests in large trees with large hollows (Garnett and Crowley 2000).	Potential
Circus assimilis	Spotted Harrier	—	V	The Spotted Harrier is found in mainland Australia and Indonesia. It is widespread but sparsely distributed. The Spotted Harrier is found in open wooded country in tropical and temperate Australia, particularly in arid and semi-arid areas (BIB, 2006).	Unlikely
Climacteris picumnus Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)		V	Distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. The Brown Treecreeper occupies eucalypt woodlands, particularly open woodland lacking a dense understorey. It is sedentary and nests in tree hollows within permanent territories. (NSW Scientific Committee 2001).	Unlikely – no potential habitat
Daphoenositta chrysoptera	Varied Sittella	—	V	Varied Sitellas are endemic and widespread in mainland Australia. Varied Sitellas are found in eucalypt woodlands and forests throughout their range. They prefer rough-barked trees like stringybarks and ironbarks or mature trees with hollows or dead branches (BIB, 2006)	Unlikely

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
Ephippiorhynchus asiaticus	Black-necked Stork	—	E1	Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands floodplains (Marchant & Higgins 1993). Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains (Marchant & Higgins 1993).	Unlikely – no suitable habitat
Erythrotriorchis radiatus	Red Goshawk	V	CE	Associated with forests and woodlands with a mosaic of vegetation types, an abundance of birds and permanent water. In NSW, this species is thought to favour mixed subtropical rainforest, Melaleuca Swamp Forest, and open eucalypt forest along rivers, often in rugged terrain (Marchant & Higgins 1993; Debus 1993; DECC 2007). The Red Goshawk nests in large trees, frequently the tallest and most massive in a tall stand, and nest trees are invariably within one km of permanent water (Aumann & Baker-Gabb 1991; Debus & Czechura 1988b).	Unlikely
Glossopsitta pusilla	Little Lorikeet	—	V	In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box *Eucalyptus albens* and Yellow Box *E. melliodora* are particularly important food sources for pollen and nectar respectively.	Unlikely
Grantiella picta	Painted Honeyeater	—	V	A nomadic species that typically inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests with abundant mistletoe (DECC 2007). It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias, preferring *Amyema* sp mistletoe (DECC 2007).	Unlikely
Hieraaetus morphnoides	Little Eagle	—	V	The Little Eagle is widespread in mainland Australia, central and eastern New Guinea. The Little Eagle is seen over woodland and forest. It tends to avoid rainforest and heavy forest (BIB, 2006).	Unlikely – due current noise and activity
Irediparra gallinacea	Comb-crested Jacana	—	V	Freshwater wetlands, such as lagoons, billabongs, swamps, lakes and reservoirs, generally with abundant floating aquatic vegetation (Marchant and Higgins 1999).	Unlikely
Ixobrychus flavicollis	Black Bittern	—	V	Occurs in both terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation (DECC 2007). In areas with permanent water it may occur in flooded grassland, forest, woodland, rainforest and mangroves (DECC 2007)	Unlikely

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
Lathamus discolor	Swift Parrot	E1, Ma	E	Breeds in Tasmania between September and January. Feeds mostly on nectar, mainly from eucalypts, but also eats psyllid insects and lerps, seeds and fruit. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts. 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), White Box (E. albens) and Forest Red Gum (E. tereticornis) (DECC 2007). Box-ironbark habitat in drainage lines, and coastal forest in NSW is thought to provide critical food resources during periods of drought or low food abundance elsewhere (Mac Nally et al. 2000).	Potential - a rare winter migrant to the locality
Lophoictinia isura	Square-tailed Kite	—	V	In coastal areas associated tropical and temperate forests and woodlands on fertile soils with an abundance of passerine birds (Marchant & Higgins 1993, DECC 2007). May be recorded inland along timbered watercourses (DECC 2007). In NSW it is commonly associated with ridge or gully forests dominated by Woollybutt (Eucalyptus logifloria), Spotted Gum (E. maculata), or Peppermint Gum (E. elata, E. smithii) (DECC 2007).	Potential
Melanodryas cucullata cucullata	Hooded Robin (southeastern subspecies)	—	V	Associated with a wide range of Eucalypt woodlands, Acacia shrubland and open forests (Blakers et al. 1984). In temperate woodlands, the species favours open areas adjoining large woodland blocks, with areas of dead timber and sparse shrub cover (NSW Scientific Committee 2001). Hooded Robin home ranges are relatively large, averaging 18ha for birds from the New England Tableland (NSW Scientific Committee 2001).	Unlikely – no potential habitat
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	—	V	Predominantly associated with box-ironbark association woodlands and River Red Gum (NSW Scientific Committee, 2001).	Unlikely
Ninox connivens	Barking Owl	—	V	Associated with a variety of habitats such as savanna woodland, open eucalypt forests, wetland and riverine forest. The habitat is typically dominated by Eucalypts (often Redgum species), however often dominated by Melaleuca species in the tropics (DECC 2007). It usually roosts in dense foliage in large trees such as River She-oak (Casuarina cunninghamiana), other Casuarina and Allocasuarina, Eucalypts, Angophora, Acacia and rainforest species from streamside gallery forests. It usually nests near watercourses or wetlands (NPWS 2003) in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997).	Unlikely – no potential habitat

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
Ninox strenua	Powerful Owl	—	V	Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Garnett and Crowley 2000). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Garnett and Crowley 2000).	Potential – hunting but no roosting or breeding sites
Pandion cristatus	Eastern Osprey	—	V	Associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Olsen 1995). Osprey may nest on the ground, on sea cliffs or in trees (Olsen 1995). Ospreys generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995).	Unlikely – no potential habitat
Petroica boodang	Scarlet Robin	—	V	The Scarlet Robin is found in south-eastern and south-western Australia, as well as on Norfolk Island. In Australia, it is found south of latitude 25°S, from south-eastern Queensland along the coast of New South Wales (and inland to western slopes of Great Dividing Range) to Victoria and Tasmania, and west to Eyre Peninsula, South Australia; it is also found in south-west Western Australia. The Scarlet Robin lives in open forests and woodlands in Australia, while it prefers rainforest habitats on Norfolk Island. During winter, it will visit more open habitats such as grasslands and will be seen in farmland and urban parks and gardens at this time (BIB, 2006).	Unlikely
Ptilinopus superbus	Superb Fruit-Dove	—	V	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms (DECC 2007). It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (*ibid.*). Part of the population is migratory or nomadic (*ibid.*). At least some of the population, particularly young birds, moves south through Sydney, especially in autumn (*ibid.*).	Unlikely – no suitable habitat
Rostratula australis	Painted Snipe	V	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (*ibid.*).	Unlikely – no suitable habitat
Stagonopleura guttata	Diamond Firetail	—	V	Typically found in grassy eucalypt woodlands, but also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities (DECC 2007). It is often found in riparian areas and sometimes in lightly wooded farmland (DECC 2007). Appears to be sedentary, though some populations move locally, especially those in the south (DECC 2007).	Unlikely – no suitable habitat
Stictonetta naevosa	Freckled Duck	—	V	Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters (DECC 2007).	Unlikely

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
Tyto novaehollandiae	Masked Owl	—	V	Associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland (DECC 2007) and especially the ecotone between wet and dry forest, and non forest habitat (Garnett and Crowley 2000). Known to utilise forest margins and isolated stands of trees within agricultural land (Hyem 1979) and heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained (Kavanagh & Peake 1993).	Unlikely – no suitable habitat
Mammals-terrestrial (excluding bats)					
Cercartetus nanus	Eastern Pygmy-possum	—	V	The Eastern Pygmy Possum occurs in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2004). Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit (Turner & Ward 1995). The presence of Banksia sp. and Leptospermum sp. are an important habitat feature (DECC 2007). Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old birds nests and in the branch forks of tea-trees (Turner & Ward 1995).	Unlikely
Dasyurus maculatus	Spotted-tailed Quoll		V	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECC 2007j), more frequently recorded near the ecotones of closed and open forest and in NSW within 200km of the coast. Preferred habitat is mature wet forest (Belcher 2000), especially in areas with rainfall 600 mm/year (Mansergh 1984). Unlogged forest or forest that has been less disturbed by timber harvesting is also preferable (Catling et al. 1998, 2000). This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Garnett and Crowley 2000).	Unlikely – no suitable den sites nor an abundance of suitable prey
Dasyurus maculatus maculatus	Spotted-tailed Quoll (SE Mainland Population)	E1	—	see above	
Petaurus norfolcensis	Squirrel Glider	—	V	Associated with dry hardwood forest and woodlands (Quin 1995). Habitats typically include gum barked and high nectar producing species, including winter flower species (Menkhorst et al. 1988). The presence of hollow bearing eucalypts is a critical habitat value (Quin 1995).	Unlikely

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
Phascolarctos cinereus	Koala	V	V	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: *Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis*	Unlikely
Mammals - terrestrial (Bats)					
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998; DECC 2007). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998; DECC 2007).	Potential
Falsistrellus tasmaniensis	Eastern False Pipistrelle	—	V	Prefers moist habitats with trees taller than 20m (DECC 2007). Roosts in tree hollows but has also been found roosting in buildings or under loose bark (DECC 2007).	Potential
Miniopterus australis	Little Bent-wing Bat	—	V	Prefers well-timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests (Churchill 1998). This species shelter in a range of structures including culverts, drains, mines and caves (Garnett and Crowley 2000). Relatively large areas of dense vegetation of either wet sclerophyll forest, rainforest or dense coastal banksia scrub are usually found adjacent to caves in which this species is found (DECC 2007). Breeding occurs in caves, usually in association with M. schreibersii (Garnett and Crowley 2000, DECC 2007).	Unlikely
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	—	V	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). It forages above and below the tree canopy on small insects (Dwyer 1995). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Garnett and Crowley 2000, Dwyer 1995).	Potential
Mormopterus norfolkensis	Eastern Freetail-bat	—	V	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Garnett and Crowley 2000; Allison & Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Garnett and Crowley 2000; Allison & Hoye 1998).	Potential

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
Myotis macropus	Large-footed Myotis	—	V	Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water (Churchill 1998). While roosting is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains (Churchill 1998).	Potential
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	Potential
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	—	V	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland (Churchill 1998), open country, mallee, rainforests, heathland and waterbodies . Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock (Garnett and Crowley 2000) and in abandoned sugar glider nests (Churchill 1998). The Yellow-bellied Sheathtail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (Garnett and Crowley 2000).	Potential
Scoteanax rueppellii	Greater Broad-nosed Bat	—	V	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 1998). Within denser vegetation types use is made of natural and man made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 1998).	Unlikely
Invertebrates					
Meridolum corneovirens	Cumberland Plain Land Snail		E1	Associated with open eucalypt forests, particularly Cumberland Plain Woodland described in Benson (1992). Found under fallen logs, debris and in bark and leaf litter around the trunk of gum trees or burrowing in loose soil around clumps of grass (NPWS 1997; Rudman 1998). Urban waste may also form suitable habitat (NSW NPWS 1997; Rudman 1998). This species is not usually recorded in woodland areas with a dominance of African Olive (Hayes, 2008)	Unlikely
Migratory terrestrial species					
Apus pacificus	Fork-tailed Swift	Ma, Mi	-	Sometimes travels with Needletails. Varied habitat with a possible tendency to more arid areas but also over coasts and urban areas (Simpson & Day 2004).	Unlikely

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
Haliaeetus leucogaster	White-bellied Sea-Eagle	Ma, Mi	—	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	Unlikely
Hirundapus caudacutus	White-throated Needletail	Mi	—	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	Potential
Monarcha melanopsis	Black-faced Monarch	Mi	—	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	Unlikely
Monarcha trivirgatus	Spectacled Monarch	Mi	—	Wet forests, mangroves (Simpson and Day 1999).	Unlikely
Myiagra cyanoleuca	Satin Flycatcher	Mi	—	Associated with drier eucalypt forests, absent from rainforests (Blakers et al. 1984), open forests, often at height (Simpson & Day 1999).	Unlikely
Rhipidura rufifrons	Rufous Fantail	Mi	—	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	Potential
Xanthomyza phrygia	Regent Honeyeater	E1, Mi	E1	SEE DIURNAL BIRDS ABOVE	
Migratory Wetland species					
Ardea alba	Great Egret	Mi	—	The Great Egret is common and widespread in Australia (McKilligan, 2005). It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (McKilligan, 2005).	Unlikey
Ardea ibis	Cattle Egret	Mi	—	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (McKilligan, 2005). Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leave the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing	Unlikey

Scientific Name	Common Name	EPBC Act	NSW TSC Act	Habitat Associations	Likelihood of Occurrence
				Range (McKilligan, 2005).	
Gallinago hardwickii	Latham's Snipe	Mi	—	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1999). Occupies a variety of vegetation around wetlands (Marchant and Higgins 1999) including wetland grasses and open wooded swamps (Simpson and Day 1999).	Unlikey
Rostratula benghalensis s. lat.	Painted Snipe	V, Mi	—	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (*ibid.*). Breeding is often in response to local conditions; generally occurs from September to December (DECC 2007). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECC 2007). Feeds on worms, molluscs, insects and some plant-matter (*ibid.*).	Unlikely

E1 = Endangered; E2 = Endangered Population; CE = Critically Endangered; V = Vulnerable; Mi = Migratory; Ma = Marine

Disclaimer: Data extracted from the Atlas of NSW Wildlife and DSEWPaC Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. 'Migratory marine species' and 'listed marine species' listed on the EPBC Act (and listed on the DSEWPaC protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine habitat.

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Flora Likelihood of Occurrence Table

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Acacia bynoeana	Bynoe's Wattle	E	V	*Acacia bynoeana* is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (OEH 2013). The species seems to prefer open and sometimes slightly disturbed sites (OEH 2013). Characteristic overstorey species include: *Corymbia gummifera, Eucalyptus haemastoma, E. parramattensis, E. sclerophylla, Banksia serrata* and *Angophora bakeri*. Shrubs often associated with the species include *B. spinulosa, B. serrata, A. oxycedrus, A. myrtifolia* and *Kunzea* spp. (Winning 1992; James 1997). It flowers from September to March and fruits mature in November (OEH 2013).	No
Acacia gordonii	*Acacia gordonii*	E	E	*Acacia gordonii* is restricted to the north-west of Sydney, occurring in the lower Blue Mountains in the west, and in the Maroota/Glenorie area in the east, within the Hawkesbury, Blue Mountains and BaulkhamHills local government areas. Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops (OEH 2013).	No
Acacia pubescens	Downy Wattle	V	V	*Acacia pubescens* occurs on the NSW Central Coast in Western Sydney, mainly in the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. It is associated with Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest growing on clay soils, often with ironstone gravel (NPWS 1997; Benson and McDougall 1997).	No
Allocasuarina glareicola	*Allocasuarina glareicola*	E	E	*Allocasuarina glareicola* is primarily restricted to the Richmond district on the north-west Cumberland Plain, with an outlier population found at Voyager Point. It grows in Castlereagh woodland on lateritic soil (OEH 2013). Found in open woodland with *Eucalyptus parramattensis, E. fibrosa, Angophora bakeri, E. sclerophylla* and *Melaleuca decora.* Common associated understorey species include *Melaleuca nodosa, Hakea dactyloides, H. sericea, Dillwynia tenuifolia, Micromyrtus minutiflora, Acacia elongata, A. brownii, Themeda australis* and *Xanthorrhoea minor* (OEH 2013).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Asterolasia elegans	*Asterolasia elegans*	E	E	*Asterolasia elegans* is restricted to a few localities on the NSW Central Coast north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs. It is found in sheltered forests on mid- to lower slopes and valleys, in or adjacent to gullies (OEH 2013).	No
Caladenia tessellata	Thick Lip Spider Orchid	E	V	*Caladenia tessellata* occurs in grassy sclerophyll woodland, often growing in well-structured clay loams or sandy soils south from Swansea, usually in sheltered moist places and in areas of increased sunlight (OEH 2013). It flowers from September to November (OEH 2013).	Unlikely
Callistemon linearifolius	Netted Bottlebrush	V		*Callistemon linearifolius* has been recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW, growing in dry sclerophyll forest (OEH 2013). For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (OEH 2013).	No
Chamaesyce psammogeton	Sand Spurge	E		*Chamaesyce psammogeton* is known from coastal sites north from near Jervis Bay as well as on Lord Howe Island. It is a prostrate perennial herb, which grows on foredunes and exposed sites on headlands often with Spinifex (OEH 2013).	No
Clematis fawcettii	Northern Clematis	V	V	*Clematis fawcettii* occurs north from Cambridge Plateau (north west of Casino), on the NSW North Coast. It usually grows in subtropical or dry rainforest (Harden et al. 2006).	Unlikely
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	*Cryptostylis hunteriana* is known from a range of vegetation communities including swamp-heath and woodland (OEH 2013). The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); where it appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*) (OEH 2013). ell (2001) has identified Coastal Plains Scribbly Gum Woodland and Coastal Plains Smoothed-barked Apple Woodland as potential habitat on the Central Coast. Flowers between November and February, although may not flower regularly (OEH 2013; Bell 2001).	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Cynanchum elegans	White-flowered Wax Plant	E	E	*Cynanchum elegans* is a climber or twiner with a variable form, and flowers between August and May, peaking in November (OEH 2013). It occurs in dry rainforest gullies, scrub and scree slopes, and prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest (NPWS 1997). The species has also been found in littoral rainforest; *Leptospermum laevigatum – Banksia integrifolia* subsp. *integrifolia* coastal scrub; *Eucalyptus tereticornis* open forest/ woodland; *Corymbia maculata* open forest/woodland; and *Melaleuca armillaris* scrub to open scrub (OEH 2013).	Unlikely
Darwinia biflora	*Darwinia biflora*	V	V	*Darwinia biflora* is an erect or spreading shrub to 80cm high associated with habitats where weathered shale capped ridges intergrade with Hawkesbury Sandstone, where soils have a high clay content (NPWS 1997).	No
Darwinia peduncularis	*Darwinia peduncularis*	V		*Darwinia peduncularis* occurs as local disjunct populations in coastal NSW in the Blue Mountains, Brooklyn, Berowra, Galston Gorge, Hornsby, Bargo River, Glen Davis, Mount Boonbourwa and Kings Tableland, and usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone (OEH 2013).	No
Deyeuxia appressa	*Deyeuxia appressa*	E	E	Almost nothing is known of the habitat and ecology of this highly restricted NSW endemic known only from two records in the Sydney area; first collected in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown; then collected in 1941 from Killara, near Hornsby (OEH 2013).	No
Dillwynia tenuifolia	*Dillwynia tenuifolia*	V	V	*Dillwynia tenuifolia* has a core distribution within the Cumberland Plain, where it may be locally abundant within scrubby, dry heath areas within Castlereagh Ironbark Forest and Shale/Gravel Transition Forest on tertiary alluvium or laterised clays (OEH 2013). It may also be common in the ecotone between these areas and Castlereagh Scribbly Gum Woodland (OEH 2013).	Unlikely
Epacris purpurascens var. *purpurascens*	*Epacris purpurascens* var. *purpurascens*	V		*Epacris purpurascens* var. *purpurascens* has been recorded between Gosford in the north to Avon Dam in the south, in a range of habitats, but most have a strong shale soil influence (OEH 2013).	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Eucalyptus benthamii	Camden White Gum	V	V	*Eucalyptus benthamii* occurs in wet open forest on well drained sandy alluvial soils along stream channels, small terraces and alluvial flats on valley floors (OEH 2013).	Potential
Eucalyptus camfieldii	Camfield's Stringybark	V	V	*Eucalyptus camfieldii* is associated with shallow sandy soils bordering coastal heath with other stunted or mallee eucalypts, often in areas with restricted drainage and in areas with laterite influenced soils, thought to be associated with proximity to shale (OEH 2013).	No
Eucalyptus sp. Cattai	*Eucalyptus* sp. Cattai	E		*Eucalyptus* sp. Cattai occurs in the area between Colo Heights and Castle Hill, north western Sydney. It occurs as a rare emergent in scrub, heath and low woodland on sandy soils, usually as isolated individuals or occasionally in small groups. The sites at which it occurs are generally flat and on ridge tops and associated soils are laterised clays overlying sandstone (OEH 2013).	No
Galium australe	Tangled Bedstraw	E		*Galium australe* is known from the Towamba Valley near Bega, Lake Yarrunga near Kangaroo Valley, Cullendulla Creek Nature Reserve near Batemans Bay, Conjola National Park, Swan Lake near Swanhaven, and the Big Hole in Deua National Park. Tangled Bedstraw was recorded historically from the Clyde River near Batemans Bay and the Mongarlowe area near Braidwood (OEH 2013). The species also occurs beside Lake Windemere in Jervis Bay, is widespread in Victoria and is also found in South Australia and Tasmania (OEH 2013). In NSW Galium australe has been found in moist gullies of tall forest, *Eucalyptus tereticornis* forest, coastal Banksia shrubland, and *Allocasuarina nana* heathland, while in other states the species is found in a range of near-coastal habitats, including sand dunes, sand spits, shrubland and woodland.	Unlikely
Genoplesium baueri	Bauer's Midge Orchid	E		Known from coastal areas from northern Sydney south to the Nowra district. Previous records from the Hunter Valley and Nelson Bay are now thought to be erroneous. Grows in shrubby woodland in open forest on shallow sandy soils.	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Grammitis stenophylla	Narrow-leaf Finger Fern	E		In NSW, *Grammitis stenophylla* has been found on the south, central and north coasts, and as far west as Mount Kaputar National Park near Narrabri, in moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest (OEH 2013).	Unlikely
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	V		*Grevillea juniperina* subsp. *juniperina* is endemic to Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town. It grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium, typically containing lateritic gravels (OEH 2013). It is recorded from Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest (OEH 2013).	No
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	*Grevillea parviflora* subsp. *parviflora* is sporadically distributed throughout the Sydney Basin mainly around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie and Cessnock and Kurri Kurri. It grows in sandy or light clay soils over thin shales, often with lateritic ironstone gravels. It often occurs in open, slightly disturbed sites such as tracks (OEH 2013). Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones, and soil landscapes include Lucas Heights and Berkshire Park (OEH 2013).	No
Gyrostemon thesioides	*Gyrostemon thesioides*	E		Within NSW, *Gyrostemon thesioides* has only been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers; most recently as a single male plant near the Colo River within Wollemi National Park (OEH 2013). It grows on hillsides and riverbanks and may be restricted to fine sandy soils (OEH 2013).	No
Haloragis exalata subsp. exalata	Square Raspwort	V	V	*Haloragis exalata* has been recorded in 4 widely scattered localities in eastern NSW; the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW; where it appears to require protected and shaded damp situations in riparian habitats (OEH 2013).	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Haloragodendron lucasii	*Haloragodendron lucasii*	E	E	Known locations of this species are confined to a very narrow distribution on the north shore of Sydney. *Haloragodendron lucasii* is associated with low woodland on sheltered slopes near creeks on moist loamy sand on bench below small sandstone cliff lines, with continuous seepage (Benson and McDougall 1997).	Unlikely
Hibbertia puberula	*Hibbertia puberula*	E		*Hibbertia puberula* is currently only known from near Warrimoo in Blue Mountains National Park on the Central Coast. There also several old records from a number of localities in the Sydney basin. It grows in heathy open forest in thin rocky/sandy light brown soil over sandstone (RBG Herbarium records).	No
Hibbertia sp. Bankstown (R.T. Miller & C.P. Gibson s.n. 18/10/06).		CE	CE	*Hibbertia* sp. Bankstown is currently known from only one population at Bankstown Airport in Sydney's southern suburbs, in the Bankstown LGA. The known site is modified from the natural state, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. The remnant vegetation at the site and soil type are consistent with an inferred pre-settlement cover of Castlereagh Ironbark Forest (OEH 2013).	No
Hygrocybe anomala var. ianthinomarginata		V		A small gilled fungus. Type locality, Lane Cove Bushland Park, Lane Cove Local Government Area. Other records from Royal and Blue Mountains NPs (OEH, 2013)	No
Hygrocybe aurantipes		V		As above	No
Hygrocybe austropratensis		E1		As above	No
Hygrocybe collucera		E1		As above	No
Hygrocybe griseoramosa		E1		As above	No
Hygrocybe lanecovensis		E1		As above	No
Hygrocybe reesiae		V		As above	No
Hygrocybe rubronivea		V		As above	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Hypsela sessiliflora	*Hypsela sessiliflora*	E	Extinct	*Hypsela sessiliflora* is currently known from only two adjacent sites at Erskine Park in the Penrith LGA, while previous sightings are all from western Sydney, at Homebush and at Agnes Banks (OEH 2013). This species is known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone (OEH 2013).	Unlikely
Lasiopetalum joyceae	*Lasiopetalum joyceae*	V	V	*Lasiopetalum joyceae* grows in ridgetop woodland, heath, woodland or open scrub, often with a clay influence (NPWS 1997).	No
Lepidium hyssopifolium	Aromatic Peppercress	E	E	*Lepidium hyssopifolium* occurs near Bathurst, near Bungendore, near Crookwell and near Armidale, occurring in a variety of habitats including woodland with a grassy understorey and grassland (OEH 2013).	No
Leucopogon exolasius	Woronora Beard-heath	V	V	*Leucopogon exolasius* is found along the upper Georges River area and in Heathcote National Park (OEH 2013). It is associated with Sydney Sandstone Gully Forest on rocky hillsides and creek banks (NPWS 1997).	Unlikely
Leucopogon fletcheri subsp. *fletcheri*	*Leucopogon fletcheri* subsp. *fletcheri*	E		*Leucopogon fletcheri* subsp. *fletcheri* is restricted to north-western Sydney between St Albans in the north and Annangrove in the south, within the local government areas of Hawkesbury, Baulkham Hills and Blue Mountains. It occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs (OEH 2013).	No
Marsdenia viridiflora subsp. *viridiflora*	*Marsdenia viridiflora* subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGA	E2		This Endangered Population of *Marsdenia viridiflora* subsp. *viridiflora* occurs in the Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys areas of western Sydney. It grows in vine thickets and open shale woodland (OEH 2013).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Maundia triglochinoides	*Maundia triglochinoides*	V		Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct (OEH 2013). *Maundia triglochinoides* is an aquatic herbaceous plant found in swamps or shallow fresh water on heavy clay on the north and central NSW coast.	Unlikely
Melaleuca deanei	Deane's Paperbark	V	V	Found in heath on sandstone (OEH 2013), and also associated with woodland on *broad* ridge tops and slopes on sandy loam and lateritic soils (Benson and McDougall 1998).	No
Micromyrtus minutiflora	*Micromyrtus minutiflora*	E		*Micromyrtus minutiflora* is restricted to the area between Richmond and Penrith in western Sydney on the Central Coast. It grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, and open forest on tertiary alluvium and consolidated river sediments (OEH 2013).	Unlikely
Pelargonium sp. (G.W. Carr 10345)		E		In NSW, *Pelargonium* sp. (G.W. Carr 10345) is known from the Southern Tablelands (PlantNet 2011). Otherwise, only known from the shores of Lake Omeo near Benambra in Victoria where it grows in cracking clay soil that is probably occasionally flooded (Walsh & Entwisle 1999).	Unlikely
Persicaria elatior	Tall Knotweed	V	V	*Persicaria elatior* has been recorded from a number of localities along the NSW coast. It normally grows in damp places, especially beside streams and lakes or occasionally in swamp forest or associated with disturbance (OEH 2013).	Unlikely
Persoonia bargoensis	Bargo Geebung	E	V	Associated with woodland to dry sclerophyll forest, on sandstone and clayey laterite on heavier, well-drained, loamy, gravelly soils of the Hawkesbury Sandstone and Wianamatta Shale in the catchments of the Cataract, Cordeaux and Bargo Rivers (NSW Scientific Committee 2013).	No
Persoonia glaucescens	Mittagong Geebung	E	V	*Persoonia glaucescens* occurs on the south eastern part of the NSW Central Tablelands from near Berrima north to near Buxton. It grows in woodland to dry sclerophyll forest on clayey and gravely laterite, usually on ridge-tops, plateaux and upper slopes (OEH 2013).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Persoonia hirsuta	Hairy Geebung	E	E	*Persoonia hirsuta* occurs from Singleton in the north, south to Bargo and the Blue Mountains to the west (OEH 2013). It grows in dry sclerophyll eucalypt woodland and forest on sandstone (PlantNet 2011).	No
Persoonia mollis subsp. *maxima*	*Persoonia mollis* subsp. *maxima*	E	E	Deep gullies or on the steep upper hillsides of narrow gullies incised from Hawkesbury Sandstone, characterised by steep sideslopes, rocky benches and broken scarps, with creeks fed by small streams and intermittent drainage depressions. Occurrences of this plant have been recorded on the dry upper-hillsides of gullies and in more exposed aspects (Scribbly Gum *E. haemastoma*, Grey Gum (*E. punctata*) (NPWS 1999).	No
Persoonia nutans	Nodding Geebung	E	E	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained (Benson and McDougall 2000). Endemic to the Western Sydney (Benson and McDougall 2000).	No
Pilularia novae-hollandiae	Austral Pillwort	E		*Pilularia novae-hollandiae* has been recorded in southern NSW from a number of widely separated coastal and inland localities. It grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous (OEH 2013).	Unlikely
Pimelea curviflora var. *curviflora*	*Pimelea curviflora* var. *curviflora*	V	V	*Pimelea curviflora* var. *curviflora* is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. It grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (OEH 2013).	No
Pimelea spicata	Spiked Rice-flower	E	E	In western Sydney, *Pimelea spicata* occurs on an undulating topography of well-structured clay soils, derived from Wianamatta shale (OEH, 2013). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines (*Ibid.*). Has been located in disturbed areas that would have previously supported CPW (*Ibid.*).	Potential

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pomaderris brunnea	Rufous Pomaderris	V	V	*Pomaderris brunnea* occurs in a limited area around the Colo, Nepean and Hawkesbury Rivers as well as near Walcha on the Northern Tablelands. It grows in moist woodland or forest on clay or alluvial soils of floodplains and creek lines (OEH 2013).	Unlikely as the density of weeds would preclude colonisation
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Terrestrial orchid predominantly found in Hawkesbury Sandstone Gully Forest growing in small pockets of soil that have formed in depressions in sandstone rock shelves (NPWS 1997). Known from Georges River National Park, Ingleburn, Holsworthy, Peter Meadows Creek, St Marys Tower (NSW Scientific Committee 2013).	No
Pultenaea parviflora	*Pultenaea parviflora*	E	V	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays (OEH 2013). May also be common in ecotone between these communities and Castlereagh Scribbly Gum Woodland (*ibid.*). *Eucalyptus fibrosa* is usually the dominant canopy species (*ibid.*). *E. globoidea, E. longifolia, E. parramattensis, E. sclerophylla and E. sideroxylon* may also be present or co-dominant, with *Melaleuca decora* frequently forming a secondary canopy layer (*ibid.*). Associated species may include *Allocasuarina littoralis, Angophora bakeri, Aristida spp. Banksia spinulosa, Cryptandra spp., Daviesia ulicifolia, Entolasia stricta, Hakea sericea, Lissanthe strigosa, M. nodosa, Ozothamnus diosmifolius* and *Themeda australis* (*ibid.*). Often found in association with other threatened species such as *Dillwynia tenuifolia, Dodonaea falcata, Grevillea juniperina, Micromyrtus minutiflora, Persoonia nutans* and *Styphelia laeta* (*ibid.*). Flowering may occur between August and November (*ibid.*).	No
Pultenaea pedunculata	Matted Bush-pea	E		In NSW, *Pultenaea pedunculata* is known from three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn. It grows in woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area (OEH 2013).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Rulingia prostrata	Dwarf Kerrawang	E	E	Occurs on sandy, sometimes peaty, soils in a wide variety of habitats: Snow Gum (*Eucalyptus pauciflora*) woodland at Rose Lagoon; Blue leaved Stringybark (*E. agglomerata*) open forest at Tallong; and in Brittle Gum (*E. mannifera*) low open woodland at Penrose; Scribbly Gum (*E. haemastoma*)/ Swamp Mahogany (*E. robusta*) ecotonal forest at Tomago (OEH 2013). Associated native species may include *Imperata cylindrica*, *Empodisma minus* and *Leptospermum continentale* (*ibid*). Appears to respond positively to some forms of disturbance (eg. some Victorian records are from gravel road surfaces and the Tomago population is on an area previously subject to sandmining); however, there are conflicting reports about the response of the species to fire (*ibid*).	No
Streblus pendulinus	Siah's Backbone		E		Unlikely
Syzygium paniculatum	Magenta Lilly Pilly	V	V	This species occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW. On the Central Coast, it occurs on Quaternary gravels, sands, silts and clays, in riparian gallery rainforests and remnant littoral rainforest communities (Payne 1997). In the Ourimbah Creek valley, *S. paniculatum* occurs within gallery rainforest with *Alphitonia excelsa, Acmena smithii, Cryptocarya glaucescens, Toona ciliata, Syzygium oleosum* with emergent *Eucalyptus saligna*. At Wyrrabalong NP, *S. paniculatum* occurs in littoral rainforest as a co-dominant *with Ficus fraseri, Syzygium oleosum, Acmena smithii, Cassine australe*, and *Endiandra sieberi*. Payne (1991) reports that the species appears absent from Terrigal formation shales, on which the gully rainforests occur. *S. paniculatum* is summer flowering (November-February), with the fruits maturing in May (OEH 2013).	No
Tetratheca glandulosa	*Tetratheca glandulosa*	V	V	Associated with ridgetop woodland habits on yellow earths also in sandy or rocky heath and scrub (NPWS 1997). Often associated with sandstone / shale interface where soils have a stronger clay influence (NPWS 1997). Flowers July to November.	No
Thelymitra sp. Kangaloon (D.L. Jones)	Kangaloon Sun Orchid		CE		Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Thesium australe	Austral Toadflax	V	V	Widespread throughout the eastern third of NSW but most common on the North Western Slopes, Northern Tablelands and North Coast. Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (Themeda australis) (DECC 2007). The preferred soil type is a fertile loam derived from basalt although it occasionally occurs on metasediments and granite.	No
Wilsonia backhousei	Narrow-leafed Wilsonia	V		In NSW, *Wilsonia backhousei* is found on the coast between Mimosa Rocks National Park and Wamberal north of Sydney (Nelson's Lake, Potato Point, Sussex Inlet, Wowly Gully, Parramatta River at Ermington, Clovelly, Voyager Point, Wollongong and Royal National Park). It grows on the margins of salt marshes and lakes (OEH 2013).	No
Zannichellia palustris	Zannichellia palustris	E		*Zannichellia palustris* inhabits shallow, still to slowly moving, waterbodies which contain either fresh or brackish waters (Greenwood 2001). The species appears to prefer ephemeral habitats which dry out completely. Winning (1992) suggests the species prefers fresh to brackish water adjacent to tidal estuaries, as both known populations occurred in previously estuarine areas which had been separated from tidal flows by control structures.	Unlikely
Zieria involucrata	*Zieria involucrata*	E	V	*Zieria involucrata* has a disjunct distribution north and west of Sydney, in the Baulkham Hills, Hawkesbury, Hornsby and Blue Mountains local government areas (OEH 2013). Associated with Sydney Sandstone Gully Forest on sheltered slopes and among gullies (NPWS 1997).	No
CE = Critically Endangered; E = Endangered; E2 = Endangered Population; V = Vulnerable					

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Appendix B: Flora Species Lists

Native Species

Scientific Name	Common Name
Acacia decurrens	Black Wattle
Acacia implexa	Weetjellan
Acacia parramattensis	Sunshine Wattle
Angophora floribunda	Rough-barked Apple
Austrodanthonia racemosa	Wallaby Grass
Brunoniella australis	Blue Trumpet
Casuarina cunninghamiana	River Sheoak
Casuarina glauca	Swamp Oak
Dichondra repens	Kidney Weed
Eucalyptus botryoides	Bangalay
Eucalyptus crebra	Muggago
Eucalyptus elata	River Peppermint
Eucalyptus moluccana	Grey Box
Eucalyptus tereticornis	Forest Red Gum
Hardenbergia violacea	False Sarsparilla
Lomandra longifolia	Spiny-headed Mat-rush
Olearia viscidula	Wallaby Weed

Weed Species

Scientific Name	Common Name	Noxious	WONS
Ailanthus altissima	Tree of Heaven		
Andropogon virginicus	Whiskey Grass		
Araujia sericiflora	Moth Vine		
Arundo donax	Giant Reed		
Asparagus aethiopicus	Asparagus Fern		√
Asparagus asparagoides	Bridal Creeper	4	√
Cardiospermum sp.	Balloon Vine	4	
Celtis occidentalis	Hackberry		
Cestrum parqui	Green Cestrum	3	
Chloris gayana	Rhodes Grass		
Cirsium vulgare	Spear Thistle		
Conyza sp.	Fleabane		
Cortaderia sp.	Pampas grass	3	
Eragrostis curvula	African Love Grass		
Gleditsia triacanthos	Honey Locust		
Gomphocarpus fruticosus	Narrow-leaved Cotton Bush		
Hypochaeris radicata	Catsear		
Lantana camara	Lantana	4	√
Ligustrum lucidum	Large-leaf Privet	4	
Ligustrum sininse	Small-leaf Privet	4	
Lonicera japonica	Japanese Honeysuckle		
Lycium ferocissimum	African Boxthorn	4	√
Melinis repens	Red Natal Grass		
Olea europaea subsp. *cuspidata*	African Olive	4	
Opuntia stricta	Prickly Pear	4	√
Paspalum dilatatum	Paspalum		
Pennisetum clandestinum	Kikuyu		
Pinus radiata	Radiata Pine		
Plantago lanceolata	Plantain		
Ricinus communis	Castor oil Plant	4	
Rubus fruticosus aggregate species	Blackberry	4	√
Salix babylonica	Weeping Willow	5	
Schinus areira	Pepper Tree		
Senecio madagascariensis	Fireweed	4	√
Senna pendula var. glabra	Cassia		
Sida rhombifolia	Paddy's Lucerne		
Verbena spp.	Purpletop		

Appendix C: Assessment of Significance

Cumberland Plain Woodland (CPW)

Cumberland Plain Woodland is a Critically Endangered Ecological Community (CEEC) that occurs from soils derived from Wianamatta Shale. This CEEC can be found throughout the drier parts of the Sydney Basin. Before European settlement, CPW was extensive across the Cumberland Plain, western Sydney. Today, only 6 percent of the original extent remains intact, with the remnants scattered widely across the Cumberland Plain (NSW Scientific Committee 2011).

Shale Plains Woodland and Shale Hills Woodland are the two sub-communities of Cumberland Plain Woodland. The Shale Plains Woodland form is the most widely spread of the two sub-communities and both can be found as small, isolated stands on well-structured soils (DECCW 2010).

Cumberland Plain Woodland supports threatened endemic flora and endemic and migratory fauna species. CPW also provides important vegetative corridors for the movement of flora and fauna species into adjacent habitats.

Two patches of CPW are mapped within the study area. The first patch is located along the northern boundary and occurs as a small isolated patch. It is surrounded by cleared lands and is in a poor condition. The second patch of CPW is also located in the north of the study area, approximately 150 metres away. It exists as a larger patch and has been categorised as moderate condition with a small patch considered in good condition located beyond the development footprint. Both patches are fragmented from CPW mapped in adjoining lands. In the greater locality a large patch of CPW has been conserved within Mt Annan Botanic Gardens and is subject to bush regeneration and a weed control program. Previous mapping by NPWS (2002) has identified CPW in the adjacent areas however, this requires field validation.

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

CPW is not a threatened species.

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

CPW is not an endangered population.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

The Cumberland Plain Woodland is naturally restricted in its geographic distribution to shale derived soils in low lying, hilly and sloping areas within the Sydney Basin (NSW Scientific Committee 2011). Since European settlement, the community has been extensively cleared for agriculture, housing and development such that only 6% of the estimated original 125,000 ha of Cumberland Plain Woodland remains (NSW Scientific Committee 2011).

The proposed rezoning will allow low density industrial development within the study area. Approximately 2.36 ha of CPW have been mapped by ELA within the study area. Under the proposal 0.69 ha of CPW or 29 % of the total CPW within the study area will be removed. The remaining 1.67 ha of CPW will be retained.

The CPW earmarked for removal represents only a small proportion of CPW located within the locality of the study area. Approximately 23.08 ha of CPW is conserved within Mt Annan Botanic Gardens and is connected to the study area through a number of weedy vegetation patches. Given that only a small extent of CPW will be removed within the study area and a larger extent will remain intact in the study area and other patches are conserved in the adjacent habitat it is unlikely that the proposal would place the local occurrence of this community at risk of extinction.

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

The proposal will permanently remove up to 0.69 ha of CPW or 29% of the CPW mapped within the study area. Under the proposal one patch of CPW located along the northern boundary of the study area will be reduced by approximately one third of its original extent. This patch is in a poor condition and is highly fragmented from adjacent patches. Under the proposal this patch may result in the loss of species diversity and genetic diversity due to genetic isolation and invasion of exotic weeds.

A second patch of CPW to be removed contributes towards a larger intact patch which will be retained as part of the proposal. This larger patch of CPW varies from high to moderate CPW outside the construction footprint, to low condition inside the proposed area to be cleared.

The proposed removal of 0.69 ha of low condition CPW is unlikely to cause the local occurrence of CPW to be placed at risk of extinction given the small extent, the poor quality of habitat and the significant amount of CPW of moderate condition retained in the study area and adjacent habitats.

d. in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will permanently remove up to 0.69 ha of CPW or approximately 29% of the CPW mapped within the study area. The clearing of vegetation along the northern boundary is likely to result in the significant modification of a small patch of fragmented and disturbed patch of CPW. Potential impacts may include a reduction in the size of the remaining CPW through loss of genetic diversity, fragmentation of species invasion of exotic weeds.

The second patch of CPW to be removed contributes towards a larger intact patch which will be retained as part of the proposal. This latter patch is also located in the north of the study area and forms a narrow band of CPW surrounded by dense weeds to the east and west and cleared land to the south. The removal of a small extent of poor condition CPW is unlikely to result in the modification of the 1.67 ha remaining within the study area.

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

The proposed development will impact on two small patches of CPW mapped within the study area. Both patches are currently fragmented from each other. The first patch is located along the northern boundary. It exists as a small highly fragmented patch of CPW separated from native vegetation by

cleared lands and weed infestation along the study area boundary. Under the proposal approximately one third of this patch will be removed. Under the proposal this will reduce the patch size but it is unlikely to result in additional isolation due to the highly fragmented nature of the patch.

The second patch of CPW is located over 150 metres to the west of the first patch. This patch includes one large *Eucalyptus crebra* (Narrow-leaved Ironbark) and weedy groundcover. The removal of this tree and groundcover will unlikely fragment or isolate the remaining CPW retained in the study area. There is potential that the weedy and native vegetation within the study area and adjacent lands may form a 'stepping stone' habitat and facilitate the genetic flow into Mt Annan Botanic Gardens. The proposal is unlikely to result in fragmentation or isolation of this larger CPW patch.

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

The CPW located along the northern boundary is highly modified and disturbed patch of vegetation surrounded by cleared areas and exotic weeds. It may however, form an important role in the movement of highly mobile species from within the study area to adjacent vegetation. However, the extent of this is unknown.

The second patch of CPW forms part of a larger patch of CPW. The removal of this small section along the edge of the patch is unlikely to result in the modification, fragmentation or isolation of species or populations.

Given only 0.69 ha of poor condition CPW will be removed under the proposed actions and the remaining 1.67 ha contains higher quality CPW it is unlikely the proposed will impact on the long-term survival of species, populations or ecological communities within the locality.

The CPW within the study area is highly fragmented

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

No critical habitat has been declared for Cumberland Plain Woodland.

f. whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

A recovery plan for the Cumberland Plain Woodland has been prepared for the management of CPW (DECCW 2010). The Cumberland Plain Recovery Plan (DECCW 2010) main objectives are to protect the long-term survival and protection of the biodiversity in remaining CPW. To achieve these objectives the recovery plan aims:

1. To build a protected area network, comprising public and private lands, focusing on the priority conservation lands
2. To deliver best practice management for threatened biodiversity across the Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation
3. To develop an understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management, and the recovery program

4. To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner.

The recovery plan also states that '*where impacts on biodiversity cannot be avoided, they should be offset using appropriate means.'* Therefore provided offsets are provided to compensate for the proposed loss, the proposal would be consistent with the Recovery Plan requirements

No relevant threat abatement plans have been prepared for this community and 18 priority actions have been identified for this community. The proposal is not inconsistent with any priority actions.

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

A number of Key Threatening Processes (KTP) are relevant to this proposal with respect to CPW. These include:

1. Clearing of native vegetation (TSC Act) / Land clearance (EPBC Act)
2. Invasion of native plant communities by exotic perennial grasses (TSC Act)
3. Removal of dead wood and dead trees (TSC Act)
4. Invasion and establishment of exotic vines and scramblers (TSC Act)
5. Invasion of native plant communities by African Olive *Olea europaea* subsp. *cuspidata* (TSC Act)
6. Invasion of native plant communities by exotic perennial grasses (TSC Act).

The proposed actions are likely to increase the spread of weeds across the study area and remove native vegetation including dead wood and trees or potential future hollow-bearing trees. However, given the small extent (0.69 ha) of the vegetation to be removed and the low condition of the vegetation the KTPs are not considered significant provided that the remaining 1.67 ha are retained and maintained in good condition.

Conclusion

Although the proposal would result in the removal of 0.69 ha of low condition CPW, the proposed clearance is considered unlikely to be significant for the following reasons:

1. The proposed clearance is small with respect to the amount of CPW within the study area;
2. A significant amount of CPW is conserved within the adjacent Mt Annan Botanic Gardens
3. The remaining 1.67 ha will be retained and should be considered for management under a Vegetation Management Plan (VMP).

On the basis of the above considerations, it is unlikely that the proposal will result in a significant impact on CPW. Consequently, a Species Impact Statement is not required for the proposal with respect to this community.

River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; (RFEF)

River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (RFEF) is a tall mixed open forest to woodland occurring on river flats and terraces in the central to upper parts of coastal floodplains. It is distinguished from other floodplain EECs by its dominance of either a mixed or single species eucalypt tree layer (including *Angophoras*), with few She-oak (*Casuarina*) or Swamp Mahogany (*Eucalyptus robusta*) trees, and a prominent groundcover of soft leaved herbs and grasses. River-flat Eucalypt Forest occurs on the flats, drainage lines and river terraces of coastal floodplains where flooding is periodic and where soils are generally rich in silt, lack deep humic layers and have little or no saline (salt) influence.

River-flat Eucalypt Forest occurs within the study area. A small patch is located to the north-eastern corner of the study area and is in moderate condition and adjoins a larger patch off-site. A second and large patch of RFEF located along the western boundary and adjoins the Nepean River to the west of the study area.

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

Not applicable, RFEF is not a threatened species.

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

Not applicable, RFEF is not an endangered population.

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

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

Approximately 6.5 ha of RFEF were mapped by ELA within the study area. Of which approximately 0.59 ha of RFEF is earmarked for removal under the proposed rezoning of the study area. This small extent of RFEF accounts for 9.1 % of the RFEF and occurs as two patches to the north-west and north-eastern boundaries of the study area. An additional 5.9 ha or 90.9% of RFEF will be retained as part of the proposed industrial development.

The two patches of RFEF identified within the study area contribute towards larger more extensive patches beyond the study area boundaries. The largest intact patch aligns the Nepean River to the west of the study area and the patch represents over 18.94 ha of RFEF. The second patch of RFEF occurs along Caleys Creek to the east of the study boundary. It forms a series of interlinking patches and represents over 23.08 ha of RFEF.

Given the small extent of RFEF to be removed and the significant amount of RFEF retained within the study area and adjoining lands the proposed rezoning is unlikely to result in the local occurrence to be placed at risk of extinction.

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

The RFEF to be removed under the proposal has been modified and altered through historical disturbances within the study area. The RFEF contains a number of exotic weeds and potential clearing of native vegetation. Under the proposal only a small extent (0.59 ha) of RFEF vegetation will be removed. Up to 5.9 ha of RFEF will be retained within the study area. Given that the vegetation proposed for removal will not result in the fragmentation or isolation of patches the genetic diversity is unlikely to be impacted. As such the ecological community is unlikely to be placed at risk of extinction.

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

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

The proposed rezoning of the study area will result in the removal of approximately 0.59 ha of RFEF for low density industrial development. The RFEF for removal occurs along the outer weedy edge of the two RFEF patches. As such the removal will not result in the fragmentation of vegetation patches. There is potential that the removal of vegetation will encourage the establishment of exotic weeds into the remaining RFEF and lead to a decline in the species diversity and assemblage. However, the RFEF within the study area already contains a high density of exotic weed species.

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

The proposed industrial development is unlikely to fragment or isolated RFEF vegetation communities mapped within the study area. There are two patches of RFEF identified in the study area. The proposed clearing of vegetation will result in the removal of the outer edge of RFEF and maintain the inner patch structure. As such the removal of vegetation is unlikely to result in the fragmentation or isolation of vegetation given the extensive amount retained in the study area and linked to the adjacent areas.

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

The RFEF vegetation along Nepean River and the unnamed drainage line forms an important corridor for the dispersal of flora and fauna species. These corridors link with the RFEF vegetation identified within the western and eastern boundaries of the study area. Of which only a small extent (0.59 ha) of the outer edges of RFEF will be removed under the proposed actions. The removal of these patches would not impend on the movement of native flora and fauna genetic flow between patches. Additionally, up to 5.9 ha of RFEF will be retained in the study area and provide suitable corridor for genetic flow. Therefore the proposed is unlikely to impact on the long term survival of a species, population or ecological community.

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

No critical habitat has been declared for RFEF.

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

No recovery plan has been prepared for RFEF. However, 26 priority actions have been described for the RFEF.

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

A key threatening process is defined under the TSC Act as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*".

A number of Key Threatening Processes (KTP) are relevant to this proposal with respect to RFEF. These include:

1. Clearing of native vegetation (TSC Act) / Land clearance (EPBC Act)
2. Removal of dead wood and dead trees (TSC Act)
3. Invasion of native plant communities by African Olive *Olea europaea* subsp. *cuspidata* (TSC Act).

The invasion of exotic woody weeds is listed as a KTP and has the potential to impact on the ecological function and long-term survival of RFEF. The removal of native vegetation including RFEF has the potential to impact on the long-term survival of endangered ecological communities. However, given the extent of vegetation to be cleared the KTP are unlikely to have a significant impact on the long-term survival of RFEF. It is recommended that a Vegetation Management Plan (VMP) is implemented to mitigation these potential KTPs.

Conclusions

The proposal is unlikely to impose a significant impact on RFEF given that the proposed works:

1. The proposed clearance is small (9.1 %) with respect to the amount of RFEF within the study area;
2. The remaining 5.9 ha of RFEF will be retained and should be considered for management under a Vegetation Management Plan (VMP)

On the basis of the above considerations, it is unlikely that the proposal will result in a significant impact on RFEF. Consequently, a Species Impact Statement is not required for the proposal with respect to this community.

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