



NARLA
environmental

Biodiversity Assessment Report

Hurlstone Agricultural High School (Hawkesbury)

State Significant Development Application (SSD 8614)

December 2017

HASH-00-SD-EC-RP-0001



Prepared for:	Conrad Gargett Ancher Mortlock Woolley
Prepared by:	Narla Environmental Pty Ltd
Project no:	coga1
Date:	December 2017
Version:	V1.0

© Narla Environmental Pty Ltd

The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of the Engagement for the commission.

This report and all information contained within is rendered void if any information herein is altered or reproduced without the permission of Narla Environmental. Unauthorised use of this document in any form whatsoever is prohibited.

This report is invalid for submission to regulatory authorities to any while it is in draft stage. Narla Environmental Pty Ltd will not endorse this report if it has been submitted to council while it is still in draft stage. This document is and shall remain the property of Narla Environmental Pty Ltd.

Disclaimer:

Narla Environmental Pty Ltd has completed this assessment in accordance with the relevant federal, state and local government legislation as well as current industry best practices including guidelines. Narla Environmental Pty Ltd accepts no liability for any loss or damages sustained as a result of reliance placed upon this report and any of its content or for any purpose other than that for which this report was intended.

Narla Environmental Pty Ltd
www.narla.com.au

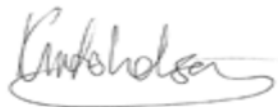
Report Certification

Works for this report were undertaken by:

Name	Company / Position	Role
Kurtis Lindsay BSc (Hons)	Narla Environmental – Principal Ecologist	Project Management, Biobanking accredited assessor 0224
Alexander Graham BSc	Narla Environmental – Ecologist	Report Writing, Field Ecologist, Mapping, Desktop Review
Emily Benn BSc (Hons)	Narla Environmental – Ecologist	Field Ecologist

I, Kurtis Lindsay, certify that:

- this document has been prepared in accordance with the brief provided by Conrad Gargett Ancher Mortlock Woolley and OEH requirements of a Biodiversity Assessment Report and the SEARs provided (SSD 8614).
- the information presented in this report is a true and accurate record of the study findings in the opinion of the authors.



Kurtis Lindsay
Principal Ecologist and Manager
Narla Environmental Pty Ltd
02 9986 1295
0414 314 859
kurtis.lindsay@narla.com.au

Contents

1.	Glossary	1
2.	Introduction	2
2.1	Project Background	2
2.2	Proposed Development	3
2.3	Site Description and Location	3
2.4	Geology and Soils.....	3
3.	Assessing Native Vegetation	5
3.1	Description of the Vegetation on the Subject Site	5
3.1.1	Desktop Assessment	5
3.1.2	Site Assessment	5
3.1.2.1	Grasslands.....	5
3.1.2.2	Paddock Screens	5
3.1.2.3	Drainage Line.....	5
3.2	Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin (PCT 835)	7
3.3	Identifying Vegetation Zones	10
3.4	Biometric Plots and Transects	11
4.	Assessing threatened species and populations	14
4.1	Threatened and Conservation Significant Flora.....	14
4.1.1	Targeted Species Credits Survey.....	14
4.1.1.1	Flora Species	14
4.1.1.1	Fauna Species.....	14
5.	Impact Assessment and Credit Calculations.....	16
5.1	Assessment of Impacts	16
5.2	Mitigation of impacts	16
5.3	Credit Calculations	17
5.3.1	Ecosystem Credits	17
5.3.2	Species Credits	17
5.4	Thresholds for the assessment and offsetting of unavoidable impacts	17
6.	Conclusion	18
	References.....	19
	Appendices.....	20
	Appendix A. Flora Inventory	21
	Appendix B. Sample Survey Pro-forma.....	23



1. Glossary

Acronym	Description
BAR	Biodiversity Assessment Report
BioMetric	Refers to the State Government devised methodology for vegetation assessment
BCC	Bio-banking Credit Calculator
CPW	Cumberland Plain Woodland
DPE	NSW Department of Planning and Environment
Subject Site	Hurlstone Agricultural High School (Hawkesbury) (Lot2/DP1051798)
EEC	Endangered Ecological Community
EPBC Act	<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</i>
FBA	Framework for Biodiversity Assessment
IBRA	Interim Bio-regionalisation of Australia
LGA	Local Government Area
LPI	Land and Property Information
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
RFEF	River-Flat Eucalypt Forest
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
m	Metres
km	Kilometres
ha	Hectares
TSC Act	<i>NSW Threatened Species Conservation Act 1995</i>

2. Introduction

2.1 Project Background

This Biodiversity Assessment Report (BAR) has been prepared to accompany the State Significant Development (SSD) Application (8614) relating to the proposed development of the new Hurlstone Agricultural High School (Hawkesbury) at (Lot 2/DP1051798) (hereafter referred to as the 'Subject Site').

Secretary's Environmental Assessment Requirements (SEARs) have been issued by the Department of Planning and Environment (DPE). The SEARs stipulate that the biodiversity impacts for the proposal be assessed in accordance with the Framework for Biodiversity Assessment (FBA) (OEH 2014). The FBA (OEH 2014) assessment and BAR have been prepared by Kurtis Lindsay (accredited BioBanking assessor No.224), to satisfy the requirements of the SEARs.

For the purposes of the BAR, the Subject Site has been divided into three sections;

- 'Developed' land, comprising small polygons within the north of the Subject Site;
 - This includes all buildings, hard landscaping, car parking lots and ornamental gardens.
- 'Cleared/exotic' land, comprising the largest area within the Subject Site;
 - This includes all areas that are dominated by exotic vegetation and could not be assigned to a PCT.
- 'River-Flat Eucalypt Forest' (RFEF) located along the drainage line in the south of the Subject Site.
 - This encompasses the only identifiable Plant Type Community (PCT) within the Subject Site.

In accordance with Section 2.3.1.2 of the FBA (OEH 2014), the current assessment provides limited discussion of the works proposed in the northern and eastern portions of the Subject Site, as these are not associated with clearing vegetation (except limited removal of exotic and ornamental species).

BiMetric plot analysis of the development area determined that only one native vegetation community was present within the Subject Site: 'Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin (HN526/ PCT 835)'. This PCT is consistent with 'River-flat Eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South-East Corner bioregions', as the listed Endangered Ecological Community (EEC) under the *Threatened Species and Conservation Act 1995* (TSC Act).

2.2 Proposed Development

The proposed development includes:

- The construction of Hurlstone Agricultural High School (Hawkesbury), including;
 - the construction of a new Assembly Court and Boarding Accommodation & Agricultural Enterprises Field (not within the scope of this SEAR's);
 - the development of all associated infrastructure and hard-landscaping;
 - The delineation of new 'Agricultural Landscaped Space'
- The construction of 'Service Access Road' along the southern boundary of the Subject Site.

2.3 Site Description and Location

The Subject Site is located within University of Western Sydney Hawkesbury Campus, Richmond, New South Wales, Australia (Lot 2/DP1051798) (**Figure 1**). The site is situated between Londonderry Road, and Vines Drive within the Richmond Council Area. The University of Western Sydney, Hawkesbury Campus occupies approximately 291 hectares (ha) of land zoned as 'SP1 - Special Activities: Education Agriculture'.

The Subject Site is comprised of approximately 12.61 ha of historically cleared land that is currently occupied by large expanses of exotic grassland. Aerial imagery depicts a landscape, subject to extensive land management practices; including tilling and ploughing (**Figure 2**).

The Subject Site contains approximately 0.38 ha existing buildings, hard surface landscaping and carparks in the north. Along the southern boundary of the Subject Site, a vegetated drainage line, comprised of 12.2 ha of native vegetation (both remnant and planted) exists (**Figure 1**). This vegetation is the focus of the BAR.

2.4 Geology and Soils

The Subject Site is situated on the Berkshire Park Soil Landscape (Chapman and Murphy 1989). The Berkshire Park Soil Landscape is characterised by dissected, gently undulating low rises on the Tertiary terraces of the Hawkesbury/Nepean River Systems. The soils of this landscape are the result of three depositional phases of Tertiary alluvial/colluvial origin. The lowest deposit is the St Marys formation. This is overlain by the Rickabys Creek gravel formation which is of varying thickness and, in turn, is topped by the Londonderry Clay formation. All of these formations are derived from sandstone and clay. Erosion of the surface has led to exposure of all three formations in different locations across the distribution of this soil landscape.

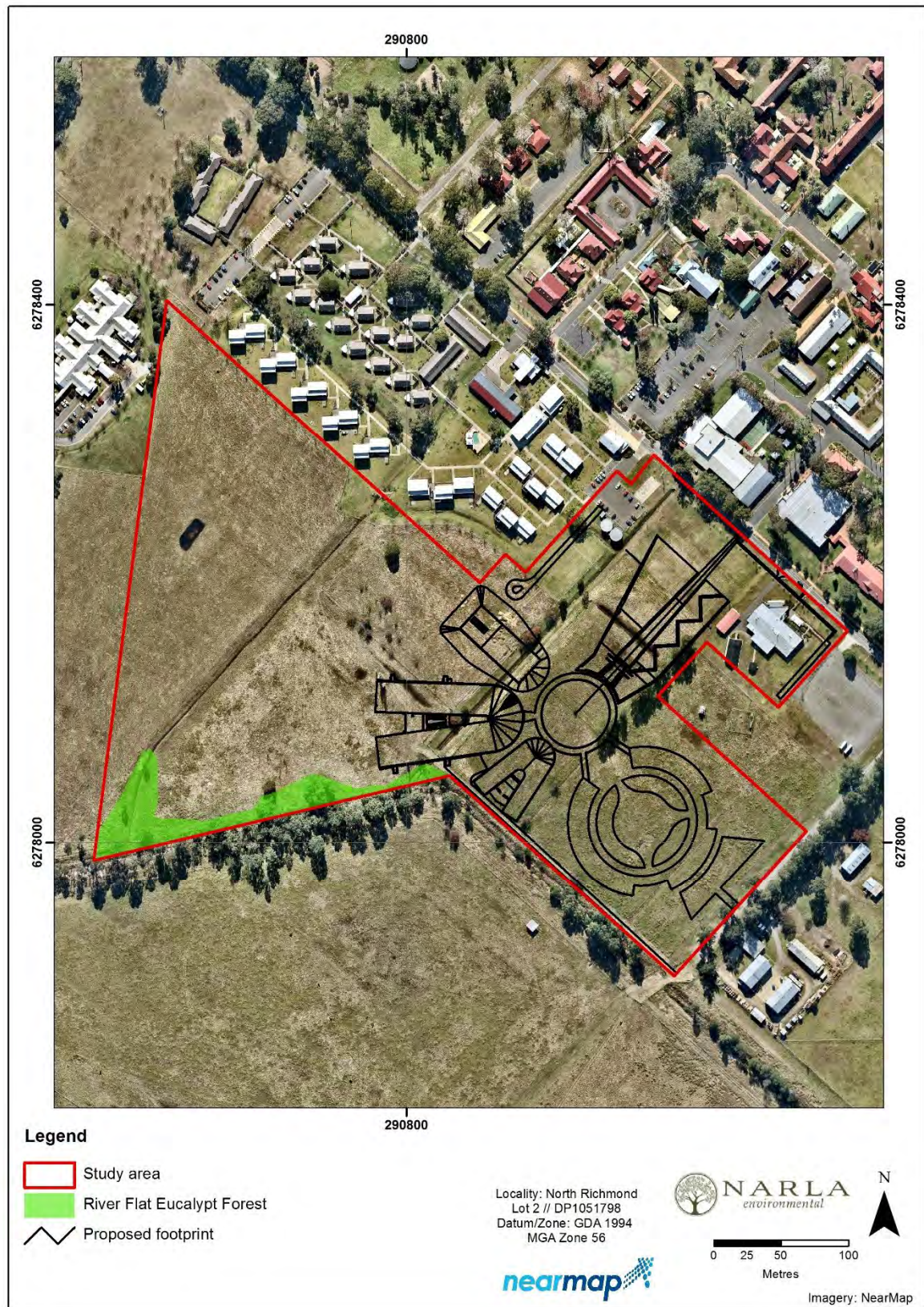


Figure 1. Proposed development footprint and mapped PCTs within the Subject Site

3. Assessing Native Vegetation

3.1 Description of the Vegetation on the Subject Site

3.1.1 Desktop Assessment

None of the vegetation within the Subject Site had been historically mapped within *Remnant Vegetation Mapping of the Cumberland Plain VIS_ID 2221 – 2223* (OEH 2014). This suggested that the vegetation on the Subject Site was either derived or planted.

3.1.2 Site Assessment

Site assessment undertaken by Narla Environmental Ecologists in September 2017. The Ecologists determined that the majority of the vegetation within the Subject Site consisted of enriched, exotic pastures.

3.1.2.1 Grasslands

The flora assemblage of all grassland areas on the Subject Site was influenced by a history of disturbance, heavy grazing and the introduction of exotic pasture grasses. The grassland areas of the Subject Site have been extensively managed for pasture improvement over multiple decades with evidence of vegetation clearing, tilling, ploughing, fertiliser application and sowing of pasture grasses and legumes (**Figure 2**). These areas have also been subject to extensive, historical grazing by domestic ruminants including, sheep, cattle and horses. These areas could not be assigned to PCTs, and have been designated as 'cleared/exotic' in the vegetation mapping in this report (**Figure 3**).

Owing to an absence of sufficient rain, it is possible that native and exotic perennial graminoids may have been suppressed to the extent that the native species assemblage was reduced by the time of the site assessment. However, it is considered more likely that historical land management has permanently altered the floristic assemblage of the landscape to an extent that it no longer contains a natural assemblage of native ground cover plants.

3.1.2.2 Paddock Screens

A monoculture of planted *Casuarina glauca* was identified within the east of the Subject Site, these trees have been planted in a row as a screen between paddocks (**Plate 1**). No native mid-storey or groundcover species were identified in proximity to these trees, accordingly no Plant Community Type (PCT) could be assigned.

3.1.2.3 Drainage Line

The native vegetation on the Subject Site was entirely restricted to remnant canopy trees dispersed along the narrow drainage line in the southern extent of the Subject Site. Site assessment and Biometric plot analysis determined that only one native vegetation community was represented within the Subject Site: 'Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin (HN526/ME018/PCT 835)'. This PCT is consistent with 'River-flat Eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South-East Corner bioregions.' This community is listed as an endangered ecological community under the *Threatened Species and Conservation Act 1995* (TSC Act). This PCT was restricted to the southern boundary of the Subject Site (**Figure 3**). It was characterised by the dominance of *Angophora subvelutina* (Broad-leaved Apple) and *Eucalyptus tereticornis* (Forest Red Gum) situated on alluvial soils.



Plate 1. Row of historically planted *Casuarina glauca* (Swamp Oak) within the east of the Subject Site.



Plate 2. Typical enriched exotic pastureland throughout the Subject Site, dominated by *Eragrostis curvula*.



Figure 2. Evidence of ploughing within the Subject Site (dated 5/05/2017)

3.2 Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin (PCT 835)

Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin (PCT 835) (hereafter referred to as 'River-flat Eucalypt Forest') was the only represented vegetation community within the Subject Site. This community was identified by a floristic assemblage dominated by Broad-leaved Apple and Forest Red Gum. *Acacia parramattensis* (Parramatta Wattle) was represented within the mid-storey, while minor occurrences of native *Einadia trigonos* (Fishweed), *Sporobolus creber* (Slender Rat's Tail Grass) and *Juncus usitatus* are present within the groundcover. Ground covers were sparse and with low species diversity reflective of competition from thick exotic perennial grasses (i.e. *Eragrostis curvula* [African Lovegrass] and *Chloris gayana* [Rhodes Grass]) (Plate 3).



Plate 3. River-flat Eucalypt Forest along the southern boundary of the Subject Site

Table 1: Mapped Plant Community Types and other features

Narla Environmental Vegetation Community	Vegetation type (OEH 2011)	Plant community type / Other feature (Narla Environmental 2017)	Total area (ha)
River-flat Eucalypt Forest	River-flat Eucalypt Forest	PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	0.51
Cleared/Exotic Pastureland	N/a	Cleared and exotic pasture land (could not be assigned to PCT due to absence of the required diversity of native flora)	12.61
Developed Areas	N/a	Built structure (i.e. carpark, buildings)	0.38
Total area (ha)			13.5



Figure 3: Field validated vegetation and other features

3.3 Identifying Vegetation Zones

A total of sixteen (16) Ecologist hours were spent surveying the Subject Site across its entire area. Extensive survey was undertaken by Narla Environmental Ecologists with extensive experience working within the natural landscape of Western Sydney.

A single vegetation zone was identified based on the PCT classification and an assessment on condition consistent with the requirements of the FBA (OEH 2014). Condition class was determined by the Narla Environmental Ecologists, based on the definitions of 'Low condition' and 'Moderate-Good condition' vegetation within the FBA (OEH 2014).

The Framework for Biodiversity Assessment defines 'Vegetation in Low Condition' as:

- "Woody native vegetation with native over-storey percent foliage cover less than 25% of the lower value of the over-storey percent foliage cover benchmark for that vegetation type, and where either:
 - Less than 50% of ground cover vegetation is indigenous species, or
 - Greater than 90% of ground cover vegetation is cleared
- OR
- Native grassland, wetland or herbfield where either:
 - Less than 50% of ground cover vegetation is indigenous species, or
 - More than 90% of ground cover vegetation is cleared.

Native vegetation that is not in low condition is in moderate to good condition"

Based on the definitions of 'Vegetation in Low Condition' within the FBA, River-flat Eucalypt Forest within the Subject Site was determined to meet the criteria for *moderate-good condition* vegetation; as woody native vegetation with native over-storey percent foliage cover less than 25% of the lower value of the over-storey percent foliage cover benchmark (21%) for Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion – PCT 835.

The total area of the vegetation zone is provided in **Table 2** and displayed in **Figure 4**.

Table 2: Vegetation zones

PCT ID / Biometric vegetation ID	Common Name	PCT name	Condition	Area impacted In APZ (ha)	Area impacted in Construction Footprint (ha)
PCT835 / ME018	Cumberland Riverflat Forest	835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	Moderate - Good	0	0

3.4 Biometric Plots and Transects

Biometric plot and transect based surveys (as per the FBA - OEH 2014) were undertaken by Narla Environmental Ecologists Alexander Graham and Emily Benn on the 5th of September 2017. Both Ecologists were experienced in the undertaking of field assessment within Western Sydney, particularly on the Cumberland Plain. A total of 16 personnel hours were spent collecting biometric data from eight (8) plots within the Subject Site.

A summary of the weather conditions on the day in the locality of the Subject Site. Richmond weather station observations are included in **Table 3** below and are typical of the conditions during that time of the year. Strong westerly winds were noted during survey. This information is provided by the Bureau of Meteorology (2017).

Table 3: Weather conditions taken from the nearest weather station (Richmond) in the lead up and during the field survey (BOM 2017) (Survey date in bold)

Survey date	Minimum Temp.	Maximum Temp. °C	Rainfall (mm)
30/08/2017	6.4	22.8	0
31/08/2017	10.9	24.1	0
01/09/2017	0.9	19.0	0
02/09/2017	1.5	23.4	0
03/09/2017	3.7	30.4	0
04/09/2017	7.0	22.4	0
05/09/2017	7.5	18.8	0

Eight (8) plots and transects were established within the Subject Site to best sample the natural variation of the vegetation across the Subject Site. This exceeds the requirements of the FBA (OEH 2014), which sets the minimum as 1 plot and transect per 2 ha (or part thereof). Plots were randomly stratified to attain best coverage across the Subject Site. An example of the plot sheets used is provided in **Appendix B**.

The summarised results obtained from each plot are provided in **Table 4**. The (8) eight plot and transect locations are shown in **Figure 4**.

Table 4: Biometric plot and transect results

Plot No.	1	2	3	4	5	6	7	8
Coordinates (Easting)	0290986	0290994	0290582	0290761	0290749	0290908	0290981	0290692
Coordinates (Northing)	6277940	6278027	6278011	6278185	6278046	6278045	6278129	6278267
Native Plant Species Richness (%)	1	3	4	3	0	1	1	2
Native Over-storey Cover (%)	0	0	10.5	0	0	0	0	0
Native Mid-storey Cover (%)	0	0	0	0	0	0	0	0
Native Ground Cover (Grasses) (%)	0	0	0	0	0	0	0	0
Native Ground Cover (Shrubs) (%)	0	0	0	0	0	0	0	0
Native Ground Cover (Other) (%)	0	0	0	6	0	0	2	4
Exotic Plant Cover (%)	100	100	98	94	98	98	98	96
Number of Trees with Hollows	0	0	2	0	0	0	0	0
Over-storey Regeneration (score) (%)	0	0	0	0	0	0	0	0
Fallen Logs (m)	0	0	3	0	0	0	0	0

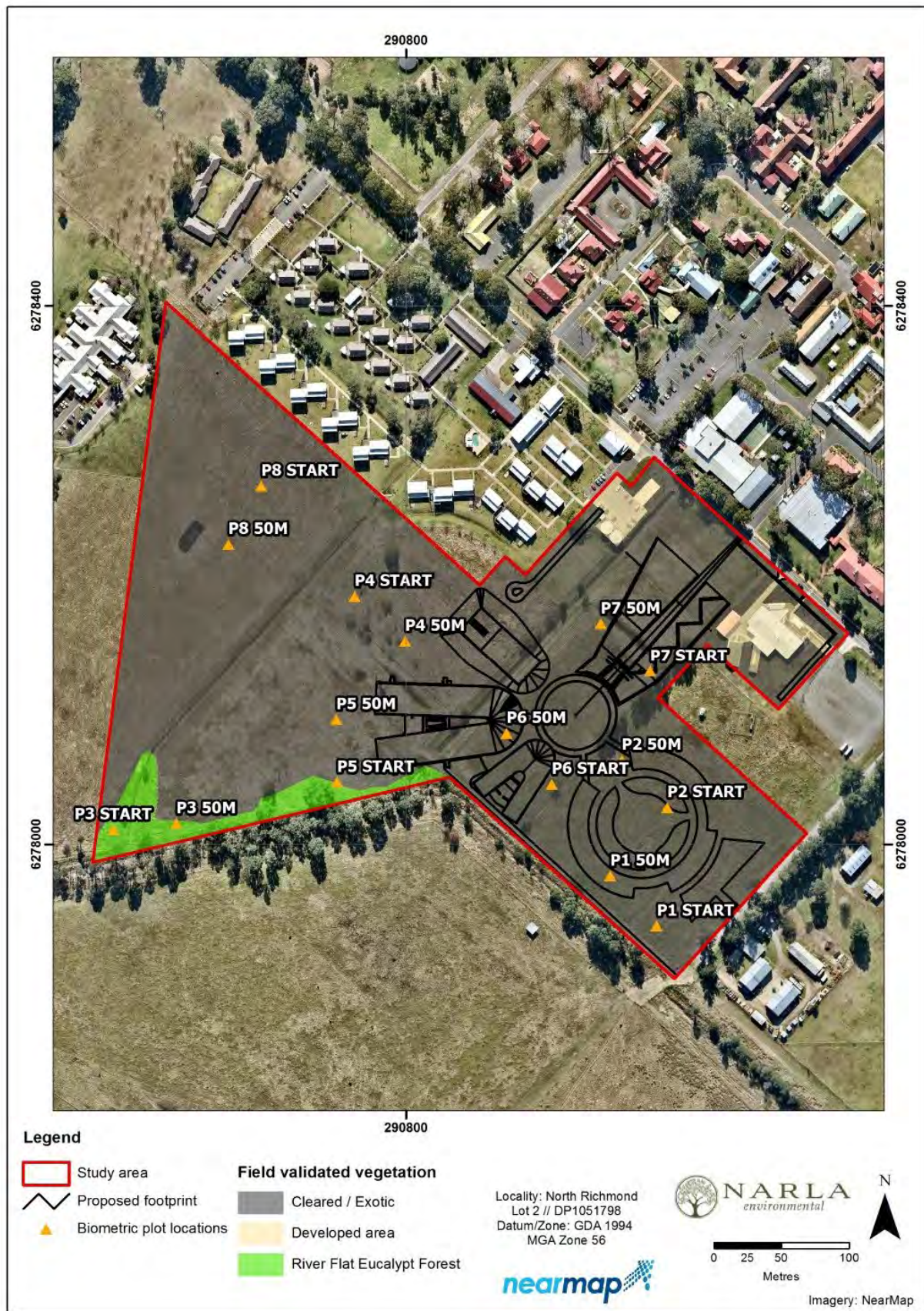


Figure 4: Vegetation zones within construction footprint

4. Assessing threatened species and populations

4.1 Threatened and Conservation Significant Flora

Where suitable habitat for threatened flora occurred within the Subject Site, extensive survey was undertaken to determine its presence. Sensitive herbs such as *Pimelea spicata* may only emerge after suitable rainfall, and at certain times of the year such as spring and early summer, as such they could not be surveyed for during the site visit owing to the dry prevailing conditions in September 2017.

Table 5. Threatened flora deemed as having potential to occur on the Subject Site

Species	TSC Act	EPBC Act
<i>Dillwynia tenuifolia</i>	Vulnerable	-
<i>Acacia pubescens</i>	Vulnerable	-
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Vulnerable	-
<i>Pimelea spicata</i>	Endangered	Endangered

4.1.1 Targeted Species Credits Survey

4.1.1.1 Flora Species

Narla Environmental Ecologists undertook targeted survey for all threatened flora with potential to occur. The Random Meander technique documented by Cropper (1993) was employed with maximum effort directed toward sampling areas likely to be directly affect by the proposal (**Figure 5**).

Despite extensive survey Narla Environmental did not identify the presence of any locally occurring threatened flora. It is considered possible that some threatened flora species may occur on the site in dormancy (e.g. in the soil bank). No TSC Act or EPBC Act listed flora were confirmed on or immediately adjacent the Subject Site. This does not rule out the potential for some threatened species to still exist on the Subject Site in a state of dormancy.

4.1.1.1 Fauna Species

Narla Environmental Ecologists undertook targeted surveys for *Meridolum corneovirens* (Cumberland Plain Land Snail). The Ecologists searched the entire subject site of all suitable habitat, including leaf litter, coarse woody debris and at the base of trees that presented suitable sheltering habitat. No individuals were identified, nor were signs of past use (empty shells) identified. No Cumberland Plain Land Snail sheltering habitat will be impacted by the proposed development.

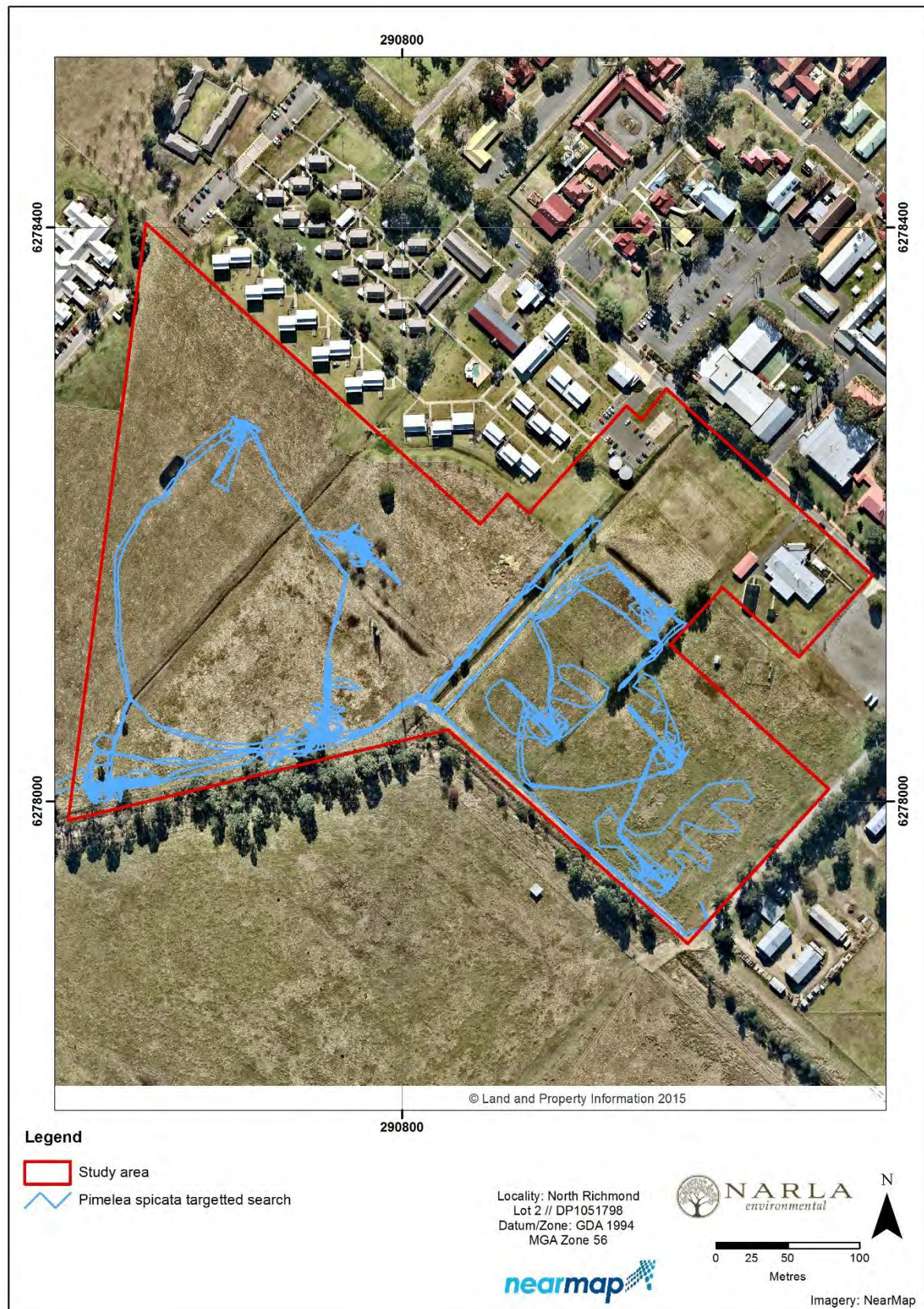


Figure 5. Threatened flora (targeted search) meandering transect

5. Impact Assessment and Credit Calculations

5.1 Assessment of Impacts

The proposed development will not impact upon any areas of native vegetation or threatened species habitat. The proposed development will directly impact upon approximately 3.3ha of 'cleared/exotic' vegetation. No impact from the development or its proposed Bushfire Asset Protection Zones (APZ) upon any mapped PCT will occur. The final project impact is provided in **Table 6**.

Biometric plot and transect data revealed that mapped PCT 835: *Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain*, Sydney Basin is 'moderate – good' condition, as woody native vegetation with native over-storey percent foliage cover less than 25% of the lower value of the over-storey percent foliage cover benchmark (21%). This PCT will not be impacted upon by the proposed development and its APZ.

Table 6: Total impact on native vegetation

Plant community type	Total Area (ha)	Area impacted in development footprint (ha)
PCT 835 – Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flat of the Cumberland Plain, Sydney Basin	0.51	0
Cleared/Exotic Vegetation	12.61	3.3
Developed Areas	0.38	0

5.2 Mitigation of impacts

Several measures will be implemented to reduce impacts where possible. Details are provided below.

- Fencing off all native vegetation, particularly mapped River-flat Eucalypt Forest EEC.
- Maintaining and enhancing bushland revegetation and weed management post construction phase.
- Managing vegetation on the Subject Site under a Biodiversity Management Plan that provides management actions and performance criteria.
- Assigning an Ecologist to undertake a pre-clearing survey of the vegetation prior to track construction. If any significant ecological values such as nests are found, these are to be recorded and mapped.
- Assigning an Ecologist to be present on site during all vegetation clearance. The Ecologist will be able to guide works crews away from sensitive ecological features, and will be on hand to capture and relocate displaced fauna.
- Preventing the inadvertent introduction of exotic flora propagules by following the DEP (2015) 'Arrive Clean, Leave Clean' Guidelines.
- Ensuring appropriate erosion and sedimentation controls are maintained throughout the construction phase and the period immediately following as outlined in the 'Blue Book' (Landcom 2004).

5.3 Credit Calculations

The proposed development will have no impact on any native vegetation community or threatened species habitat therefore no calculations were undertaken using the Framework for Biodiversity Assessment (FBA) Calculator.

5.3.1 Ecosystem Credits

No Ecosystem Credits will be impacted by the development or any associated structures or APZ.

5.3.2 Species Credits

Targeted survey was undertaken for all threatened species with potential to occur (see **section 4.1.1**) no individuals were identified within the Subject Site. Furthermore, potential habitat was considered to be suboptimal for these species. It is unlikely that any species credit species will occur in the footprint of the proposed development, or be impacted by the development or its ancillary components. No further assessment is required.

5.4 Thresholds for the assessment and offsetting of unavoidable impacts

Section 9: Table 4 of the FBA (OEHS 2014) provides thresholds for the assessment and offsetting for the unavoidable impacts of development. Four thresholds have been defined, including:

- i. Impacts that require further consideration by consent authority
- ii. Impacts for which the assessor is required to determine an offset
- iii. Impacts for which the assessor is not required to determine an offset
- iv. Impacts that do not require further assessment by the assessor.

The proposed development meets the requirements of (iv), as outlined below.

As documented in Section 9.5 of the FBA (OEHS 2014) an assessor is not required to assess areas of land on the development site without native vegetation under Chapter 4 or Chapter 5, unless the SEARs issued for the project require an assessment of the land in accordance with those chapters.

The proposed development is not required to determine an offset as no PCT will be impacted upon by the proposed development.

6. Conclusion

The proposed development has been assessed pursuant to the FBA, including the preparation of a site scale vegetation map and completion of the eight Biometric plots and transects.

The results of the assessment found that zero (0) ecosystem credits were required to offset 0 ha of impact to native vegetation from the proposed development. No species credits are required for the proposal.

The application of threshold (iv) of the FBA (OEH 2014) means the development is not required to determine an offset. It is therefore proposed that the development proceeds without the purchase or retirement of ecosystem or species credits irrespective of the credit calculation results.

References

- Benson D & Howell J 1990. Taken for Granted - The Bushland of Sydney and its suburbs. Kangaroo Press, Kenthurst.
- Chapman and Murphy (1989) Soil Landscapes of the Sydney 1:100 000 Sheet, Soil Conservation Service of NSW, Sydney.
- Cropper, S.C. (1993) Management of Endangered Plants, CSIRO Publishing, Melbourne.
- Department of the Environment (DEP) (2015) Arrive Clean, Leave Clean: Guidelines to help prevent the spread of invasive plant diseases and weeds threatening our native plants, animals and ecosystems, The Commonwealth of Australia
- NSW Land and Property Information (LPI) (2017). SIX Maps. <https://maps.six.nsw.gov.au/>
- Herbert, C. (1983) Geology of the 1:100 000 Sheet 9130. Geological Survey of NSW, Sydney.
- Landcom (2004) Managing urban stormwater: harvesting and reuse 'The Blue Book'
- NSW Department of Primary Industries (DPI) (2017) Weeds declared in the Local Control Authority area of Richmond Local Government Area, Weeds Wise, [September 2017]
- NSW Office of Environment and Heritage (2017) Atlas of NSW Wildlife database (Bionet). [September 2017].
- NSW Office of Environment and Heritage (OEH) (2011a) NSW Scientific Committee - final determination: River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – endangered ecological community listing, [September 2017] <http://www.environment.nsw.gov.au/determinations/RiverflatEucalyptForestEndSpListing.htm>
- NSW Office of Environment and Heritage (OEH) (2013) The Native Vegetation of the Sydney Metropolitan Area, Volume 2: Vegetation Community Profiles, Version 2.0, NSW Office of Environment and Heritage, Sydney.
- NSW Office of Environment and Heritage (OEH) (2014a) Framework for biodiversity assessment. State of NSW and Office of Environment and Heritage, Sydney.
- NSW Office of Environment and Heritage (OEH) (2014b) Remnant Vegetation Mapping of the Cumberland Plain VIS_ID 2221-2223, NSW Office of Environment and Heritage, Sydney
- NSW Office of Environment and Heritage (OEH) (2016a) NSW soil and land information, eSPADE Online Database, <http://www.environment.nsw.gov.au/eSpadeWebapp/>
- PlantNET (The NSW Plant Information Network System) (2016), 'NSW Flora Online: Plant Species Profiles' Royal Botanic Gardens and Domain Trust, Sydney. [September 2017] <http://plantnet.rbgsyd.nsw.gov.au>
- Ralph, M. (2003) 'Growing Australian Native Plants from Seed – For Revegetation Tree Planting and Direct Seeding', Second Edition, Bushland Horticulture Publications
- Richardson, F, Ricardson, R., Shepard, R. (2011) 'Weeds of the South-East – An Identification Guide for Australia', Second Edition, R.G. and F.J Richardson
- Robinson, L. (2003) 'Field Guide to the Native Plants of Sydney', Third Edition, Kangaroo Press

Appendices

Appendix A – Flora inventory

Appendix B - Sample Survey Pro-forma

Appendix A. Flora Inventory

Scientific Name	Exotic	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
<i>Acacia implexa</i>					1				
<i>Acetosella vulgaris</i>	*								3
<i>Andropogon virginicus</i>	*				3				
<i>Briza minor</i>	*	3		2					
<i>Bromus catharticus</i>	*			2					
<i>Cerastium glomeratum</i>	*	4b	6				2	4b	
<i>Chloris gayana</i>	*		2	3					
<i>Cynodon dactylon</i>	*	4b	4b		1		4b	5	7
<i>Cyperus eragrostis</i>	*			1					
<i>Einadia trigonos</i>				1					
<i>Eragrostis curvula</i>	*	5	3		4a	5	4a	2	
<i>Eucalyptus tereticornis</i>				5					
<i>Euphorbia peplus</i>	*							1	
<i>Fumaria officinalis</i>	*					4a			
<i>Gleditsia triacanthos</i>	*			1					
<i>Hypochaeris radicata</i>	*	2	2	4a					4a
<i>Juncus usitatus</i>		2	3	3	4a		1	4a	1
<i>Lepidium africanum</i>	*			2					
<i>Lolium perenne</i>	*						1	2	
<i>Medicago sativa</i>	*	4a	4a	3	2			3	4a
<i>Microlaena stipoides</i>			1						
<i>Oxalis exilis</i>									1
<i>Pennisetum clandestinum</i>	*	4a	2				2	3	3
<i>Phytolacca octandra</i>	*	2	2				1	3	
<i>Plantago lanceolata</i>	*			3		3		3	3
<i>Plantago lanceolata</i>	*				3				

Scientific Name	Exotic	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
<i>Poa annua</i>	*	4a					3	4a	
<i>Prunus serrulata</i>	*				2				
<i>Senecio madagascariensis</i>	*	3	3	3	4a	3	3	3	4a
<i>Setaria parviflora</i>	*	3	4a	2	4a		4b	5	5
<i>Sida rhombifolia</i>	*			4a		3			
<i>Sonchus oleraceus</i>	*			1				1	
<i>Sporobolus africanus</i>	*				1				
<i>Sporobolus creber</i>			1	1	2				
<i>Stellaria media</i>	*	4a		2	2	2		3	2
<i>Trifolium repens</i>	*	4a					3		
<i>Trifolium repens</i>	*			4	2	2		4a	
<i>Verbena bonariensis</i>	*			2		1			
<i>Vicia sativa</i>	*	4a	4a	3	2	3	4a	4a	3
<i>Vicia villosa</i>	*			1					

Appendix B. Sample Survey Pro-forma

Monitoring Plot Data Sheet (Biometric)										Site Sheet No.		P3			
Plot Information				Recorders				AG, EB		Date		5/9/2017			
Site Name/Code				P3											
Start Easting				0290982				20m Easting		0290599		50m Easting		0290629	
Start Northing				6278011				20m Northing		6278008		50m Northing		6278016	
Orientation of transect plot (direction and degrees)				NE 68°				Photo No. start				Slope (degrees)			
								Photo No. end of 50m transect							

* Record Easting and Northing of each stake, from the start, 20m mark and end of 50m transect

Vegetation Zone Identification	
Location	Trees - Riverflat Eucalypt Forest (REEF)
Vegetation Community	REEF
Condition (Low or Mod-Good)	Mod-Good
Habitat Features (rocks etc.)	Hollows, bark around base of tree
Comments	

Average Canopy Cover (Specht)	5m	10m	15m	20m	25m	30m	35m	40m	45m	50m	Sum /10 %	
Native overstorey cover (%)	5	-	-	15	45	35	5	-	-	-	105	10.5
Native mid-cover (%)	-	-	-	-	-	-	-	-	-	-	-	-
Exotic overstorey cover (%)	-	-	-	-	-	-	-	-	-	-	-	-
Exotic mid-cover (%)	-	-	-	-	-	-	-	-	-	-	-	-

Point Intersect (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Sum x 2 %	
Native Shrub																											
Native Grass																											
Native Other																											
Exotic	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24	48
Bare Earth (BE), Leaf (L)					1																					1	2

Point Intersect (m)	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Sum x2 %	
Native Shrubs																											
Native Grasses																											
Native Other																											
Exotic	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	50
Bare Earth (BE), Leaf (L)																											

20m x 50m		Number of individual trees with hollows (only hollow >5cm diameter):										Total length fallen logs in metres (only logs >10cm width)									
Quadrat		2										3m									

Whole Veg. Zone	Over-storey regeneration	Over-storey Species	Regenerating (<5cm)	Comments
		Euc teret		

Cover: <1, 1,2,3,4,5, 15,20,25,30,35 etc foliage cover %



NARLA

environmental

Eastern Sydney Office

2/26-30 Tepko Road
Terrey Hills
NSW 2084

Western Sydney Office

7 Twenty-Fifth Avenue
West Hoxton
NSW 2171

Hunter Valley Office

10/103 Glenwood Drive
Thornton
NSW 2322

Ph: 02 9986 1295
office@narla.com.au

www.narla.com.au