OAKDALE SOUTH ESTATE STATE SIGNIFICANT DEVELOPMENT APPLICATION

Biodiversity Assessment Report

For:

Goodman Property Services (Aust) Pty Ltd

August 2016

Final

cumberland ecology

PO Box 2474

Carlingford Court 2118

Report No. 14039RP6

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Version	Date Issued	Amended by	Details
1	15/06/2016	MFh/GK	Draft
2	18/07/2016	GK	Final Draft
3	02/08/2016	GK	Final draft – executive summary
4	18/08/2016	GK	Final

Approved by: David Robertson

Position: Director

Signed: David Robertson

Date: *18 August, 2016*

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Glossary of Terms

BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology
BOS	Biodiversity Offset Strategy
DoE	Commonwealth Department of the Environment
DP&E	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act 1994*
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NSW	New South Wales
OEH	NSW Office of Environment and Heritage of the Department of Premier and Cabinet
PCT	Plant Community Type
the Project	The staged development of a warehouse and distribution complex within the Oakdale South precinct of the broader Oakdale Estate which is located within the Western Sydney Employment Area
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
TEC	Threatened Ecological Community
TSC Act	NSW *Threatened Species Conservation Act 1995*
WSEA SEPP	NSW *State Environmental Planning Policy (Western Sydney Employment Area) 2009*

Executive Summary

Cumberland Ecology was commissioned by Goodman Property Services (Goodman) to prepare a Biodiversity Assessment Report (BAR) for Stage 1 of the Oakdale South Project (the 'Project').

The Environmental Impact Statement (EIS) for the Project was submitted in November 2015. However subsequent amendments to the Masterplan for the Project require the submission of a Section 96 (S.96) application to amend the Project. This BAR has been prepared to support the S.96 application for minor amendments to the Masterplan for the Project, previously submitted in November 2015.

As per the original proposal, the ecological impacts of the S.96 application are to be offset by the establishment of an offset site adjacent to the development site secured under a BioBanking Agreement and, purchase and retirement of additional ecosystem credits for all ecological impacts not fully satisfied by the offset site.

The development site is wholly located within Lot 12 DP1178389 and Lot 87 DP752041. The primary amendments to the Masterplan that affect the ecological assessment include a minor increase in the total area of the development site with consequent reduction in the total area of the offset site and an alteration in the alignment for the reconstructed tributary of Ropes Creek.

The increased area of the development site mainly passes through areas of exotic grassland. Consequently there are only very minor changes in the total areas of the Plant Community Types (PCTs) in the development site and related credit requirements between the original development and the S.96 variation. These are summarised in **Table S.1** below

Table S.1 Comparison of areas of PCT and Related Credit Requirements

PCT Name	Area to be cleared (ha)		Credits required	
	Original development	S.96 Variation	Original development	S.96 Variation
HN526: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	2.11	2.11	104	104
HN528: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	0.31	0.29	13	12

Table S.1 Comparison of areas of PCT and Related Credit Requirements

PCT Name	Area to be cleared (ha)		Credits required	
	Original development	S.96 Variation	Original development	S.96 Variation
HN594: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	1.16	1.15	43	42

The reduction in the total area of the offset site and the realignment of the constructed Ropes Creek tributary have resulted in an alteration in the total number of credits generated at the offset site.

In response to concerns raised by the Office of Environment and Heritage (OEH) in relation to numbers of credits generated within the riparian corridor areas subject to a Vegetation Management Plan (VMP) to fulfill obligations under the *Water Management Act 2000*, additional vegetation management zones have been created for the offset site as part of the S.96 application. These management zones divide the PCTs within the offset site based on both vegetation conditions as well as areas that are either are or are not subject to the VMP. As a precautionary measure, a discount has been calculated for credits generated in Management Zones subject to actions under the VMP, in accordance with the requirements of Section 12 and Table 10 of the BioBanking Assessment Methodology (BBAM) 2014.

As was the case with the original application, HN528 credits are not generated at the offset site and the requisite credits are to be purchased and retired. Although comparatively fewer HN526 and HN594 credits are generated at the offset site following the reduction in area and application of discounts compared to the original application, the total number of credits generated fully meets the credit requirements for HN526 and HN594 for the S.96 application. A comparison of the credits generated for the original and S.96 variation is summarised in **Table S.2** below.

Table S.2 Comparison of Credits generated and surplus credit balances

Credit Requirements	Total Area retained or regenerated at offset site (Original development)	Total Area retained or regenerated at offset site (S.96 variation)	Total credits generated across relevant management zones (original development)	Total credits generated across relevant management zones (S.96 variation)*	Surplus credits for PCT (Original development)	Surplus credits for PCT (S.96 variation)
HN526: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	14.17	13.84	145	140	41	36
HN594: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	7.26	7.28	95	79	52	37

* discount applied for VMP zones in S.96 application

Chapter 1

Introduction

Cumberland Ecology was commissioned by Goodman Property Services (Goodman) to prepare a Biodiversity Assessment Report (BAR) for Stage 1 of the Oakdale South Project (the 'Project'). The Environmental Impact Statement (EIS) for the Project was submitted in November 2015. However subsequent amendments to the Masterplan for the Project require the submission of a Section 96 (S.96) application to amend the Project. This BAR has been prepared to support the S.96 application for minor amendments to the Masterplan for the Project, previously submitted in November 2015.

1.1 Purpose

This BAR has been prepared to inform a State Significant Development Application (SSDA) for the staged development of the Oakdale South Estate (OSE). The aim of the BAR is to assess the potential impacts of the revised masterplan of the proposed development on flora and fauna (see **Figure 1.1**) and has been prepared in accordance with the NSW *Framework for Biodiversity Assessment 2014 (OEH 2014a)*. The report responds to the Secretary's Environmental Assessment Requirements (SEARs) as they relate to flora and fauna. The specific SEARS relevant to this SSD that have been considered and are addressed in this report are shown in **Table 1.1.**

Table 1.1 Relevant SEARS addressed in the BAR

Relevant SEARS	Response
Details of the quantity and type of any vegetation to be cleared	This report includes identification and description of plant community types that exist within the Project detailed in Section 4.4 and 4.5.
An assessment of impacts (direct or indirect) on threatened species, populations, ecological communities (including groundwater dependent ecosystems) and their habitat, critical habitat (including riparian habitat) and native vegetation in accordance with the Framework for Biodiversity Assessment (Oct 2014)	An assessment of impacts on threatened species, populations, ecological communities and their habitat in accordance with the Framework for Biodiversity Assessment has been undertaken and are included in Chapter 5.
Proposed measures to avoid, mitigate or offset any significant impacts in accordance with the	Proposed measures to avoid, mitigate or offset any significant impacts in accordance with the

Table 1.1 Relevant SEARS addressed in the BAR

Relevant SEARS	Response
NSW Biodiversity Offset Policy for Major Projects	NSW Biodiversity Offset Policy for Major Projects is provided in Chapter 6.

This report supports the S.96 application to modify the development, in particular estate infrastructure works and should be read in conjunction with the Environmental Impact Statement (EIS) prepared for the SSDA and development plans submitted with the S.96 modification application.

1.2 Project Description

1.2.1 Location

The Project is located within the Oakdale South precinct of the broader Oakdale Estate which is located within the Western Sydney Employment Area as identified under the NSW *State Environmental Planning Policy (Western Sydney Employment Area) 2009* (WSEA SEPP). The project is located within Penrith Local Government Area (LGA) and the nearest town centres are Erskine Park and Horsley Park which are both approximately 6 km west and east respectively from the Project. The Project is accessed currently via Old Wallgrove Road; which is currently being upgraded as part of a government funded upgrade. The development site is 95.36 ha in size and is wholly located within Lot 12 DP1178389 and Lot 87 DP752041. The location of the Project is shown in **Figure 1.1** and **Figure 1.2**.

1.2.2 Overview

The Oakdale South Estate represents the second stage of development within the broader Oakdale Estate. The land within the Oakdale South Estate is owned by a Joint Venture between Goodman and Brickworks Limited. Goodman has entered into the Joint Venture with Brickworks to develop the Oakdale Estate into a regional warehousing and distribution hub. Goodman is the applicant for the Project. The Project seeks to facilitate the development of the Oakdale South precinct. The Project itself is being assessed as a staged development under Division 2A of the EP&A Act.

The SSDA for the OSE seeks approval for:

- An overarching planning framework to guide the staged development of the OSE including:
  - An Indicative Master Plan and Structure Plan;
  - Development Controls for the OSE;
  - A Biodiversity Offset Strategy.

- Stage 1 Development of the Estate including:
  - A package of estate-wide site preparation works to be implemented in stages including:
    - Subdivision;
    - Bulk earthworks (including construction of detention basins); and
    - Construction of retaining walls, road and utility infrastructure/services.
    - Environmental management measures and protocols for the site.
  - Development for the purposes of warehousing and distribution including:
    - The construction of warehouse buildings in Precincts 1, 4 and 5;
    - The construction of hardstand, loading, car parking and landscaping in Precincts 1, 4 and 5;
  - The fit out and use of buildings in Precincts 1, 4 and 5 for generic warehousing and distribution uses.

A detailed description of the Project components is provided within the EIS submitted in November 2015 and supporting documentation for the S.96 application. Although the main components of the Project remain unchanged, the amendments to the masterplan have resulted in minor alterations to the conceptual layout of the Project. The updated conceptual layout of the Project is shown in **Figure 1.3**.

1.2.3 Identification of Development Site Footprint

The extent of the construction and operational footprints are shown in **Figure 1.3**. The construction footprint of the Project will encompass all works associated with the Project and is wholly contained within the development site. The construction footprint includes all roads, precincts, earthworks, set down areas, bio-retention basins and temporary fencing. The operational footprint of the Project for this Stage 1 assessment will include Precinct 1, 2, 4 and 5, the Services Lot, and all earthworks, roadways, utility infrastructure, batters, and bio-retention basins.

1.3 General Description of Development Site

i. Landform, Geology and Soils

Landform at the development site is relatively uniform, with undulating rises and alluvial flats bisected by narrow, ephemeral creek lines. Floodplain areas on the site are restricted to the lower lying areas adjacent to Ropes Creek in the western extent of the site and in areas directly adjacent to the Ropes Creek tributaries while the eastern extent of the site lies above the floodplain. The topography does not have any large variances like mountains or cliff

lines, with high elevations within the development site of less than 50 m above the depressions.

Underlying geology of the site is best described as an alluvial plain with high clay content on shaly soils. The soil landscape is described as Cumberland Plain (DECCW 2008) which is present on low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones forming a down-warped block on the coastal side of the Lapstone monocline (DECCW 2008).

ii. Vegetation

Native vegetation comprises approximately 3.7% of the vegetated cover of the development site. The majority of the development site is cleared for agriculture and is dominated by exotic pasture grasses. Native vegetation within the development site is primarily limited to narrow riparian corridors which excise cleared paddocks. The native vegetation typically comprises regenerating stands of *Eucalyptus tereticornis* (Forest Red Gum) and *Casuarina glauca* (Swamp Oak). There is also a small stand of regenerating woodland with a native understorey in the southern portion of the development site. This area predominately comprises *E. tereticornis* and appears to be regenerating from the natural seed bank within a cleared paddock. Sparsely scattered remnant trees occur within the paddocks throughout the development site. The condition of vegetation within the development site is degraded due to persistent impacts from grazing. Within areas of native vegetation, the ground layer is frequently dominated by exotic species, and the shrub layer is almost absent.

iii. Hydrology

The development site occurs within the Hawkesbury-Nepean Catchment. The development site occurs at the headwaters of the alluvial plain and is bisected by first order streams. These streams drain to Ropes Creek, a third order stream, which flows into South/Wianamatta Creek approximately 13 km north of the development site. The drainage system within the development site is in relatively poor condition, due to erosion and trampling by cattle.

iv. Land Uses

The development site has previously been utilised for the purpose of cattle grazing. This land use has resulted in the majority of the development site being extensively cleared of vegetation which has resulted in a significant loss of flora and fauna habitats. Land surrounding the development site has also historically been utilised for agricultural purposes.

The development site and adjoining land is zoned IN1 – General Industrial and E2 – Environmental Conservation under the WSEA SEPP. The objective of the IN1 - General Industrial zoning is to facilitate a wide range of employment-generating development including industrial, manufacturing, warehousing, storage and research uses and ancillary office space. The objectives of E2 – Environmental Conservation are to protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values; and to prevent development that could destroy, damage or otherwise have an adverse effect on those values. Some adjoining land within the Oakdale Central Estate has already been developed

for industrial purposes. Other nearby land uses includes a brick and roofing quarry and rural living.

1.4 Information Sources

1.4.1 Database Analysis

A number of databases were utilised as part of this assessment, including:

- Atlas of NSW Wildlife;
- Threatened Species Profile Database;
- VIS Classification Database;
- Department of Primary Industries Threatened and protected species - records viewer; and
- BoM Atlas of Groundwater Dependent Ecosystems.

1.4.2 Literature Review

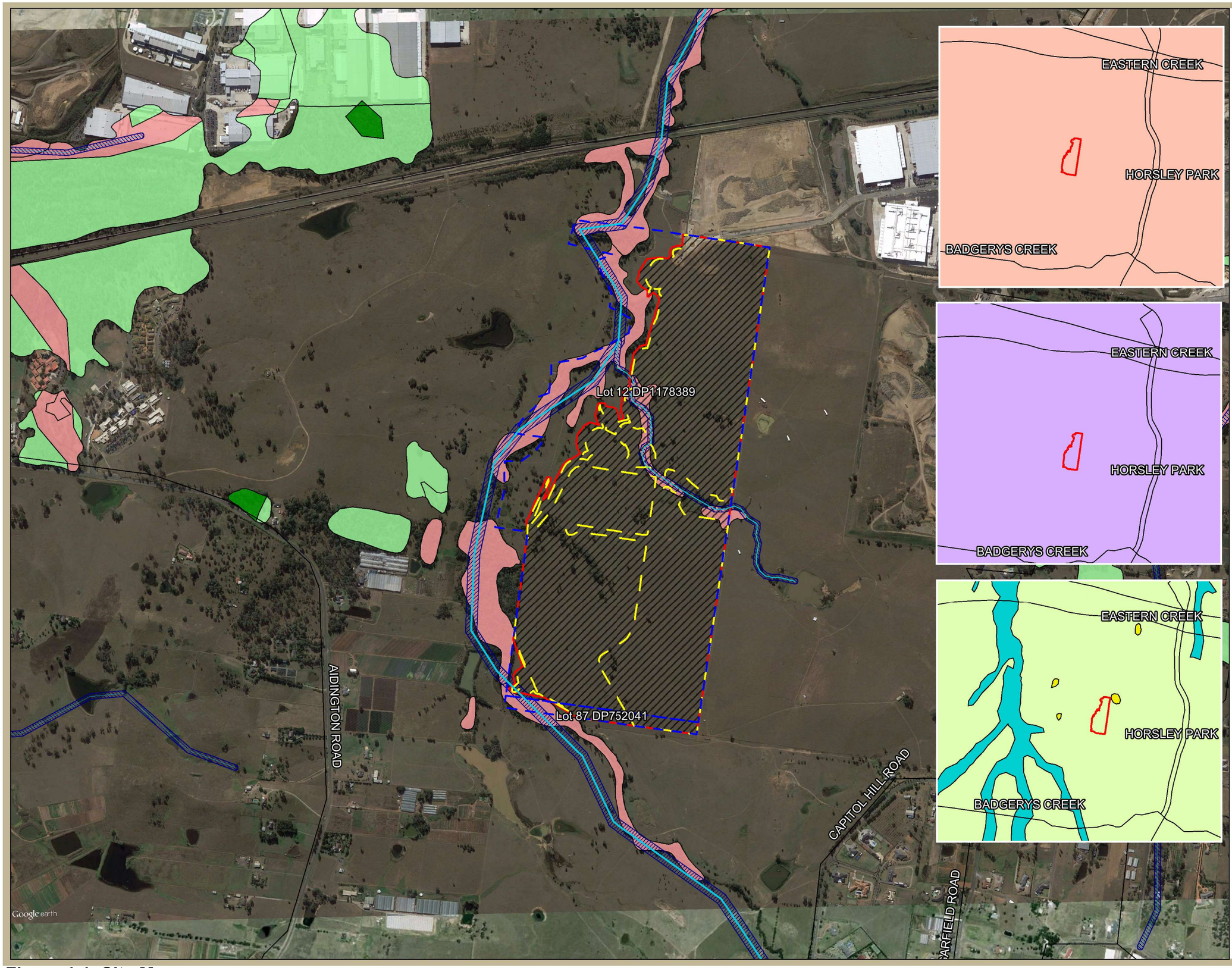
A review of ecological literature relevant to the development site was undertaken as part of this assessment to evaluate the biodiversity values associated with the development site. Key documents reviewed for this BAR include:

- Ecological Assessment - Oakdale Concept Plan (Cumberland Ecology 2007); and
- Cumberland Plain Vegetation Mapping (DECCW 2007).

1.4.3 Aerial Photography

The aerial imagery used was taken from Google Earth Pro. This aerial is dated 05-05-2016. SIXmaps imagery managed by the Department of Lands was also utilised. The SIXmaps aerial was dated 4-01-2014.

Coordinate System: MGA Zone 56 (GDA 94)



N
Grid North

Legend

- Development site
- Construction Footprint
- Operational Footprint
- Lot Boundary
- Road

Native Vegetation (DECCW, 2008)

- Shale Plains Woodland
- Shale Hills Woodland
- Shale/Gravel Transition Forest
- Alluvial Woodland

Rivers and Streams

- 1st Order Stream
- 2nd Order Stream

Riparian Buffer

- 10m Buffer (1st Order Stream)
- 20m Buffer (2nd Order Stream)

IBRA7 Region

- Sydney Basin

IBRA7 subregions

- Cumberland

Mitchell Landscapes

- Cumberland Plain
- Hawkesbury - Nepean Channels and Floodplains
- Sydney Basin Diatremes

Scale: 1:12,811 @ A3 page
Date Prepared: 11/08/2016

Image Source:
Google Earth
(dated 05-05-2016)

Data Source:
© Copyright Commonwealth of Australia (Geoscience Australia) 2006
DECC (2008), Landscapes (Mitchell) of NSW - Verson 3
DECC 2008, Native Vegetation of the Cumberland Plain

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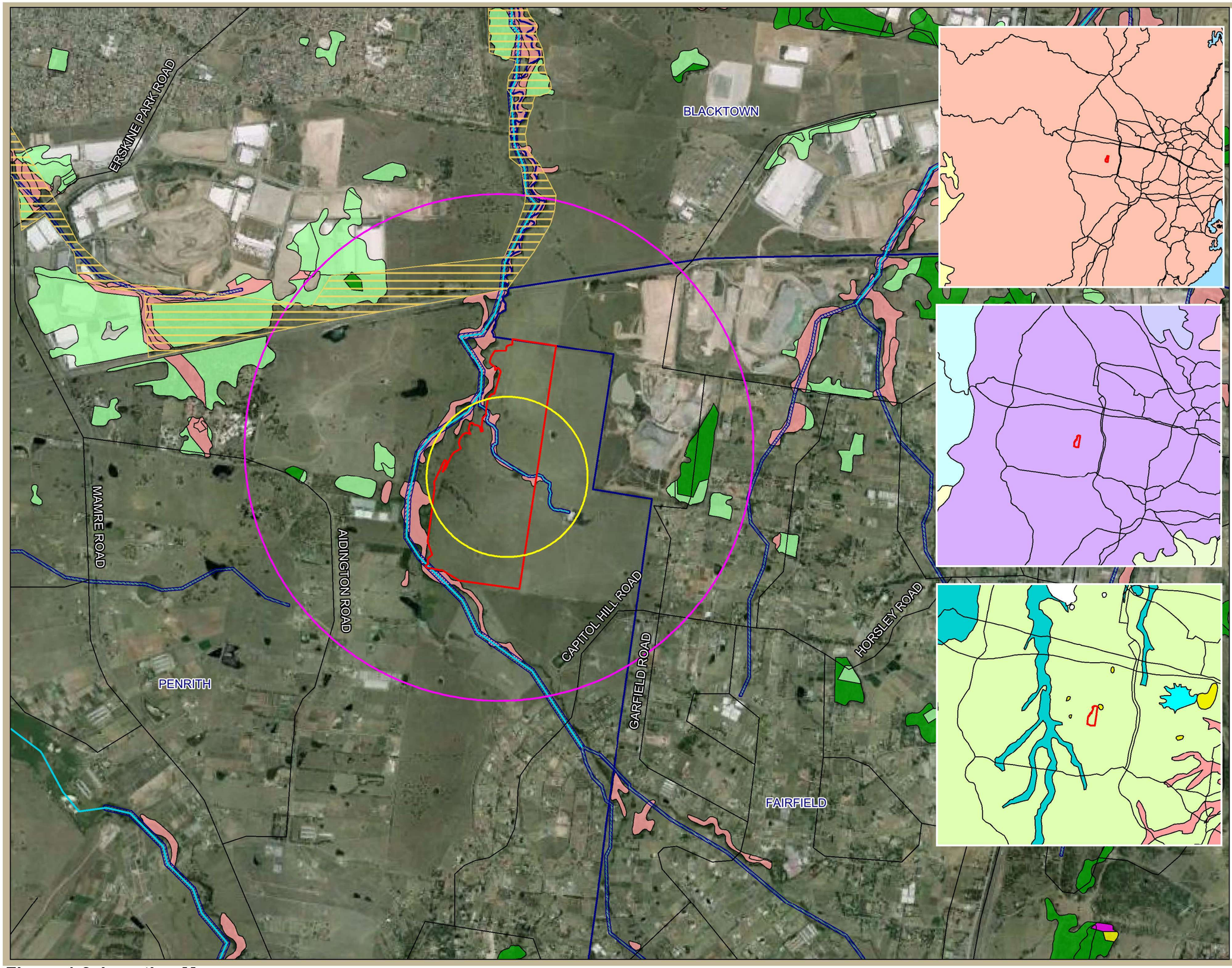
I:\...\14039\Figures\RP6_BAR\20160811\Figure 1.1. Site Map

Figure 1.1. Site Map

250 0 250 500 750 1000m

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Development site
- Local Government Area
- Outer Assessment Circle (1000ha)
- Inner Assessment Circle (100ha)
- Road

Native Vegetation (DECCW, 2008)

- Shale Plains Woodland
- Shale Hills Woodland
- Shale/Gravel Transition Forest
- Alluvial Woodland
- Western Sydney Dry Rainforest

Rivers and Streams

- 1st Order Stream
- 2nd Order Stream

Riparian Buffer

- 10m Buffer (1st Order Stream)
- 20m Buffer (2nd Order Stream)

Regional Biodiversity Link

- Cumberland Conservation Corridor

IBRA7 Region

- Sydney Basin
- South Eastern Highlands

IBRA7 subregions

- Wollemi
- Cumberland
- Yengo
- Burragorang
- Pittwater
- Sydney Cataract

Mitchell Landscapes

- Cumberland Plain
- Hawkesbury - Nepean Channels and Floodplains
- Sydney Basin Diatremes
- Georges River Alluvial Plain
- Estuary/Water Added

Scale: 1:25,731 @ A3 page
Date Prepared: 11/08/2016

Image Source:
Image © 2014 Sinclair Knight Merz

Data Source:
© Copyright Commonwealth of Australia (Geoscience Australia) 2006
DECC (2008), Landscapes (Mitchell) of NSW - Verson 3
DECC 2008, Native Vegetation of the Cumberland Plain

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Grid North

I:\...\14039\Figures\RP1_BAR\20160811\Figure 1.2. Location Map

Figure 1.2. Location Map

500 0 500 1000 1500 2000m

Coordinate System: MGA Zone 56 (GDA 94)

Legend

- Development site
- Construction Footprint
- Operational Footprint
- Road
- Watercourse

Development Layout

- Precinct
- Road
- Bio-retention Basin
- Ropes Creek Tributary Re-alignment
- Existing Transgrid Easement
- Batters

Grid North

Scale: 1:7,034 @ A3 page
Date Prepared: 11/08/2016

Image Source:
Google Earth
(dated 05-05-2016)

Data Source:

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I:\...\14039\Figures\BAR_RP6\20160811\Figure 1.3. Indicative Development Layout

Figure 1.3. Indicative layout of the Development site

100 0 100 200 300 400m

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Chapter 2

Legislation and Policies

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's principal piece of environmental legislation and is administered by the Commonwealth Department of the Environment (DoE). It is designed to protect national environmental assets, known as Matters of National Environmental Significance (MNES), which include threatened species of flora and fauna, endangered ecological communities, migratory species as well as other protected matters. Among other things, it defines the categories of threat for threatened flora and fauna, identifies key threatening processes and provides for the preparation of recovery plans for threatened flora, fauna and communities.

Under the EPBC Act, any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES must be referred to the Commonwealth Minister for the Environment. The following MNES were identified within the development site:

- Cattle Egret (*Ardea ibis*) - Migratory; and
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable.

A preliminary assessment of the MNES present within the development site indicated that there would not be a significant impact as a result of the Project and, as such, no referral was required.

2.1.2 Environmental Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy

Under the *Environmental Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*, environmental offsets are actions taken to counterbalance significant residual impacts on MNES. Offsets are used as a last resort in instances where an action will give rise to residual impacts, even after the application of management measures.

The policy came into force in October 2012 and provides guidance on the role of offsets in environmental impact assessments and how DoE considers the suitability of a proposed offset package (SEWPaC 2012). According to the policy, an offsets package is a "*suite of*

actions that a proponent undertakes in order to compensate for the residual significant impact of a project" (SEWPaC, 2012b). It can comprise a combination of direct offsets and other compensatory measures.

The Project is not considered to result in a significant impact to MNES and, as such, no offsets will be required under the EPBC Act.

2.2 New South Wales

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act is the overarching planning legislation in NSW that provides for the creation of planning instruments that guide land use. The EP&A Act also provides for the protection of the environment, including the protection and conservation of native animals and plants. This includes threatened species, populations and ecological communities, and their habitats of biodiversity values, as listed in the NSW *Threatened Species Conservation Act 1995* (TSC Act) and NSW *Fisheries Management Act 1994* (FM Act). The protection of the environment is addressed in Section 5A of the EP&A Act - Significant effect on species, populations or ecological communities or their habitats.

The applicant is seeking State Significant Development (SSD) Consent under Division 4.1 of Part 4 of the EP&A Act. The Project is to be a staged development made under Clause 83B, Division 2A of Part 4 of the EP&A Act. A SSD can be declared under the *State Environmental Planning Policy (State and Regional Development) 2011* or by the Minister for Planning. The Development Application submitted for the SSD must be accompanied by an EIS, which is to be prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs).

The SEARs for the Project were issued by the NSW Department of Planning and Environment (DP&E) on 22 April 2015. The provisions that are relevant to this BAR are reproduced below.

The EIS must address the following specific matters that relate to the Masterplan and Stage 1 works:

- *Flora and fauna – including:*
  - *details of the quantity and type of any vegetation to be cleared;*
  - *an assessment of impacts (direct or indirect) on threatened species, populations, ecological communities (including groundwater dependant ecosystems) and their habitat, critical habitat (including riparian habitat) and native vegetation in accordance with the Framework for Biodiversity Assessment (Oct 2014); and*
  - *proposed measures to avoid, mitigate or offset any significant impacts in accordance with the draft Biodiversity Offset Policy for Major Projects.*

An assessment of the quantum and type of impacts resulting from the Project were presented within the BAR and BOS submitted as part of the EIS in November 2015. The amendment to the Masterplan has resulted in minor changes in the quantum of impacts, Therefore, an assessment of the quantum and type of impacts resulting from the proposed amendment to the Project on biodiversity values and measures to avoid and mitigate these impacts is presented within this BAR. A separate Biodiversity Offset Strategy (BOS) to address offset measures has been prepared for the amendment to the Project and is provided as part of the S.96 application documentation.

2.2.2 Threatened Species Conservation Act 1995

The TSC Act is the key piece of legislation in NSW relating to the protection and management of biodiversity and threatened species. The TSC Act aims to protect and encourage the recovery of threatened species, populations and communities that are listed under the Act through threat abatement and species recovery programs. The TSC Act requires consideration of whether a development (Part 4) or an activity (Part 5) is likely to significantly impact threatened species, populations, communities or their habitat. The potential impacts of any developments, land use changes or activities do not need to undergo an "Assessment of Significance" under Section 5A of the EP&A Act as the project has been declared a SSD. The impacts of the Project are therefore assessed within this Biodiversity Assessment Report.

2.2.3 Fisheries Management Act 1994

The FM Act provides for the protection, conservation and recovery of fish stocks, key fish habitats, threatened species, populations and ecological communities of fish and marine vegetation as well as management of threats to threatened species, populations and ecological communities defined under the Act. In particular, the FM Act has mechanisms for the protection of fish, fish habitats, mangroves, seagrasses and seaweeds on public water land and foreshores.

2.2.4 NSW Biodiversity Offsets Policy for Major Projects

The *NSW Biodiversity Offsets Policy for Major Projects* was adopted in September 2014 and applies to SSD and State Significant Infrastructure designated under the EP&A Act. The policy provides a standard method for assessing impacts of major projects on biodiversity and determining offsetting requirements (OEH 2014b). The policy is underpinned by six principles, which must be considered when assessing offsets for major projects.

The Framework for Biodiversity Assessment (FBA) has been developed in conjunction with the policy to provide a method for determining the quantum of impacts. The FBA provides rules and software for calculating the number and type of credits that a development site will require in order to offset its impacts and thus improve or maintain biodiversity values. "Credits" are the currency used within FBA and they are not specifically area measurements. Rather, they are a measure of the current quality of habitat. Where a proponent is proposing to establish an offset site as part of the BOS, the BioBanking Assessment Methodology (BBAM) must be used to assess the biodiversity values of the offset site and to identify the number and type of credits that may be created on the offset site (OEH 2014a).

The FBA requires the preparation of the following documents:

- Biodiversity Assessment Report: To describe the biodiversity values present within the development site and the impact of the project on these values; and
- Biodiversity Offset Strategy: To outline how the proponent intends to offset the impacts of the project.

These reports were submitted as part of the EIS in November 2015. The BAR and BOS have been updated to reflect the amendments to the masterplan layout and are to be submitted as part of the documentation for the S.96 application.

As the FBA applies predominantly to terrestrial biodiversity, the NSW Offsets Policy for Major Projects and FBA refers to the NSW Department of Primary Industries *Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013)* for guidance on assessing and offsetting aquatic impacts. Offsets for identified key fish habitats are required once avoidance and mitigation measures have been implemented. No key fish habitats have been identified within the Penrith LGA. The development site includes Ropes Creek Tributary, a first order stream (see **Figure 1.1** and **Figure 1.2**), which is not considered as key fish habitat.

2.2.5 State Environmental Planning Policy (Western Sydney Employment Area) 2009

The development site is located within Precinct 8 (South of Sydney Catchment Authority Warragamba Pipelines) of the Western Sydney Employment Area designated under the WSEA SEPP. The development site is located within the Oakdale South sub-precinct of the Oakdale Estate within Precinct 8. The WSEA SEPP requires that a consent authority must not grant consent to development unless a development control plan has been prepared for that land. The *Penrith Development Control Plan (DCP) 2014* applies to the land within the development site. However, pursuant to Clause 11 of the NSW *State Environmental Planning Policy (State and Regional Development) 2011*, development control plans do not apply to SSDs. As such, the provisions of the *Penrith DCP 2014* are not relevant to the Project; however, development controls for the OSE will form part of the Master Plan and will be ultimately incorporated into the Penrith DCP 2014.

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Chapter 3

Landscape Features

3.1 Landscape Features

For the purposes of this BAR a 100 ha inner assessment circle and 1,000 ha outer assessment circle was established for identifying the landscape features associated with the Project.

3.1.1 IBRA Bioregions and IBRA Subregions

i. Bioregions

Development site: Sydney Basin Bioregion (100%)

Outer assessment circle: Sydney Basin Bioregion (100%)

The development site and outer assessment circle are wholly contained within the Sydney Basin Bioregion. This bioregion occupies approximately 3.6 million hectares (approximately 4.5% of NSW) and extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee (NSW NPWS 2003). The Sydney Basin Bioregion is one of the most species diverse in Australia, which is the result of the variety of rock types, topography and climates in the bioregion (NSW NPWS 2003). This bioregion contains significant flora, fauna and wetlands.

The extent of the Sydney Basin bioregion within the development site is shown in **Figure 1.1**. The extent of the bioregion within the outer assessment circle is shown in **Figure 1.2**.

ii. Subregions

Development site: Cumberland Subregion (100%)

Outer assessment circle: Cumberland Subregion (100%)

The development site and outer assessment circle are wholly contained within the Cumberland Subregion. This subregion is typified by low rolling hills and wide valleys in the rain shadow below the Blue Mountains (NSW NPWS 2003). The underlying geology of this subregion predominately comprises Triassic Wianamatta group shales and sandstones (NSW NPWS 2003). Vegetation communities of this subregion that occur in the vicinity of the development site include: Grey Box, Forest Red Gum, Narrow-leaved Ironbark woodland

with some Spotted Gum on the shale hills; and Broad-leaved Apple, Cabbage Gum and Forest Red Gum with abundant Swamp Oak on river flats (NSW NPWS 2003).

The extent of the Cumberland subregion within the development site is shown in **Figure 1.1**. The extent of the subregion within the outer assessment circle is shown in **Figure 1.2**.

3.1.2 Mitchell Landscapes

Development site: Cumberland Plain (100%)

Outer assessment circle: Cumberland Plain (98%) and Sydney Basin Diatremes (2%)

The extent of the Cumberland Plain Mitchell Landscape within the development site is shown in **Figure 1.1**. The extent of the Mitchell Landscapes within the outer assessment circle is shown in **Figure 1.2**.

The development site is wholly contained within the Cumberland Plain Mitchell Landscape. This landscape is characterised by low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones (DECC 2002). There are some occurrences of volcanic vents and is partly covered by Tertiary river gravels and sands with main streams containing quaternary alluvium. The general elevation of this Mitchell Landscape is between 30 and 120 m. Woodlands and open forest consist of *Eucalyptus moluccana* (Grey Box), *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus crebra* (Narrow-leaved Ironbark), *Eucalyptus eugenioides* (Thin-leaved Stringybark), *Eucalyptus amplifolia* (Cabbage Gum) *and Angophora subvelutina* (Broad-leaved Apple) (DECC 2002). This vegetation has Grassy to shrubby understorey often dominated by *Bursaria spinosa* (Blackthorn), poorly drained valley floors, often salt affected with *Casuarina glauca* (Swamp Oak) *and Melaleuca sp.* (DECC 2002).

3.1.3 Rivers and Streams

The development site and outer assessment circle occurs within the Hawkesbury-Nepean Catchment. One first order stream, Ropes Creek Tributary, and one third order stream, Ropes Creek, have been identified within the development site and outer assessment circle, respectively. Stream data was obtained from Geoscience Australia, with stream orders defined using the Strahler stream ordering system. A buffer of 15 m and 30 m either side of the waterway were applies to first and second order streams, respectively. Ropes Creek Tributary flows west into Ropes Creek, which flows north, eventually reaching South/Wianamatta Creek which is located 13 km north of the development site. All streams within the development site are ephemeral and did not have any water at the time of survey. Ropes Creek had a small amount of flowing water (<10cm) at the time of survey.

The extent of the streams and their associated buffers within the development site are shown in **Figure 1.1**. The extent of the streams and their associated buffers within the outer assessment circle is shown in **Figure 1.2**.

3.1.4 Wetlands

No important or local wetlands occur within the development site or outer assessment circle. The closest wetlands to the development site are located more than 19 km to the north near Windsor Downs, where South/Wianamatta Creek and Eastern Creek merge.

3.1.5 Native Vegetation Extent

The outer assessment circle, which is 1,000 ha in size, occurs within an area in which a number of broad-scale vegetation mapping projects have been undertaken. To map the extent of native vegetation within the outer assessment circle, the 2008 update to the vegetation mapping of the Cumberland Plain (DECCW 2007) was overlain on a 2014 aerial available through the Department of Lands SIXmaps application. The extent of native vegetation cover was then revised through aerial photographic interpretation and surveys of the development site. Amendments to the extent of native vegetation were made using a Geographic Information System (GIS), MapInfo Professional 12.5. The boundaries of native vegetation were reduced in areas that have been cleared since the DECCW mapping was prepared and the boundaries were extended in areas where the DECCW mapping

Native vegetation occurring in the outer assessment circle is shown in **Figure 1.2**. Native vegetation occupies approximately 96.8 ha, which represents 9.68% of the outer assessment circle. Native vegetation within the outer assessment circle is predominately confined to riparian corridors, with some larger patches also occurring. The remaining land within the outer assessment circle comprises cleared land.

3.1.6 State or Regionally Significant Biodiversity Links

No state or regionally significant biodiversity links occur within the development site or outer assessment circle. Cumberland Conservation Corridor occurs within the outer assessment circle, directly to the north of the development site and is shown on **Figure 1.2**. The Cumberland Conservation Corridor link Priority Conservation Sites identified within the Approved Cumberland Plain Recovery Plan (DECCW 2011).

3.1.7 Other Landscape Features

No other landscape features within the development site or outer assessment circle were identified in the SEARs.

3.2 Landscape Value Score

3.2.1 Attributes

i. Percent Native Vegetation Cover

A 100 ha inner assessment circle and 1,000 ha assessment circle were utilised for the Project. The assessment circles were centred over the area of native vegetation that is most impacted by the Project. The locations of the inner and outer assessment circles are shown in **Figure 1.2**. The current and future percentage of native vegetation cover within the inner

and outer assessment circles was determined in increments of 5% using GIS. These calculations utilised the native vegetation extent identified in ***Section 3.1.5*** and the development site. The Project will result in the loss of 3.55 ha of native vegetation within the development site. A summary of the current and future percentage of native vegetation cover in the inner and outer assessment circles is provided in **Table 3.1**.

Table 3.1 Current and future extent of native vegetation within the assessment circles

Assessment Circle	Current Extent of Native Vegetation			Future Extent of Native Vegetation		
	Area (ha)	% Cover	Score	Area (ha)	% Cover	Score
Inner assessment circle	5.42	≤5	0.75	2.43	≤5	0.75
Outer assessment circle	96.78	6-10	2.5	93.76	6-10	2.5

ii. Connectivity Value

The following connecting links have been identified within the development site:

- Connecting link 1: vegetated corridor along the Ropes Creek tributary that is to be re-aligned and revegetated as part of the Project; and
  - Linkage width: 15 m;
  - Over-storey condition: % foliage cover within benchmark;
  - Mid-storey or groundcover condition: % foliage cover of mid-storey or ground cover within benchmark;
- Connecting link 2: vegetated corridor along Ropes Creek:
  - Linkage width: 5 m;
  - Over-storey condition: % foliage cover within benchmark;
  - Mid-storey or groundcover condition: % foliage cover of mid-storey or ground cover within benchmark.

Figure 1.2 shows the location of the connecting links within the development site. The vegetation within these corridors is in moderate to good condition, has a patch size of greater than one hectare, is separated by less than 100 m and is not separated by a hostile link. A summary of the current and future width class and condition class values of the two connecting links is shown in **Table 3.2**.

The final connectivity score for the Project is represented by the link with the highest connectivity score. As both connecting links have the identical score, the final connectivity value score for the Project is 0.

Table 3.2 Current and future connecting links within the assessment circles

Connecting Link	Linkage Width Class			Linkage Condition Class			Connectivity Value
	Current	Future	Classes Crossed	Current	Future	Classes Crossed	
1	Narrow (>5-30m)	Narrow (>5-30m)	0	3	3*	0	0
2	Very narrow (0-5m)	Very narrow (0-5m)	0	3	3	0	0

** Connecting link is to be realigned and revegetated back to original condition as part of the Project; as such the connecting link is considered to be not impacted*

iii. Patch Size

As the Project is a site-based development, patch size has been determined in accordance with Appendix 4 of the FBA. The development site occurs within the Cumberland Plain Mitchell Landscape which has a cleared native vegetation value of 91%. The native vegetation within the development site and assessment circles has been identified in ***Section 3.1.5***. Of this vegetation, the largest patch of native vegetation, of which a portion occurs within the development site, is 201.9 ha in size. Based on the Cumberland Plain Mitchell Landscape, the patch size class of this vegetation is categorised as 'Extra large' which has a corresponding patch size score of 12.

3.2.2 Score

Using the results from the assessment of landscape attributes in ***Section 3.2.1*** and Equation 4 in Appendix 1 of the FBA, the landscape value score for the development site is 12.

Chapter 4

Native Vegetation

4.1 Review of Existing Data

The following primary sources of information were consulted as part of a desktop assessment of the native vegetation within the development site:

- VIS Classification Database;
- Cumberland Plain Vegetation Mapping (DECCW 2007);
- Ecological Assessment – Oakdale Concept Plan (Cumberland Ecology 2007).

Information obtained during the review of existing data was utilised in conjunction with field data to assess native vegetation within the development site.

4.2 Surveys

4.2.1 Overview

Surveys of the vegetation within the development site and adjoining land were conducted on 15 October 2014 and 27 May 2015. The first round of surveys undertaken were conducted prior to the Project being determined as a SSD and, as such, were designed for the purposes of a flora and fauna assessment for approval from Penrith Local Government Authority. These surveys included obtaining an overview of the nature and extent of vegetation not just within the development site but also within adjacent lands owned by the proponent, as well as mapping of vegetation communities and floristic sampling. The condition and extent of previously mapped vegetation communities (Cumberland Ecology 2007, DECCW 2007) was noted and any changes in the areas of native vegetation were delineated using a handheld Global Positioning System (GPS) unit. The updated vegetation mapping was conducted using a combination of aerial photograph interpretation and site notes.

The second round of surveys were undertaken following the SSD determination and was designed to meet the requirements of the FBA. These surveys included a full floristic survey of the PCTs identified within the development site and plot and transect surveys of vegetation zones identified within the development site.

This assessment utilised full floristic plots and plot and transect site location both within the development site and adjoining land. Due to the small size of the development site and the observed condition of the native vegetation, no obvious environmental variation occurred between the development site and adjoining land. As such, the use of data outside the development site, but in close proximity, was considered appropriate for this assessment.

For the purposes of assigning PCTs to native vegetation communities, plot based full floristic survey was undertaken in accordance with Table 1 of the FBA at five sites across the development site and within adjacent land. Once PCTs were assigned to vegetation communities, three plot and transect surveys were undertaken within the development site as shown in **Table 4.1**.

Table 4.1 Summary of flora survey techniques

Survey Method	Development Site			Adjacent Land				
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Plot-based Full Floristic Survey				X	X	X	X	X
Plot and Transect Survey	X	X	X	X	X	X	X	X

4.2.2 Plot-based Full Floristic Survey

Five full floristic plots plot surveyed within the adjoining land on 27 May 2015 have been utilised in this assessment. The following information was collected at each of the five 20 x 20 m full floristic plots in accordance with Table 1 of the FBA:

- Stratum (and layer): stratum and layer in which each species occurs;
- Growth form: growth form for each recorded species;
- Species name: scientific name and common name;
- Cover: a measure or estimate of the appropriate cover measure for each recorded species; recorded from 1–5% and then to the nearest 5%. If the cover of a species is less than 1% and the species is considered important, then the estimated cover should be entered (e.g. 0.4); and
- Abundance rating: a relative measure of the number of individuals or shoots of a species within the plot. Use the following intervals; numbers above about 20 are estimates only: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, or 1,000, or specify a number greater than 1,000 if required.

The locations of these plots are shown in **Figure 4.1**. The locations of the full floristic plots were determined by randomly marking a point within each observable PCT within adjoining land to the development site.

4.2.3 Plot and Transect Surveys

Eight plot and transect sites surveyed within the development site and adjoining land on 15 October 2014 and 27 May 2015 have been utilised in this assessment. The following information was collected at each of the 20 x 50 m plot and transect sites in accordance with Section 5.3.2 of the FBA:

- Native species richness recorded within each stratum of a 20 m x 20 m sub-plot;
- Native overstorey cover recorded at 10 points along a 50 m transect;
- Native midstorey cover recorded at 10 points along a 50 m transect;
- Native ground cover recorded at 50 points along a 50 m transect for three life forms (shrubs, grasses and other);
- Exotic plant cover expressed as a total percent cover across all strata (each strata measured using the same method for native overstorey, midstorey and ground cover);
- Number of trees with hollows visible from the ground within the 20 m x 50 m plot;
- The total length of fallen logs >10 cm in diameter within the 20 m x 50 m plot; and
- The proportion of regenerating overstorey species within the vegetation zone.

The locations of the plot and transect sites are shown in **Figure 4.1**. The locations of the plot and transect sites were determined by randomly marking a point within each observable vegetation zone within the development site.

The minimum number of plot and transect sites required, based on the condition and extent of each vegetation zone is shown in **Table 4.2**. Amendments to the extent of the development site following field surveys resulted in an increase to the minimum number of plot and transect sites required for PCT Zone 1. As a result, two plots located outside of the development site, but within the same associated vegetation patch, has been utilised as part of this assessment. This approach is considered appropriate given the lack of obvious environmental variation between the development site and the location of the plot and transect site within adjoining land.

Table 4.2 indicates that the minimum number of plot and transect sites and the number that has been sampled for this assessment.

Table 4.2 Plot and transect survey effort

PCT Zone	Condition	Area (ha)	Minimum Plot and Transect Sites Required	Number of Plot and Transect Sites Sampled
1	Moderate to good	2.11	2	3*

Table 4.2 Plot and transect survey effort

PCT Zone	Condition	Area (ha)	Minimum Plot and Transect Sites Required	Number of Plot and Transect Sites Sampled
2	Moderate to good	0.29	1	1
3	Moderate to good	1.15	1	1

** Plots were taken from development site and adjoining land*

4.3 Native Vegetation Extent

The development site is 95.36 ha in size, which includes 3.55 ha of native vegetation and 91.81 ha of cleared land. The extent of native vegetation extent within the development site is shown in **Figure 1.2**. This extent has been determined through aerial photograph interpretation and field surveys. It is considered that there are no significant differences between the mapped vegetation extent and aerial imagery utilised by this assessment.

The remaining areas of the development site comprise cleared land, which include exotic grassland (see ***Section 4.5.3***) and dams. In accordance with Section 5.1.1.3 of the FBA, these areas do not require further assessment unless they provide habitat for species credit species.

4.4 Identification of Plant Community Types

Identification of the PCTs occurring within the development site was guided by the results of the review of existing data (see ***Section 4.1***) and surveys of the development site (see ***Section 4.2***). The data collected during surveys of the development site was analysed in conjunction with a review of the PCTs held within the VIS Classification Database. Consideration was given to the following:

- Occurrence within the Cumberland IBRA subregion;
- Vegetation formation;
- Landscape position;
- Dominant upper, mid and ground strata species.

The analysis determined that the vegetation within the development site aligned with three PCTs held within the VIS Classification Database. **Table 4.2** lists the PCTs that have been identified within the development site and the justification for their selection.

Table 4.3 Justification for selection of PCTs within the development site

PCT Code	PCT Name	Evidence Used for Identification	Species Relied upon for Identification
HN526	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	**IBRA Subregion:** Occurs within the Cumberland IBRA subregion **Vegetation formation:** Coastal Valley Grassy Woodlands **Landscape position:** Occurs on stream banks and alluvial flats on the Cumberland Plain	**Upper stratum species**: *Eucalyptus amplifolia subsp. amplifolia* **Mid stratum species**: *Acacia parramattensis, Bursaria spinosa* **Ground stratum species**: *Dichondra repens, Echinopogon ovatus, Entolasia marginata, Microlaena stipoides, Solanum prinophyllum, Veronica plebeia*
HN528	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	**IBRA Subregion:** Occurs within the Cumberland IBRA subregion **Vegetation formation:** Coastal Valley Grassy Woodlands **Landscape position:** Occurs on clay/loam soils derived from Wianamatta Shales on the Cumberland Plain at low altitudes (mainly below 150m).	**Upper stratum species**: *Eucalyptus tereticornis* **Mid stratum species**: *Bursaria spinosa* **Ground stratum species**: *Cheilanthes sieberi, Dichelachne micrantha, Dichondra repens, Eragrostis leptostachya, Lomandra filiformis, Microlaena stipoides, Paspalidium distans*
HN594	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	**IBRA Subregion:** Occurs within the Cumberland IBRA subregion **Vegetation formation:** Coastal Floodplain Wetlands **Landscape position:** Occurs on sandy saline sediments fringing the high tide mark in coastal estuaries below 5m.	**Upper stratum species**: *Casuarina glauca* **Mid stratum species**: *Melaleuca styphelioides* **Ground stratum species**: *Alternanthera denticulata, Centella asiatica*

4.5 Description of Plant Community Types

4.5.1 Overview

Table 4.3 provides a summary of the PCTs occurring within the development site, including vegetation formation, percent cleared within the Hawkesbury/Nepean catchment and extent within the development site. The distribution of these PCTs within the development site is shown in **Figure 4.2**.

Table 4.4 Summary of PCTs occurring within the development site

PCT Code	PCT Name	Vegetation Formation	Vegetation Class	% Cleared within Catchment	Area within Development Site (ha)
HN526	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	Grassy Woodlands	Coastal Valley Grassy Woodlands	95	2.11
HN528	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	Grassy Woodlands	Coastal Valley Grassy Woodlands	95	0.29
HN594	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Forested Wetlands	Coastal Floodplain Wetlands	95	1.15

4.5.2 Threatened Ecological Communities

All three PCTs identified within the development site are associated with a Threatened Ecological Community (TEC) according to the VIS Classification Database as shown in **Table 4.4**. HN526 and HN528 are associated with only one TEC, whilst HN594 is associated with three. Assessment of HN594 within the development site has indicated that the PCT comprises Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. The subsequent assessment of each of the PCTs is based on the assessment of the associated TECs as shown in **Table 4.4**. The distribution of TECs within the development site is shown in **Figure 4.3**.

Table 4.5 TECs associated with PCTs occurring within the development site

PCT Code	PCT Name	TEC Name	TEC Status	Assessed as Associated TEC?
HN526	Forest Red Gum - Rough-	River-Flat Eucalypt Forest on	Endangered	Yes

Table 4.5 TECs associated with PCTs occurring within the development site

PCT Code	PCT Name	TEC Name	TEC Status	Assessed as Associated TEC?
	barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		
HN528	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	Yes
HN594	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	Yes
		Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	No
		River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Part)	Endangered	No

None of the PCTs occurring within the development site are considered to conform to any TECs listed under the EPBC Act. The vegetation condition at the development site was assessed against the listing advice for Cumberland Plain Shale Woodland under the EPBC Act (**Table 4.6**). Due to the condition of HN528 within the development site, it was determined as not conforming to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest as listed under the EPBC Act.

Table 4.6 Evaluation of HN528 at Development site against EPBC Act listing advice thresholds

Category and Rationale	Threshold	Development site details
Core thresholds that apply under most circumstances: patches with an understorey dominated by natives and consistent with the minimum mapping unit size applied in NSW.	Minimum patch size is ≥ 0.5 ha; AND ≥ 50% of the perennial understorey vegetation cover is made up of native species	The patch size at the development site is 0.29 ha
OR		
Larger patches which are inherently valuable due to their rarity.	The patch size is ≥ 5 ha; AND ≥ 30% of the perennial understorey vegetation cover is made up of native species.	The patch size at the development site is 0.29 ha
OR		
Patches with connectivity to other larger native vegetation remnants in the landscape.	The patch size is ≥ 0.5 ha; AND ≥ 30% of the perennial understorey vegetation cover is made up of native species; AND The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is ≥ 5ha in area.	The patch size at the development site is 0.29 ha
OR		
Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain.	The patch size is ≥ 0.5 ha in size; AND ≥ 30% of the perennial understorey vegetation cover is made up of native species; AND The patch has at least one tree with hollows per hectare or at least one large tree (≥80 cm dbh) per hectare from the upper tree layer species outlined in the Description and Appendix A (of the EPBC listing advice: Threatened Species Scientific Committee 2008)	The patch size at the development site is 0.29 ha

4.5.3 Description of Plant Community Types within the Development Site

i. HN526: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin

HN526 occurs predominately in the lower floodplain areas in the central area of the development site where it is associated with ephemeral streams, occurring in linear bands, and forms a mosaic with HN594. A representative photograph of this PCT is shown in **Photograph 4.1**.

The upper stratum is dominated by *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum), *Eucalyptus moluccana* (Grey Box), *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Angophora subvelutina* (Broad-leaved Apple). Other species present within the upper stratum include *Eucalyptus eugenioides* (Thin-leaved Stringybark) and *Eucalyptus tereticornis* (Forest Red Gum). A small tree layer is present in areas consisting of younger individuals of the upper stratum species present, along with *Casuarina glauca* (Swamp She-oak) and *Melaleuca styphelioides* (Prickly-leaved Tea Tree). The mid stratum is degraded with sparse cover due to previous and current land uses. The shrub layer, where present, consists of species such as *Melaleuca nodosa* (Prickly-leaved Paperbark), *Bursaria spinosa* (Blackthorn), *Melaleuca styphelioides* (Prickly-leaved Tea Tree), *Acacia parramattensis* (Sydney Green Wattle) and juvenile Eucalypts of the canopy species present.

The ground stratum is grassy with high abundances of both exotic herbs and grasses. The ground stratum of this PCT is dominated by a mosaic of exotic and native grasses. The most common native grasses of sampled areas are *Microlaena stipoides* (Weeping Grass), *Aristida ramosa* (Purple Wiregrass) and *Chloris ventricosa* (Tall Chloris). Common exotic grasses include *Cynodon dactylon* (Couch), *Paspalum dilatatum* and *Briza subaristata* (Chilean Quaking Grass). Native dicotyledonous herbs recorded within this PCT include *Stackhousia viminea* (Slender Stackhousia), *Dichondra repens* (Kidney Weed), *Solanum prinophyllum* (Forest Nightshade), *Rumex brownii* (Swamp Dock) and *Plantago debilis*. Exotic species present include *Senecio madagascariensis* (Fireweed), *Facelis retusa* (Annual Trampweed), *Sida rhombifolia* (Paddy's Lucerne) and *Lepidium africanum* (Common Pepper-cress). Monocotyledonous species recorded include natives such as *Wurmbea dioica* subsp. *dioica* (Early Nancy), *Dianella longifolia* var. *longifolia* (Pale Flax-lily) and *Carex inversa*, and the exotic *Romulea rosea* (Onion Grass). Native climbers present in some areas include *Polymeria calycina*, *Clematis glycinoides* (Headache vine), and *Desmodium varians* (Slender Tick-trefoil).

Photograph 4.1 HN526 within the development site

ii. HN528: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin

HN528 occurs within the development site as an isolated patch on a crest between two tributaries and comprises regrowth vegetation. A representative photograph of this PCT is shown in **Photograph 4.2**.

The upper stratum is dominated by a small trees layer of *Eucalyptus tereticornis* (Forest Red Gum). A native mid stratum layer is mostly absent, with *Bursaria spinosa* (Blackthorn) occurring at low abundances, along with a small number of the exotic *Lycium ferocissimum* (African Boxthorn).

The ground stratum has large occurrences of exotic herbs, including *Senecio madagascariensis* (Fireweed), *Hypochaeris microcephala* (White Flatweed, *Plantago lanceolata* (Lamb's Tongue) and *Gamochaeta calviceps* (Cudweed). Native herb diversity is relatively low for the PCT, with dicotyledonous herbs present including *Asperula conferta* (Common Woodruff), *Phyllanthus virgatus*, *Einadia trigonos* (Fishweed) and *Dichondra repens* (Kidney Weed). Monocotyledonous native herbs include *Arthropodium milleflorum* (Pale Vanilla Lily), *Lomandra filiformis* (Wattle mat-rush) and *Fimbristylis dichotoma* (Common Fringe-Sedge). The dominant grass is the native *Microlaena stipoides* (Weeping Grass), with *Aristida ramosa* (Purple Wiregrass) also occurring. Other native grasses present include *Bothriochloa macra* (Red-leg Grass), *Chloris ventricosa* (Tall Chloris) and *Eragrostis leptostachya* (Paddock Lovegrass). However exotic grasses are present in high abundances within this PCT. Exotic grasses include *Briza subaristata* (Chilean Quaking Grass), *Cynodon dactylon* (Couch) and *Paspalum dilatatum*. The native climber *Glycine*

tabacina is also present in small numbers in the ground layer of the patch. Weed cover within the ground stratum was about 85%. However a sufficient number of native species are present in grassy areas between the trees for these areas to be included as part of the open grassy areas of the woodland community.

Photograph 4.2 HN528 within the development site

iii. HN594: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion

HN594 is distributed within the lower floodplain areas in the central area and western boundary of the development site, generally as linear strips lining permanent and ephemeral creeks. A representative photograph of this PCT is shown in **Photograph 4.3**.

The upper stratum this PCT is dominated almost entirely by *Casuarina glauca* (Swamp She-oak) with isolated occurrences of *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum). The small tree layer is similar to the upper stratum with *Melaleuca nodosa* and *Melaleuca styphelioides* also occurring in some areas. The mid stratum consists of juvenile *Casuarina glauca* (Swamp She-oak) individuals, along with scattered occurrences of the native *Bursaria spinosa* (Blackthorn) and the exotic *Lycium ferocissimum* (African Boxthorn).

The ground layer of this PCT is heavily degraded across much of its extent within the development site, in which it consists nearly entirely of dense occurrences of the exotic sedge *Juncus acutus* (Sharp Rush), up to one metre in height. Herbs occurring within this PCT are generally exotic and occur in low abundances and include *Senecio madagascariensis* (Fireweed), *Rumex crispus* (Curled Dock) and *Solanum linnaeanum* (Apple of Sodom). Exotic grasses are the most prevalent grasses, the most commonly

occurring species being *Cynodon dactylon* (Couch) with *Ehrharta erecta* (Panic Veldtgrass) also occurring in some areas. Native grasses such as *Microlaena stipoides* and *Rytidosperma bipartitum* (Wallaby Grass) are present in some patches in low densities, along with the native sedges *Carex appressa* (Tall Sedge) and *Juncus usitatus*.

Photograph 4.3 HN594 within the development site

iv. Other Vegetation

The remaining vegetation within the development site is non-native and requires no further assessment unless it provides habitat for species credit species. The non-native vegetation within the development site comprises exotic grassland and does not conform to the determination for Derived Native Grassland due to its high percentage of exotic species cover and lack of native species present in the ground storey. The vegetation condition is a result of historic degradation due to past and present grazing of the development site and pasture improvement. A representative photograph of this PCT is shown in **Photograph 4.4**.

Exotic grasses are dominant in all areas, although some native grass species are present. Dominant exotic grasses include *Cynodon dactylon* (Couch), *Axonopus fissifolius* (Carpet Grass), *Briza subaristata* (Chilean Quaking Grass) and *Paspalum dilatatum*, with *Vulpia bromoides* (Squirrel Tail Fescue) and *Briza minor* (Shivery Grass) occurring less frequently. The most commonly occurring native grass is *Microlaena stipoides* (Weeping Grass). Other native grasses present include *Dichelachne micrantha* (Shorthair Plume Grass), *Bothriochloa macra* (Red-leg Grass) and *Sporobolus creber* (Slender Rat's Tail Grass). Common exotic herbs include *Senecio madagascariensis, Hypochaeris radicata* (Catsear), *Lotus uliginosus* (Greater Birds-foot Trefoil), and *Cerastium glomeratum* (Sticky Mouse-ear Chickweed), but these occur at low densities. Native herbs recorded in grassland areas

include *Chrysocephalum apiculatum* (Common Everlasting), *Wahlenbergia gracilis* (Native Bluebell), *Arthropodium milleflorum* (Pale Vanilla Lily) and *Oxalis perennans* (Wood Sorrel).

Photograph 4.4 Exotic Grassland at the development site

Scattered trees are present within the grassland, which are representative of the PCTs that are may have historically occurred across the development site prior to grassland improvement. Scattered tree species include *Melaleuca styphelioides*, *Eucalyptus eugenioides*, *Eucalyptus tereticornis* and *Eucalyptus crebra*.

The grasslands are dominated by exotic pasture grasses, but do contain trace occurrences of non-woody species that are listed under the TSC Act final determination for the threatened community Cumberland Plain Woodland in the Sydney Basin Bioregion. Given the sparse occurrence of species such as *M. stipoides*, it is determined that the exotic grasslands do not conform to the threatened ecological community species listing as the listing states that:

"The ground cover is dominated by a diverse range of grasses including *Aristida ramosa* (Purple Wiregrass), *A. vagans* (Threeawn Speargrass), *Cymbopogon refractus* (Barbed Wire Grass), *Dichelachne micrantha* (Plumegrass), *Echinopogon caespitosus* (Forest Hedgehog Grass), *Eragrostis leptostachya* (Paddock Lovegrass), *Microlaena stipoides* (Weeping Grass), *Paspalidium distans* and *Themeda australis* (Kangaroo Grass), and with graminoids *Carex inversa* (Knob Sedge), *Cyperus gracilis, Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush) and *L. multiflorus* subsp. *multiflorus* (Many-flowered Mat-rush)."

4.6 Vegetation Zones

The three PCTs occurring within the development site were stratified into areas that are low condition and areas that are in moderate to good condition. As each of the three PCTs was assessed as being within one broad condition state, three vegetation zones were identified within the development site. A summary of the vegetation zones within the development site is provided in **Table 4.4** and their distribution is shown in **Figure 4.4**.

Each vegetation zone was assessed using plot and transect surveys or full floristic surveys to determine the site value score. Plot and transect data collected from the vegetation zones are provided in **Appendix A** The calculated site value score for each of the vegetation zones identified within the development site is shown in **Table 4.5**. All of the vegetation zones within the development site have a site value score of ≥17 and therefore must be further assessed.

Table 4.7 Vegetation zones within the development site

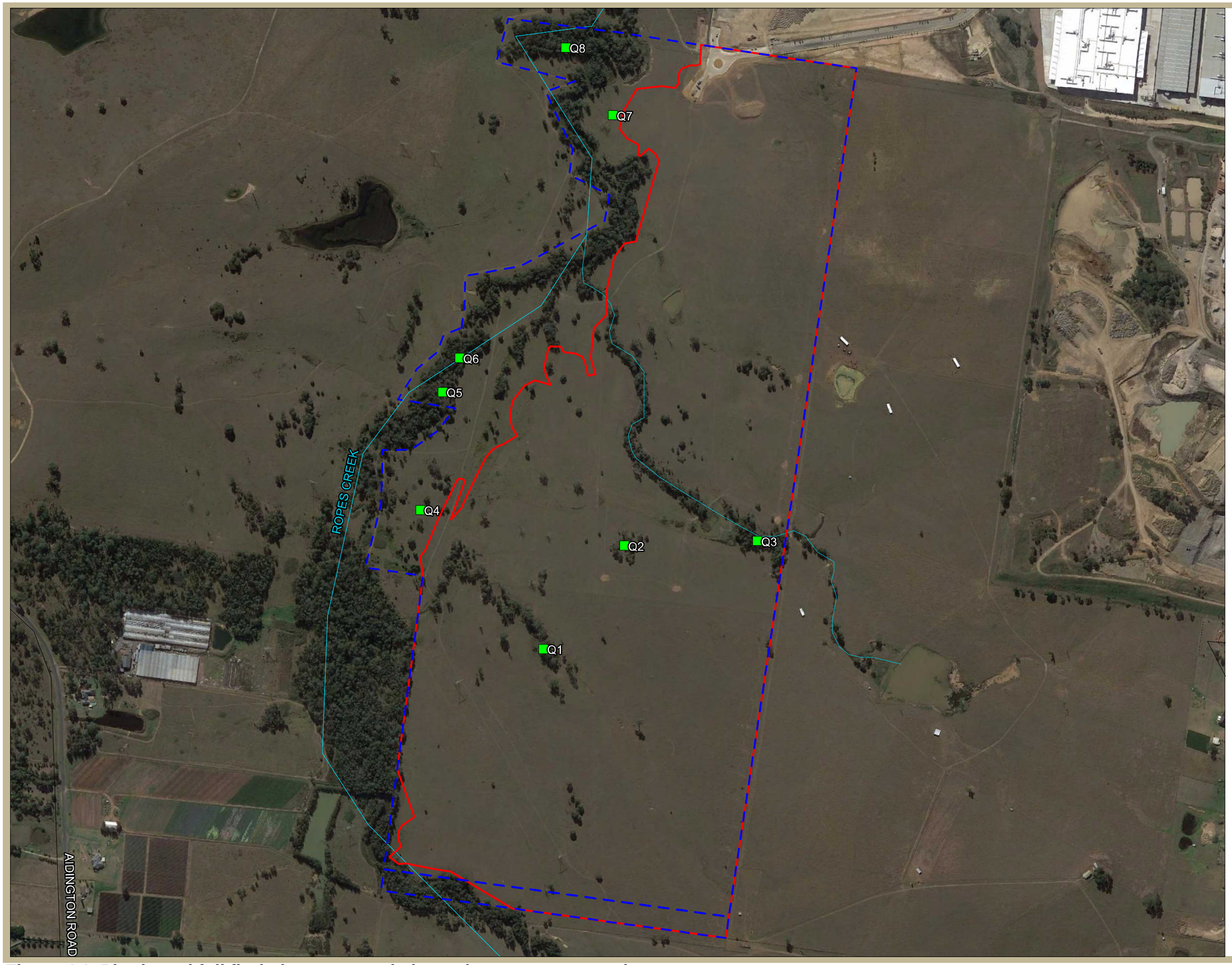
Zone	PCT	Condition Class	Area (ha)	Site Value Score
1	HN526: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	Moderate to good	2.11	61.63
2	HN528: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	Moderate to good	0.29	50.72
3	HN594: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Moderate to good	1.15	44.93

4.7 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) were initially assessed by reviewing the Groundwater Dependent Ecosystem Atlas (BOM 2015) for the site.

One GDE was identified within the development site as Cumberland River Flat Forest, which corresponds to the PCT HN526: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin and HN594: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion previously identified within **Section 4.5**. The impacts to both PCTs that are identified as GDEs within the development site will be assessed in **Chapter 7**. A figure showing the location of all GDEs identified within the development site is shown in **Figure 4.5**.

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Development site
- Lot Boundary
- Road
- Watercourse
- Flora Plot Location

Grid North

Scale: 1:7,154 @ A3 page
Date Prepared: 11/08/2016

Image Source:
Google Earth
(dated 05-05-2016)

Data Source:

cumberland ecology

I:\...\14039\Figures\BAR_RP1\20160811\Figure 4.1. Flora Plot Locations

Figure 4.1. Plot-based full floristic survey and plot and transect survey sites

100 0 100 200 300 400m

Coordinate System: MGA Zone 56 (GDA 94)

Legend

- Development site
- Road
- Watercourse

PCT

- HN526: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin
- HN528: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin
- HN594: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion

N
Grid North

Scale: 1:7,154 @ A3 page
Date Prepared: 11/08/2016

Image Source:
Google Earth
(dated 05/05/2016)

Data Source:
© Copyright Commonwealth of Australia
(Geoscience Australia) 2006

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I:\...\14039\Figures\BAR_RP6\20160811\Figure 4.2. PCTs_Development

Figure 4.2. PCTs within the development site

100 0 100 200 300 400m

Coordinate System: MGA Zone 56 (GDA 94)

Legend

- Development site
- Road
- Watercourse

TEC

- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Cumberland Plain Woodland in the Sydney Basin Bioregion
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

N
Grid North

Scale: 1:7,154 @ A3page
Date Prepared: 11/08/2016

Image Source:
Google Earth
(dated 05-05-2016)

Data Source:

cumberland ecology

I:\...\14039\Figures\BAR_RP6\20160811\Figure 4.3. TECs_Development

Figure 4.3. TECs within the development site

100 0 100 200 300 400m

Coordinate System: MGA Zone 56 (GDA 94)

Legend

- Development site
- Road
- Watercourse

Vegetation Zone

- Zone 1: HN526
- Zone 2: HN528
- Zone 3: HN594

N
Grid North

Scale: 1:7,154 @ A3 page
Date Prepared: 11/08/2016

Image Source:
Google Earth
(dated 05-05-2016)

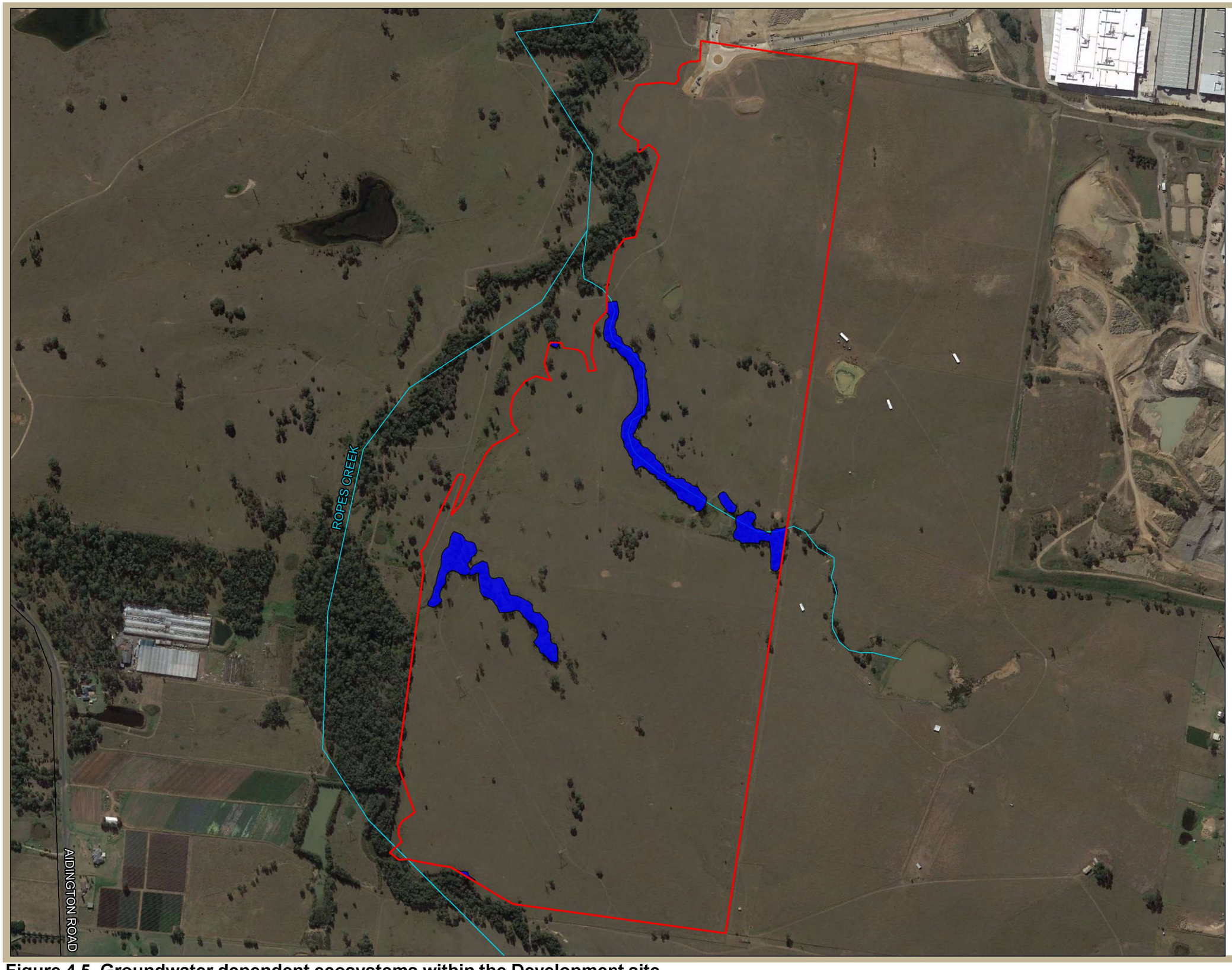
cumberland ecology

I:\...\14039\Figures\BAR_RP6\20160811\Figure 4.4. Vegetation Zones_Development

Figure 4.4. Vegetation zones within the development site

100 0 100 200 300 400m

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Development site
- Road
- Watercourse

Groundwater Dependent Ecosystems

- Cumberland River Flat Forest

Grid North

Scale: 1:7,154 @ A3 page
Date Prepared: 11/08/2016

Image Source:
Google Earth
(dated 05-05-2016)

Data Source:

cumberland ecology

100 0 100 200 300 400m

F:\...\14039\Figures\RP6_BAR\20150811\Figure 4.5. GDEs_Development

Figure 4.5. Groundwater dependent ecosystems within the Development site