



Angas Securities Pty. Ltd.

Fernhill Lot 1 DP 549247 Two Lot Development Biodiversity Assessment

September 2017

Table of contents

1.	Introduction4				
	1.1	Overview	4		
	1.2	Proposal description	4		
	1.3	Scope of Assessment	5		
	1.4	Terms and definitions	5		
	1.5	Relationship to existing reports	6		
2.	Legis	slative context	9		
	2.1	Commonwealth legislation	9		
	2.2	NSW legislation	9		
	2.3	NSW policies and guidelines	11		
3.	Meth	ods	12		
	3.1	Overview	12		
	3.2	Desktop assessment	12		
	3.3	Field survey	13		
	3.4	Staff Qualifications	16		
4.	Exist	ing Environment	17		
	4.1	Site Context	17		
	4.2	Vegetation	18		
	4.3	Fauna and habitats	30		
	4.4	Conservation significance	34		
5.	Impa	pact assessment4			
	5.1	Proposal description	42		
	5.2	Direct impacts	42		
	5.3	Indirect impacts	45		
	5.4	Positive impacts	46		
6.	Impa	ct Mitigation	47		
7.	Asse	essments of significance	49		
	7.1	Identification of affected threatened biota	49		
	7.2	Threatened ecological communities	51		
	7.3	Threatened fauna	52		
	7.4	Migratory fauna	56		
	7.5	Additional MNES	57		
8.	Conc	clusions	58		
9	Disclaimer				
10					
10.	References				

Table index

Table 1 Survey effort	13
Table 2 Staff qualifications	16
Table 3 Vegetation zones at the site	20
Table 4 Zone 1 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (low condition)	21
Table 5 Zone 2 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (high condition)	22
Table 6 Zone 3 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (poor condition)	23
Table 7 Zone 4 - Red Bloodwood - Grey Gum woodland	24
Table 8 Zone 5 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy	25
Table 9 Zone 6 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (poor condition)	27
Table 10 Zone 7 - Coastal freshwater wetland	28
Table 11 Priority weeds recorded during the field survey	30
Table 12 Threatened flora that may occur within the Lot 1 subdivision	36
Table 13 Threatened fauna that may occur within the Lot 1 subdivision	37
Table 14 Potential extent of vegetation removal or modification within the site	44
Table 15 Potentially affected threatened biota	50

Figure index

Figure 1 Site location	7
Figure 2 Site layout	8
Figure 3 Vegetation zones and survey effort	
Figure 4 Threatened biota	41

Appendices

Appendix A – Threatened biota assessment Appendix B – Field survey data Appendix C – Assessments of significance

1. Introduction

1.1 Overview

GHD Pty Ltd (GHD) has been engaged by Angas Securities to complete a biodiversity assessment to support a Development Application (DA) for the proposed subdivision of Lot 1 DP 549247 within the Fernhill Estate at Mulgoa, NSW (the proposal). A DA has been submitted to Council for approval under the NSW *Environment Protection and Assessment Act 1979* (EPA Act). This biodiversity assessment is a specialist appendix to support the DA. It assesses the potential for impacts on biodiversity values at the site, with particular emphasis on threatened ecological communities, populations and species listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and *Fisheries Management Act 1994* (FM Act) and *Matters of National Environmental Significance* (MNES) listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The proposal seeks subdivision of Lot 1 DP 549247 into two approximately 55 hectare allotments each of which includes a two hectare house lot. The site is shown on Figure 1. The development footprint including the layout of house lots is shown on Figure 2.

1.2 Proposal description

This report has been prepared to support DA. The parcels of land proposed for amendments to the Penrith Local Environment Plan (the LEP) are currently zoned E3 Environment Management in Lot 1 DP 549247 of the Fernhill Estate. The amendments to the LEP for the Lot 1 subdivision will allow a modest extension of the Mulgoa environmental / rural living neighbourhood.

The proposal seeks subdivision of the vacant 111 hectare site into two approximately 55 hectare allotments as follows:

- Lot 1 (55.2 hectares) comprising:
 - 53.2 hectares which is to be protected in perpetuity under a conservation agreement; and
 - A two hectare house lot including the site for a detached dwelling and ancillary compliant uses, subject to a separate DA.
- Lot 2 (55.9 hectares) of which:
 - 53.9 hectares is to be protected in perpetuity under a conservation agreement; and
 - A two hectare house lot including the site for a detached dwelling and ancillary compliant uses, subject to a separate DA.

No civil or stormwater works are proposed. No additional disturbance for access, fire management, water, sewer, utilities, etc is required beyond the boundary of the Residual Lots.

The application of conservation agreements will enable a contiguous vegetated link between the Blue Mountains National Park and the heart of the Mulgoa Valley, benefitting biodiversity values and residents of the locality through increasing native vegetation cover, contributing to the scenic qualities of the valley; and precluding further development into the future.

The proposal would not remove all the native vegetation and habitat within the development footprint. Impacts would be avoided where possible through retention of mature trees, threatened plants, other native vegetation and fauna habitat resources within each two hectare lot. The layout of lots and retention of vegetation has considered the likely locations of houses and other infrastructure along with the need to manage bush fire hazard. Mitigation measures to

further minimise impacts and prevent secondary impacts on adjoining areas of native vegetation would be included within management plans for the construction of the development.

1.3 Scope of Assessment

The aim of this Biodiversity assessment report is to:

- Describe the existing environment within the site vegetation communities, fauna habitats and flora and fauna species known or likely to occur.
- Assess the value and conservation significance of native vegetation and habitats in the site and the likelihood of occurrence of threatened biota based on the habitats present.
- Compile a list of threatened biota previously recorded or predicted to occur in the locality and assess their potential to occur at the site and/or be affected by the proposal.
- Assess the likely impacts of the proposed development.
- Recommend mitigation measures to reduce impacts on biodiversity values.
- Provide concluding statements regarding the likely significance of impact of the proposed development on threatened biota or EPBC Act MNES or the requirement or otherwise for further assessment or approvals at the State or federal level.

1.4 Terms and definitions

The following terms are used in this report:

The site	Lot 1 DP549247 at Mulgoa, NSW as shown on Figure 1.
The proposal	The proposed residential subdivision within Lot 1 DP549247 at Mulgoa, NSW as shown on Figure 1.
Locality	The area within a 10 km radius of the Lot 1 DP549247 boundary.
Conservation agreement	A binding agreement that ensures that a parcel of land is set aside and managed for biodiversity conservation in perpetuity either through a BioBanking agreement under the TSC Act or a Biodiversity Stewardship Site agreement under the BC Act.
Development footprint	The area at the site that would be developed for future dwellings and associated land uses, comprising a two-hectare house lot within the proposed Lot 1 DP549247 and a two-hectare house lot within the proposed Lot 2 DP549247 as shown on Figure 2.
Western Precinct	The land within Lot 1 DP 549247 and Lot 31 DP 237163 at the Fernhill Estate.
Threatened biota	Threatened species, populations and communities that are listed under the TSC Act, FM Act and/or the EPBC Act.
BioBanking agreement	An agreement entered into between the landowner and the Minister under Part 7A of the TSC Act for establishing a biobank site.

BioBanking	The rules of BioBanking established under the TSC Act that
Assessment	determine credits created, credits required and the circumstances
Methodology 2014	that improve or maintain biodiversity values.
(BBAM)	
BioBanking	The biodiversity banking and offsets scheme established under Part 7A of the TSC Act.

1.5 Relationship to existing reports

1.5.1 Previous rezoning application

A rezoning application for the entire Fernhill Estate (previously known as the Owston Estate) was prepared for the previous owner of the estate. The current report draws on information contained in the ecological assessment which was prepared by Eco Logical Australia (hereafter ELA; ELA, 2007a, 2007b, 2010) to support the former application.

There are, however, several important differences between the current report and that prepared by ELA:

- The current application applies to a portion of Lot 1 DP 549247 of the Fernhill estate only, whereas the previous application also included other titles within the Fernhill Estate.
- The development footprint within Lot 1 DP 549247 has been substantially revised, based on considerations including zoning within the *Penrith City Council Local Environment Plan 2010* and minimising the impact of the development on native vegetation and on the threatened Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*).
- The previous application anticipated that adjoining areas of retained vegetation would be managed as part of a community development scheme. The current intent is to proceed under the BioBanking methodology, meaning that retained areas of vegetation would be protected and managed for conservation in perpetuity under a BioBanking agreement. This approach provides greater conservation certainty and a funding mechanism to manage the site for this purpose.

1.5.2 Current rezoning assessment process

The current proponent has completed various biodiversity assessments to support planning proposals for multiple lot subdivisions at the site. The current two-Lot subdivision proposal follows on from various options for larger numbers of Lots that were considered.

This biodiversity assessment draws upon information contained in the GHD (2015a) *Lot 1 DP* 549247 subdivision 15 Lot planning proposal. GHD (2015a) describes the ecological values in Lot 1 of the Fernhill Estate, with particular emphasis on threatened ecological communities, populations and species listed under the NSW TSC Act and FM Act, and MNES listed under the Commonwealth EPBC Act.

A draft BioBanking assessment was previously prepared to support an application for a BioBanking statement for a 15 Lot subdivision at the site and data were collected to support future BioBanking agreement applications. This biodiversity assessment draws upon the field survey results and assessment data included in those unpublished BioBanking assessments.





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LEGEND





Notes: Indicative dwelling locations are based on a 28m x 18m footprint placed within Bushfire Attack Level (BAL) zones of BAL 29 or less. Full vegetation removal areas comprise a 20m buffer area around dwellings to allow for fences, garages, paving and other structures. In practice some trees and other native vegetation may be retained in these areas. Managed vegetation areas will be managed as the outer protection area of an asset protection zone. Some trees may be removed and the mid storey will be slashed or thinned to maintain a discontinuous canopy and <15% shrub cover. No hollow bearing trees or threatened plants will be removed.

Site layout

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Angas Securities Pty. Ltd.Job Number22-16709Fernhill Lot 1 DP 549247RevisionATwo Lot Development Biodiversity AssessmentDate30 Aug 2017

Figure 2

N:AU/Sydney/Projects/22/16709/G/G/S/Maps/Westerm_Precinct_Statement/22_16709_Z002_SiteLayout.mxd Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7190 E sydmall@ghd.com.au W www.ghd.com.au © 2017. Whist every care has been taken to prepare this map. GHD (and Land and Property Information, Sixmaps), MoltMacdonaid) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and dramy care check liability and responsibility of any kit (whether in correct, chi or otherwise) for any expenses. Isoses, damages and/or costs, (chicking informace or consequential damage) within are or may be incurred by any party as a result of the map being inaccurate, incomplete or normalizable in any ware in the second or may be incurred by any party as a result of the map being inaccurate.

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2. Legislative context

2.1 Commonwealth legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on MNES undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, undertaking, development or activity. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Government Minister for the Environment.

Potential impacts on any MNES must be subject to assessments of significance pursuant to the *Significant Impact Guidelines 1.1* (DotE 2013). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Commonwealth Environment Minister.

The development has the potential for impacts on threatened species and communities listed under the EPBC Act and so a referral of the proposal will be prepared and submitted to Department of the Environment and Energy (DoEE). These species and communities are also listed under the NSW TSC Act and have been included in Section 5A assessments of significance in Appendix C of this report. These assessments concluded that a significant impact is not likely on MNES of relevance to the proposal. Formal assessments of impacts in accordance with the DotE (2013) guidelines will be included in the referral.

2.2 NSW legislation

2.2.1 The Biodiversity Conservation Act 2016 (BC Act)

The BC Act was passed by NSW Parliament in November 2016 and came into effect on 25 August 2017. The *Threatened Species Conservation Act 1995* (TSC Act) as well as the *Native Vegetation Act 2003* and some parts of the *National Parks and Wildlife Act 1974* were repealed on 25 August 2017. As a result, the matters relating to the listing of threatened species, biodiversity impact assessment, offsetting and related offences will now be contained within the BC Act.

Under the BC Act the assessment of biodiversity values on land and the impacts of activities on those biodiversity values are to be carried out in accordance with the Biodiversity Assessment Method (BAM). Where proposed development or clearing has an impact on biodiversity values above a certain threshold, a biodiversity development assessment report will be required to be prepared by accredited assessors. The report will determine the impacts of proposed actions on biodiversity values and the biodiversity conservation measures (including the retirement of credits) needed to avoid or minimise that impact. Biodiversity credits can be generated on 'biodiversity stewardship sites'. Agreements will be entered into that specify management actions required to be carried out on biodiversity stewardship sites.

The *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (the BC Regulation) makes savings, transitional and other related provisions consequent on the enactment of the BC Act. Part 7 s.28 of the BC Regulation states that the former planning provisions continue to apply to an application for development consent under Part 4 of the EPA Act made within 12 months after the commencement of the new Act, if the development is within an interim

designated area. The Penrith City Council local government area (LGA) is an interim designated area.

The proposal, and future DAs for dwellings, will be made within 12 months of the commencement of the BC Act within the City of Penrith LGA interim designated area. Therefore, this biodiversity assessment has been prepared with reference to the former planning provisions as described below.

Part 5 s.14 (2) of the BC Regulation states that the Minister may within a period of 18 months after the commencement of the BC Act determine an application to enter into a BioBanking agreement under Part 7A of the TSC Act if the application is made within six months of the repeal of the TSC Act and that the minister is satisfied that relevant information was collected before the repeal of the TSC Act. Field surveys, including vegetation zone mapping and sampling of plot/transects, were completed in the proposed Lot 1 conservation area and Lot 2 conservation area in 2014 and 2016. Field data processing and GIS analysis were also substantially completed for the proposed conservation areas by mid 2016. Therefore relevant information was collected before the repeal of the TSC Act and explications for BioBanking agreements could be determined if made within six months of the repeal of the Act (i.e. before 25 February 2018).

2.2.2 Environmental Planning and Assessment Act 1979 (EPA Act)

The EPA Act forms the legal and policy platform for proposal assessment and approval in NSW and aims to, inter alia, 'encourage the proper management, development and conservation of natural and artificial resources'. All development in NSW is assessed in accordance with the provisions of the EPA Act and EPA Regulation 2000. The proposal, as an activity that requires consent, is to be determined under Part 4 of the Act and Council is the 'consent authority' for the purposes of the Act.

Section 5A of the EPA Act lists seven factors that must be taken into account in the determination of the significance of potential impacts of a proposed activity on threatened species, populations or ecological communities (or their habitats) listed under the TSC Act and the FM Act. The '7-part test' is used to assist in the determination of whether a proposal is 'likely' to impose 'a significant effect' on threatened biota and thus whether a species impact statement (SIS) is required. Section 5A of the EPA Act was repealed on 25 August 2017 however, as described above, the BC Regulation includes transitional arrangments that mean that the previous of Section 5A continue to apply to the proposal and to this biodiversity assessment. 7-part tests for threatened biota considered to have the potential to occur in the site are included in Appendix C. These assessments concluded that a significant impact is not likely.

2.2.3 Threatened Species Conservation Act 1995 (TSC Act)

The TSC Act was repealed on 25 August 2017 however, as described above, the BC Regulation includes transitional arrangments that mean that the TSC Act continues to apply to the proposal and to this biodiversity assessment.

The TSC Act provides legal status for biota of conservation significance in NSW. The Act aims to, inter alia, 'conserve biological diversity and promote ecologically sustainable development'. It contains schedules that list endangered, critically endangered and vulnerable species, endangered populations, endangered, critically endangered and vulnerable ecological communities, and key threatening processes in NSW. Potential impacts on any of these biota must be subject to an assessment of significance through the provisions of section 5A of the EPA Act as described above.

BioBanking was established under Part 7A of the *NSW Threatened Species Conservation Act* 1995 (TSC Act), which was enabled by the *Threatened Species Conservation Amendment* (*Biodiversity Banking*) *Bill 2006.* The *Threatened Species Conservation (Biodiversity Banking) Regulation 2008* provides additional rules for specific aspects of the scheme that are important for its operation. BioBanking was established by the New South Wales Department of Environment, Climate Change and Water (DECCW) (now the Office of Environment and Heritage (OEH)) as a method to address the loss of biodiversity and threatened species. The scheme attempts to create a market framework for the conservation of biodiversity values and the offsetting of development impacts.

It is likely that BioBanking agreements will be established over the majority of the two Lots created by the proposal ensuring that they are protected and managed for biodiversity conservation in perpetuity.

The BioBanking assessment methodology 2014 (BBAM) has been used to help describe and assess the biodiversity values of the site.

2.2.4 Biosecurity Act 2015

The *Biosecurity Act 2015* provides the statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds.

The primary object of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Environmental weed species were recorded during field surveys. Priority weeds that would require consideration under the Biosecurity Act are listed in Table 11. These priority weeds would require management during construction of the proposal and control once the residential subdivision has been established.

2.3 NSW policies and guidelines

2.3.1 Local Environment Plan

The site falls within the Penrith City Council LEP. The site is currently zoned as E3 Environmental Management under the LEP. The objectives of the E3 zone include: to protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values; and to provide for a limited range of development that does not have an adverse effect on those values.

The general intent of the LEP is to conserve and manage the natural environment of the Penrith LGA. The objectives of the E3 zone and the principals of the LEP have been addressed in this report by the due consideration of the potential for impacts on native biota and the local environment in Section 5, through impact mitigation and management recommendations provided in Section 6 and by the conservation of the majority of the site as biobanks.

3.1 Overview

This biodiversity assessment was prepared with reference to the BBAM (OEH 2014a). A draft BioBanking assessment was previously prepared to support an application for a biobanking statement for a 15 Lot subdivision at the site and data were collected to support future BioBanking agreement applications. The BBAM was applied across Lot 1 including:

- Mapping of plant community types (PCTs) and broad condition classes;
- Sampling of BioBanking plot/transects to calculate the site value; and
- Targeted seasonal surveys for threatened species.

Lot 1 DP 549247 and the broader Fernhill Estate has been the subject of numerous ecological assessments and studies by both GHD and ELA over the past seven years, in order to gain approval for various developments, activities and conservation agreements. The current report has referenced this body of work where appropriate, as described below.

3.2 Desktop assessment

3.2.1 Database searches

A desktop assessment was undertaken to identify threatened flora and fauna species, populations and ecological communities listed under the TSC Act and FM Act, and MNES listed under the EPBC Act that may be affected by the proposal. Database records pertaining to the site and locality (i.e. within a 10 km radius of the site) were reviewed and included:

- NSW OEH Wildlife Atlas database for records of threatened species listed under the TSC Act (OEH 2015a; data downloaded on 20 May 2015).
- Department of the Environment (DotE) Protected Matters Online Search Tool for MNES listed under the EPBC Act and predicted to occur in the locality (DotE 2015a; database queried on 20 May 2015).
- Department of Primary Industries (DPI) Threatened Species Records Viewer (DPI 2015; database queried 20 May 2015) for threatened species listed under the FM Act and recorded within the Sydney Metropolitan catchment.
- NPWS (2002) *Native Vegetation of the Cumberland Plain, Western Sydney* to identify threatened ecological communities mapped as occurring within the locality.
- OEH (2013b) *NSW Vegetation Types Database* and OEH 2014a *Biobanking Assessment Methodology* to define vegetation types and condition classes within the site.

The habitat resources present at the site (determined during the site inspection) were compared with the known habitat associations/requirements of the relevant threatened and migratory biota identified by the desktop review.

3.2.2 Literature review

A review of the following ecological assessments previously undertaken within the Fernhill estate was also undertaken:

- Eco Logical Australia (2010) *Owston Estate (Fernhill) Ecological Assessment of Proposed Rezoning.*
- Eco Logical Australia (2007a) Fernhill Ecological Assessment.

- Eco Logical Australia (2007b) Fernhill Maintain or Improve Test.
- GHD (2014) Fernhill Western Precinct Subdivision Ecological Assessment
- GHD (2013a) Fernhill Eastern Precinct Subdivision Ecological Assessment.
- GHD (2013b) Fernhill East Biobank BioBanking Assessment.
- GHD (2013c) Fernhill Central West Biobank BioBanking Assessment.
- GHD (2012) Preliminary Ecology Assessment and 7-part test to support the Development Application (DA) for the proposed Athletic Endurance course (Tough Mudder) at Fernhill NSW.
- GHD (2015a) Lot 1 DP 549247 subdivision 15 Lot planning proposal.
- GHD (2015b) Fernhill North West Biobank BioBanking Assessment.

3.2.3 Geographical Information System (GIS) Analysis

GIS was used to plot the site on a high resolution aerial photo base and to map vegetation types and biodiversity values across the site. GIS analysis was used to calculate the extent of native vegetation to be removed within the development footprint, which was entered into the credit calculator.

GIS analysis was used to accurately determine the Catchment Management Authority (CMA), CMA Sub-region and Mitchell Landscape of the site.

3.3 Field survey

3.3.1 Overview

Field surveys of the Lot 1 subdivision conducted by ELA primarily consisted of ground-truthing existing vegetation mapping, with opportunistic observations of threatened flora and fauna species (ELA 2007a, b and 2010). ELA also conducted targeted searches for the threatened Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*) and riparian assessments (ELA 2010). GHD have conducted a supplementary survey of the site in accordance with the BBAM to support this BioBanking statement application.

GHD have completed a number of field surveys over the broader Fernhill Estate that have contributed to the understanding of the existing environment for this assessment, including formal flora and fauna surveys in accordance with the BioBanking Assessment Methodology (BBAM). Survey effort that has directly contributed to this ecological assessment is summarised in Table 1. Only survey effort within the Lot 1 DP 549247 is described in the following sections.

Stage	Date	Survey Technique
Surveys incorporating the	Lot 1 Subdivision	
Fernhill South West Biobank additional detailed BBAM survey (GHD)	14, 15 September 2016	Eight 20 m x 50 m BioBanking plot / transects; targeted threatened flora searches; opportunistic fauna observations; fauna habitat assessment
Fernhill Lot 1 Subdivision additional detailed BBAM survey (GHD)	14 September 2016	Four 20 m x 50 m BioBanking plot / transects; targeted threatened flora searches; opportunistic fauna observations; fauna habitat assessment
Targeted species credit survey 2 (GHD)	26 February 2015	Targeted threatened flora searches using walked transects Active searches for Cumberland Plain Land Snail

Table 1 Survey effort

Stage	Date	Survey Technique
		Targeted Rosenberg Goanna surveys using infra-red cameras Nocturnal searches for threatened amphibians
Targeted species credit survey 1 (GHD)	27 November 2014	Targeted <i>Grevillea juniperina</i> subsp. <i>juniperina and Micromyrtus minutiflora</i> surveys
Fernhill Lot 1 Subdivision detailed BBAM survey (GHD)	15, 16, 17 July 2014	Nineteen 20 m x 50 m BioBanking plot / transects; targeted threatened flora searches; opportunistic fauna observations; fauna habitat assessment
Fernhill Lot 1 Subdivision supplementary rezoning survey / preliminary BBAM survey (GHD)	22 October 2013	Ground truthing of vegetation, habitat and threatened biota mapping (ELA 2010). Fine-scale vegetation zone mapping
'Tough Mudder' DA preliminary survey (GHD 2012)	11 December 2012	Broad-scale vegetation survey, vegetation mapping, opportunistic fauna and threatened flora observations.
Rezoning application for Owston Estate (ELA 2010)	March 2010	Targeted <i>Grevillea juniperina</i> subsp. <i>juniperina</i> surveys
Rezoning application for Owston Estate (ELA 2010)	21 December 2009	Riparian assessments
Fernhill Ecological Assessment (ELA 2007a)	2007	Validation of existing vegetation mapping, opportunistic threatened species observations

3.3.2 Survey effort within Lot 1 DP 549247

Vegetation mapping

Preliminary vegetation mapping was ground-truthed in the field via systematic walked/driven transects across the entire site and by walking the boundary of vegetation communities. Field ecologists checked mapped vegetation polygons with a hand-held Trimble GPS unit loaded with aerial photography and existing vegetation mapping. Necessary adjustments were made by hand on aerial photographs of the site and by capturing waypoints at vegetation community boundaries. The site was divided into relatively homogenous or discrete vegetation zones for assessment. Each vegetation zone represented a distinct PCT and broad condition state. Vegetation zones were identified at the site and mapped using aerial photographic interpretation within a geographical information system (GIS) as guided by the field survey results.

Vegetation zone mapping was further refined after the detailed BBAM survey. Plant species lists from plot/transects were compared with Tozer (2010) diagnostic species lists and the distribution of PCTs adjusted as appropriate. Percentage cover of native and exotic vegetation data from transects was used to adjust the distribution of vegetation condition classes as appropriate (with >50% of the groundcover present exotic the key threshold for discriminating Low from Moderate/good condition according to the BBAM; and >50% of the groundcover present exotic and no native mid storey cover the key threshold for discriminating Cleared land from Low condition vegetation). Vegetation zones are shown on Figure 3.

Vegetation within the site was assessed against identification criteria for State and Commonwealth listed threatened ecological communities (critically endangered ecological communities (CEECs), endangered ecological communities (EECs) and vulnerable ecological communities (VECs)). Vegetation and habitats were compared with descriptions provided in published threatened species profiles and management plans.

Plot/transect surveys

Plot and transect surveys were conducted on site in accordance with the BBAM to obtain data for the calculation of ecosystem credits. The site value was determined by assessing ten site condition attributes against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement. Cover abundance data was also collected for each species within the 20 metre x 20 metre portion of each plot/transect.

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. Casual fauna observations were made in suitable areas of habitat throughout the course of the flora survey and while incidentally traversing the site. This included visual inspection of trees and woody debris, active searches for small fauna and opportunistic observation of scats, tracks, burrows or other traces.

Targeted species credit surveys

Targeted threatened species surveys were conducted in November 2014 and February 2015. Multiple survey rounds for targeted surveys were used to enhance the detectability of threatened cryptic flora with variable flowering times and threatened fauna.

Targeted searches for threatened flora species known or predicted to occur in the locality were carried out using a walked transect during both the November and February survey rounds. In the November round, targeted surveys focused on the detection of flowering species including Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*), *Micromyrtus minutiflora* and *Dillwynia tenuifolia*. The February round consisted of supplementary surveys for flora which were not flowering in October and unlikely to be detected at that time and include Deane's Melaleuca (*Melaleuca deanei*), Hairy Geebung (*Persoonia hirsuta*) and Small Pale Grass-lily (*Caesia parviflora subsp. minor*).

Where threatened flora species were found, random meander searches were used to target any other individuals in the immediate area. Walked transects consisted of two ecologists walking in parallel lines to each other within the development footprint.

Targeted surveys for the Giant Burrowing Frog (*Heleioporus australiacus*) and Green and Golden Bell Frog (*Litoria aurea*) were conducted over one night in February 2015 by GHD ecologists. Both species are listed as a vulnerable species under the EPBC Act but the Giant Burrowing Frog and Green and Golden Bell Frog are listed as vulnerable and endangered respectively under the TSC Act. Weather conditions for the survey were favourable, with rain within the previous 4 hours (<1mm) and during the survey with hot weather reaching up to 25.8 °C experienced during daylight hours. Less recently, up to 37.6 mm of rain had fallen within the last week (Orchid Hills Treatment Works, BOM 2015). Cloud cover was high during the survey, surface vegetation throughout the survey remained wet and wind levels remained slight. The survey used call playback through a megaphone to illict a vocal response in these species should they occur. Active searches were conducted along small creeks and dams, where debris and leaf litter were overturned. Fringing and aquatic vegetation within dams were scanned for evidence of frogs using binoculars.

Targeted surveys for Rosenberg's Goanna (*Varanus rosenebergi*) (listed as a vulnerable species on the TSC Act) were completed in February 2015 and extended into early March. Infra-red cameras were placed in habitat likely to be used by this species including adjacent heath and open forest. Two chicken-wings placed in perforated PVC piping (to enhance olfactory cues) was used as an attractant. Infra-red cameras were left recording for 21 days.

Targeted surveys for *Grevillea juniperina* subsp. *juniperina* (listed as a vulnerable species on the TSC Act) were conducted over 2.5 days in March 2010 by ELA field ecologists. These surveys aimed to detect all individuals of this species occurring within the Lot 1 subdivision, and

logged the number, size and location (using handheld GPS) of each plant or group of plants. Further details on methodology may be found in Section 2.4 of ELA (2010).

3.4 Staff Qualifications

This report was prepared by Ben Harrington based on field surveys conducted by GHD ecologists and review of existing information. The assessment was peer reviewed by Kirsten Crosby. Staff qualifications are presented in Table 2.

Table 2 Staff qualifications

Name	Position / Project Role	Qualifications	Relevant Experience
Ben Harrington	Principal Ecologist / site surveys and reporting	BSc, MSc (Physical Geography) BioBanking Assessor Accreditation	13+ years
Mal Weerakoon	Graduate Ecologist / site surveys	BSc, MSc (Zoology)	5+ years
Rowena Hamer	Ecologist / site surveys, desktop assessments, reporting	BSc. Hons. (Biological Science)	5+ years
Kirsten Crosby	Senior Ecologist / Technical review	BSc (Zoology), Phd. BioBanking Assessor Accreditation	13+ years

4. Existing Environment

4.1 Site Context

4.1.1 Location and land uses

The site comprises Lot 1 DP 549247 within the Fernhill estate, between Mulgoa Road and the Nepean River. The site can be directly accessed via Fairlight Road, which forms the boundary of this Lot in the south and west, or via internal tracks on the Fernhill Estate.

The western boundary of the Fernhill Estate is approximately 500 m to the east of the Nepean River and lies on the north-western edge of the town of Mulgoa, approximately 10 km south of Penrith town centre. The estate falls within the Hawkesbury Nepean Catchment Management Authority (CMA), and within the Sydney Basin Bioregion.

The site is bounded to the:

- north and west by the Blue Mountains National Park.
- south and south east by private rural-residential lots.
- east and north east by native vegetation that is conserved within the Fernhill Central West biobank.

Historic land uses within the site appear to have included grazing, livestock keeping and timber felling and collecting. The site includes areas of exotic grassland and cleared land, including cleared areas adjacent to fence lines, farm dams and access tracks through native vegetation in the site. Drainage lines within site also show signs of extensive modification, apparently to create permanent dams for livestock.

4.1.2 Climate

The locality has a relatively mild climate, typical of western Sydney. Based on data from the Orchard Hills Treatment Works weather station (number 067084), the site has a mean annual rainfall of 803 mm, mean daily maximum temperature of 23.4°C and a mean daily minimum temperature of 11.6°C. The locality does experience regular extremes in temperature, with average ranges of a mean daily maximum temperature of 5.3°C to mean daily maximum temperature of 17.2°C in July, through to a mean daily maximum temperature of 15.5°C to mean daily maximum temperature of 28.5°C in December (BOM, 2013).

4.1.3 Hydrology

The drainage system in the site is part of the Mulgoa Creek Northern Tributary catchment as identified in ELA (2010). This tributary flows into Mulgoa Creek and then into the Nepean River near Jamisontown, approximately 8 km from the site (ELA 2010).

Surface water flows from south to north through the site in poorly defined, channel confined drainage lines. These drainage lines merge in the northeast portion of the site and flow into Top Dam, around 200 metres to the northeast.

Drainage lines across the site have been dammed at multiple locations along the flow channels, presumably to create permanent water points for livestock. This has caused flows along these channels to become less frequent (ELA 2010). The various dams present within the site all contain native aquatic and emergent vegetation, with plant diversity generally increasing with dam size. The drainage lines typically do not contain aquatic vegetation but support moisture-loving shrubby species such as *Leptospermum polygalifolium* and *Melaleuca thymifolia*.

4.1.4 Geomorphology and soils

The site is contained within the Kurrajong Fault Scarp Mitchell Landscape (DECC, 2008a). This landscape consists of dissected and broken slopes on Triassic Quartz sandstone and shale across the Lapstone monocline and Kurrajong fault scarp. The general elevation is 100 to 250m, with local relief of up to 100m and abundant rock outcrop with pockets of yellow-brown sand and occasional yellow texture-contrast soils (DECC 2008b). Vegetation comprises an open forest with a shrubby understorey of Blue-leaved Stringybark (*Eucalyptus agglomerata*), Turpentine (*Syncarpia glomulifera*), Red Bloodwood (*Corymbia gummifera*). Smooth-barked Apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*), Narrow-leaved Peppermint (*Eucalyptus radiata*), Grey Gum (*Eucalyptus punctata*), Blackbutt (*Eucalyptus pilularis*) and she-oaks (*Allocasuarina sp.*) along with several streams which have formed extensive reed swamps behind the fault.

The site shares some characteristics of the adjoining Cumberland Plain Mitchell landscape, which is noted to be approximately 30 – 120 m ASL, and comprises 'low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast' (DECC 2008b), with vegetation characterised by 'woodlands and open forest of Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Thin-leaved Stringybark (*Eucalyptus eugenioides*), Cabbage Gum (*Eucalyptus amplifolia*) and Broad-leaved Apple (*Angophora subvelutina*). Grassy to shrubby understorey often dominated by Blackthorn (*Bursaria spinosa*), poorly drained valley floors, often salt affected with Swamp Oak (*Casuarina glauca*) and paperbark (*Melaleuca* sp.)' (DECC 2008b).

According to the Soil Landscapes of the Penrith 1:100,000 Map Sheet the majority of the site is located on residual soil landscapes, with erosional soil landscapes occurring around the edges of the proposal (Bannerman and Hazelton 1990). Residual soils in the centre of the site primarily derive from the Blacktown subgroup of Triassic Wianamatta Shales, which is characterised by low to moderate fertility, shallow to moderately deep podzolic soils. The edges of the site are mapped as the Gymea erosional landscape with small patches of the Faulconbridge residual landscape, both of which derive from Hawkesbury Sandstone. These landscapes are typically characterised by low fertility, shallow to moderately deep yellow earths and earthy sands (Bannerman and Hazelton 1990).

There are a number of small drainage lines through the site which appear to be incised through Quaternary alluvial deposits of gravel, sand, silt and clay.

4.2 Vegetation

4.2.1 Vegetation zones

Overview

Field surveys confirmed the presence and distribution of NSW vegetation types within the site. Stands of these vegetation types include near-intact vegetation in 'moderate/good – high' condition, partially cleared vegetation in 'moderate/good – poor' condition and extensively modified regrowth in 'low' condition according to the BBAM. Vegetation zones are shown on Figure 2, summarised in Table 3 and described below.

Five of the vegetation zones within the site comprise local occurrences of threatened ecological communities (TECs) listed under the EPBC Act and/or TSC Act (see Table 3 and Section 4.4).

The distribution of vegetation zones in the site is closely tied to soil type, underlying geology and geomorphic position. The site has an overall slope from south west to north east, dropping from approximately 190 m asl in the south west corner to approximately 160 masl in the north and north east. The majority of the site is characterised by shale-influenced soils above lithic

sandstone substrate on gently rolling hills, which supports Narrow-leaved Ironbark - Broadleaved Ironbark - Grey Gum open forest (HN556). This vegetation type has been extensively affected by previous grazing and clearing activities within the site, and now occurs in a range of condition classes from moderate/good – high to low (see Table 3 and Figure 3). Patches of varying condition were defined based on the level of canopy and midstorey cover and the degree of infestation by exotic grasses and other weeds in the understorey. Better condition stands of this vegetation type are an occurrence of Shale/Sandstone Transition Forest, which is listed as a CEEC under the TSC Act and EPBC Act.

Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (HN542) occurs on Tertiary alluvium-derived soils along drainage lines through the site. This vegetation type is an occurrence of Castlereagh Scribbly Gum Woodland, which is listed as a VEC under the TSC Act and an EEC under the EPBC Act. This vegetation type has been modified to varying extents through clearing for grazing and alterations to the drainage line, and occurs as a matrix of moderate/good-high and moderate/good-poor condition patches.

There is a transition to sandstone-derived soils and vegetation communities in areas of slightly higher elevation in the north-west of the site along the western boundary. Geology in this area is Hawkesbury sandstone. These areas support patches of Red Bloodwood – Grey Gum Woodland (HN564). These patches are continuous with vegetation within the Blue Mountains National Park and are in moderate/good condition, with isolated weed patches and evidence of minor impacts associated with clearing and grazing.

Drainage lines throughout the site have been dammed at several locations and the inundated areas now support Coastal freshwater wetlands (HN630). These Coastal freshwater wetlands do not comprise an occurrence of an EEC because they are clearly artificial features.

There has been extensive clearing, canopy thinning and modification of vegetation throughout the site, presumably associated with grazing activities. There are some areas with no canopy or only isolated paddock trees remaining. These areas are dominated by Whiskey Grass (*Andropogon virginicus*) and pasture grass species, with patches of priority weeds such as Lantana (*Lantana camara*) and Blackberry (*Rubus fruticosus* spp. agg.).

There are also occasional patches of exotic grasses and noxious weeds throughout more intact vegetation across the site. Despite this evidence of historic modification, vegetation across the majority of the site exhibits a high potential for recovery. Large areas of the site subdivision previously mapped as 'cleared' by ELA (2007a) now support dense stands of native shrubs 1-2 metres tall and juvenile eucalypts and meets the standard of 'moderate/good' according to the BBAM. Vegetation with the canopy layer still present exhibits moderate to good habitat values for native fauna, including a number of hollow-bearing trees and scattered mature and overmature trees observed occurring throughout the site.

Veg Zone ID	Plant Community Type	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status
1	Narrow- leaved Ironbark - Broad- leaved Ironbark - Grey Gum open forest	HN556	Low	11.7		
2	Narrow- leaved Ironbark - Broad- leaved Ironbark - Grey Gum open forest	HN556	Moderate/good - high	53.0	CEEC (Shale/sandstone Transition Forest)	CEEC (Shale Sandstone Transition Forest)
3	Narrow- leaved Ironbark - Broad- leaved Ironbark - Grey Gum open forest	HN556	Moderate/good - poor	10.0		CEEC (Shale Sandstone Transition Forest)
4	Red Bloodwood - Grey Gum woodland	HN564	Moderate/	18.2		
5	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland	HN542	Moderate/good - medium	12.2	EEC (Castlereagh Scribbly Gum Woodland and Agnes Banks Woodland)	VEC (Castlereagh Scribbly Gum Woodland)
6	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland	HN542	Moderate/good - poor	5.0		VEC (Castlereagh Scribbly Gum Woodland)
7	Coastal freshwater wetland	HN630	Moderate/good	1.1		
	Total area			111.1		

Table 3 Vegetation zones at the site

The structure, species composition and condition of each of the vegetation zones within the development area are described below. Dominant plant species within each vegetation zone and BioBanking habitat attribute data from plot/transects are listed in Appendix B. Plant species recorded in plot/transects are listed in Appendix C.

Table 4 Zone 1 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (low condition)

Zone 2 - Narrow	v-leaved Ironbark - Broad-lea	aved Ironbark - Grey Gum open forest (high condition)			
PCT (OEH, 2016c)	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion				
PCT ID	1395	A NE WELL			
NSW Veg Type ID	HN556				
Equivalent Map Units	n/a				
Survey effort	Plot/transects 6, 8				
Conservation significance	Exotic vegetation.				
Condition	Low. Predominantly exotic vegetation with no over storey and very low native mid storey cover, and groundcover and low native species richness. High exotic plant cover, including noxious and environmental weeds.				
Landscape position	Gently rolling hills and flats.				
Structure	Grassland.				
Over storey	Absent.				
Mid storey	Typically sparse, with occasional patches of Parramatta Wattle (<i>Acacia parramattensis</i>) and Tantoon (<i>Leptospermum polygalifolium</i>).				
Groundcover	Where present, dominated by grasses, including Weeping Grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>) Kangaroo Grass (<i>Themeda triandra</i>) and Blady Grass (<i>Imperata cylindrica</i>). Occasional herbs such as Many Flowered Mat Rush (<i>Lomandra multiflora</i>) and <i>Glycine tabacina</i> .				
Exotic species	Exotic species dominate the understorey. The majority of the plant cover is pasture grasses such as Kikuyu (<i>Pennisetum clandestinum</i>) and Carpet Grass (<i>Axonopus fissifolius</i>). There are patches of noxious and environmental weeds such as Lantana (<i>Lantana camara</i>), Blackberry (<i>Rubus fruticosus</i>) Cobbler's Pegs (<i>Bidens pilosa</i>), Catsear (<i>Hypochaeris radicata</i>) and Whiskey Grass (<i>Andropogon virginicus</i>).				

Table 5 Zone 2 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (high condition)

Zone 2 - Narrov	w-leaved Ironbark - Broad-le	aved Ironbark - Grey Gum open forest (high condition)			
PCT (OEH, 2016c)	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion				
PCT ID	1395	A NY STATE AND A MARINE			
NSW Veg Type ID	HN556				
Equivalent Map Units	Cumberland Shale Sandstone Transition Forest (GW p2) Tozer et al. 2006); Shale Sandstone Transition Forest (low sandstone influence) and Shale Sandstone Transition Forest (high sandstone influence) (NPWS 2002)				
Survey effort	Plot/transects 3, 5, 18, 20, 2	1, 22, 23, 29			
Conservation significance	CEEC listed under the TSC and EPBC Acts (Shale Sandstone Transition Forest in the Sydney Basin Bioregion).				
Condition	Moderate/good – high. Remnant or regrowth native vegetation with near-intact over storey and mid storey cover, structurally diverse groundcover and high native species richness. All canopy species were observed regenerating. Occasional hollow-bearing trees. Low exotic plant cover, mainly consisting of grasses in the under storey.				
Landscape position	Gently rolling hills and flats.				
Structure	Open forest or woodland.				
Over storey	Canopy ranging up to approximately 25 m in height, dominated by Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Broad-leaved Ironbark (<i>E. fibrosa</i>), Grey Gum (<i>E. punctata</i>), Narrow-leaved Stringybark (<i>E. eugenioides</i>) and White Stringybark (<i>E. globoidea</i>).				
Mid storey	Typically sparse, with occasional patches of Parramatta Wattle (<i>Acacia parramattensis</i>), Black Wattle (<i>A. decurrens</i>), Willow Bottlebrush (<i>Callistemon salignus</i>), Black She-Oak (<i>Allocasuarina littoralis</i>), Narrow-leaved Geebung (<i>Persoonia linearis</i>), Prickly Moses (<i>Acacia ulicifolia</i>), Tantoon (<i>Leptospermum polygalifolium</i>), Tick Bush (<i>Kunzea ambigua</i>) and Broad-leaved Geebung (<i>Persoonia levis</i>).				
Groundcover	Generally dominated by grasses, including Weeping Grass (<i>Microlaena stipoides var. stipoides</i>) Kangaroo Grass (<i>Themeda triandra</i>), Threeawn Speargrass (<i>Aristida vagans</i>), Blady Grass (<i>Imperata cylindrica</i>), Two-colour Panic (<i>Panicum simile</i>) and Wiry Panic (<i>Entolasia stricta</i>). Characteristic herb and forbs include Many Flowered Mat Rush (<i>Lomandra multiflora</i>), <i>Glycine tabacina</i> , and Rough Saw-sedge (<i>Gahnia aspera</i>). Occasional shrubs including Gorse Bitter Pea (<i>Daviesia ulicifolia</i>) Wedge Guinea Flower (<i>Hibbertia diffusa</i>) and Rough Guinea Flower (<i>Hibebrtia aspera</i>).				

Zone 2 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (high condition)

ExoticExotic species are occasionally present within the understorey and include noxious andspeciesenvironmental weeds such as Cobbler's Pegs (Bidens pilosa), Catsear (Hypochaeris radicata) and
Whiskey Grass (Andropogon virginicus).

Table 6 Zone 3 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (poor condition)

Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (poor condition)			
PCT (OEH, 2016c)	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion		
PCT ID	1395		
NSW Veg Type ID	HN556		
Equivalent Map Units	Cumberland Shale Sandstone Transition Forest (GW p2) Tozer et al. 2006); Shale Sandstone Transition Forest (low sandstone influence) and Shale Sandstone Transition Forest (high sandstone influence) (NPWS 2002)		
Survey effort	Plot/transects 7, 9, 16, 17, 25, 30, 31,		
Conservation significance	CEEC listed under the TSC Act.		
Condition	Moderate/good – poor. Regrowth native vegetation with no over storey but moderate to very high native mid storey cover, predominantly native groundcover and moderate native species richness. All canopy species were observed regenerating. There is frequently moderate exotic plant cover mianly consisting of exotic grasses in the ground layer.		
Landscape position	In partially cleared and disturbed areas of the site. These areas have previously been slashed or cleared for asset protection zones or grazing.		
Structure	Derived (i.e. a result of previous clearing) scrub or grassland.		
Over storey	Occasional remnant Grey Gum.		
Mid storey	Dense regrowth of tall shrubs, especially Tantoon (<i>Leptospermum polygalifolium</i>) forming the aforementioned derived shrubland.		
Groundcover	Patchy, diverse and highly variable. Some areas are completely dominated by Tantoon, which appears to have excluded most other native understorey species. Other native shrub species present include Rough Guinea Flower (<i>Hibbertia aspera</i>). More open areas contain native grasses such as Kangaroo Grass. Weeping Grass (<i>Microlaena stinoides var. stinoides</i>) and Brown's Lovegrass		

Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (poor condition)

	(<i>Eragrostis brownii</i>) and occasional herbs and forbs such as Rock Fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), <i>Juncus usitasis, Glycine tabacina</i> and Rough Saw-sedge (<i>Gahnia aspera</i>).
Exotic species	Exotic species are occasionally present within the understorey and include Broad-leaved Carpet Grass (<i>Axonopus compressus</i>), <i>Setaria parviflora</i> , Fireweed (<i>Senecio madagascariensis</i>) and Purpletop (<i>Verbena bonariensis</i>).

Table 7 Zone 4 - Red Bloodwood - Grey Gum woodland

Zone 4 - Red Bloodwood - Grey Gum woodland			
PCT (OEH, 2016c)	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion		
PCT ID	1081		
NSW Veg Type ID	HN564		
Equivalent Map Units	Sydney Hinterland Transition Woodland (DSF p146) Tozer et al. 2006); Transitional between 'Western Sandstone Gully Forest' and 'Sandstone Ridgetop Woodland' (NPWS 2002)		
Survey effort	Plot/transects 1, 10, 11, 12, 26, 28		
Conservation significance	Native vegetation.		
Condition	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey but low mid storey cover. Native grass cover was very high while native shrubs and native other gorudncover was variable. Native plant species richness was below benchmark values in all plot/transects. All canopy species were observed regenerating. There are few hollow-bearing trees.		
Landscape position	Occurs at higher elevations along the north western border of the site along Fairlight Road, and is continuous with similar vegetation within the Blue Mountains National Park.		
Structure	Open forest or woodland. This community exhibits some signs of previous canopy thinning and disturbance from grazing. The mid storey is relatively open and the groundcover structure is relatively simple and grassy. This structure is not typical of the vegetation type and probably a product of the ongoing grazing of the site suppressing shrub regeneration.		
Over storey	Open canopy ranging up to approximately 20 m in height, with a diverse range of tree species including Red Bloodwood (<i>Corymbia gummifera</i>), Grey Gum, Turpentine (<i>Syncarpia glomulifera</i>), White Stringybark (<i>Eucalyptus globoidea</i>) and Sydney Red Gum (<i>Angophora costata</i>).		
Mid storey	Relatively sparse mid-storey of species such as Large-leaf Hop-bush (<i>Dodonaea triquetra</i>), Thyme Honey-myrtle (<i>Melaleuca thymifolia</i>), Needlebush (<i>Hakea sericea</i>), Sour Currant Bush (<i>Leptomeria acida</i>), Peach Heath (<i>Lissanthe strigosa</i>) and Narrow-leaved Geebung (<i>Persoonia linearis</i>).		

Zone 4 - Red Bloodwood - Grey Gum woodland

Groundcover	ver Diverse and includes: shrubs such as Variable Stinkweed (Opercularia varia), Wedge Guinea			
	(Hibbertia diffusa) and Prickly Moses (Acacia ulicifolia); grasses such as Kangaroo Grass, Two-			
	colour Panic (Panicum simile) and Purple Wiregrass (Aristida ramosa); and sedges such as Juncus			
	usitatus; and herbs such as Whiteroot (Pratia purpurascens), Slender Wire Lily (Laxmannia gracilis),			
	Hairy Apple Berry (Billardiera scandens), Pomax (Pomax umbellata) and Lomandra species.			
Exotic species	Occasional wind borne environmental weeds such as Catsear (<i>Hypochaeris radicata</i>) and Whisky Grass (<i>Andropogon vriginicus</i>).			

Table 8 Zone 5 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy

Zone 5 - Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (medium condition)				
РСТ (ОЕН, 2016с)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion			
PCT ID	883			
NSW Veg Type ID	HN542			
Equivalent Map Units	Castlereagh Scribbly Gum Woodland (DSF p7) Tozer et al. 2006); Castlereagh Scribbly Gum Woodland' (NPWS 2002)			
Survey effort	Plot/transects 13, 14, 15, 19			
Conservation significance	VEC listed under the TSC Act (Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion). EEC listed under the EPBC Act (Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion)			
Condition	Moderate/good – medium. Remnant or regrowth native vegetation with near-intact over storey, mid storey and groundcover and high native species richness. Very occasional hollow-bearing trees. Low exotic plant cover mainly consisting of grasses and herbs.			
Landscape position	Occurs on lower slopes and flats on alluvial terraces adjoining drainage lines.			
Structure	Low open woodland.			
Over storey	Open canopy ranging up to approximately 10 m in height, dominated by Hard-leaved Scribbly Gum (<i>E. sclerophylla</i>), Narrow-leaved Ironbark (<i>E.crebra</i>) and Flax-leaved Paperbark (<i>Melaleuca linariifolia</i>).			
Mid storey	Dense mid storey of tall shrubs such as Tantoon (<i>Leptospermum polygalifolium</i>), Parramatta Wattle (<i>Acacia parramattensis</i>), Thyme Honey-myrtle (<i>Melaleuca thymifolia</i>) and Lance-leaved Geebung (<i>Persoonia lanceolata</i>).			

Zone 5 - Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (medium condition)

Groundcover	Dense, diverse and structurally complex. Ground cover vegetation includes: shrubs such as Pimelea linifolia subsp. Linifolia, Narrow-leaved Geebung (<i>Persoonia linearis</i>), <i>Pultenaea retusa</i> and Pine- leaved Bottlebrush (<i>Callistemon pinifolius</i>) and; sedges such as <i>Juncus usitatus</i> , <i>Schoenus</i> sp., <i>Lomandra multiflora</i> subsp. <i>multiflora</i> ; herbs such as Indian Pennywort (<i>Centella asiatica</i>), Poverty Raspwort (<i>Gonocarpus tetragynus</i>) and A Sundew (<i>Drosera peltata</i>); and scramblers such as <i>Glycine microphylla</i> .
Exotic species	Only occasionally present within the community and are limited to Whiskey Grass along the edge of vegetated patches and wind borne environmental weeds such as Fireweed (<i>Senecio madagascariensis</i>), Comon Sowthistle (<i>Sonchus oleraceus</i>) and Broad-leaved Carpet Grass (<i>Axonopus compressus</i>).

Table 9 Zone 6 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (poor condition)

Zone 5 - Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (medium condition)			
РСТ (ОЕН, 2016с)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion		
PCT ID	883	a start the transfer	
NSW Veg Type ID	HN542		
Equivalent Map Units	Castlereagh Scribbly Gum Woodland (DSF p7) Tozer et al. 2006); Castlereagh Scribbly Gum Woodland' (NPWS 2002)		
Survey effort	Plot/transects 4, 24, 27		
Conservation significance	VEC listed under the TSC Act (Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion). This poor condition vegetation zone does not meet the condition criteria for the EPBC Act-listed form of the community.		
Condition	Moderate/good – poor. Regrowth native vegetation with absent over storey, moderate mid storey and groundcover and moderate native species richness. Low exotic plant cover mainly consisting of grasses and herbs.		
Landscape position	Occurs on lower slopes and flats on alluvial terraces adjoining drainage lines.		
Structure	Derived scrub, shrubland or grassland.		
Over storey	Very occasional remnant Hard-leaved Scribbly Gum and Flax-leaved Paperbark.		
Mid storey	Discontinuos but locally dense mid storey of tall shrubs such as Tantoon, Parramatta Wattle, Thyme Honey-myrtle and Lance-leaved Geebung (<i>Persoonia lanceolata</i>).		
Groundcover	Dense, diverse and structurally complex. Ground cover vegetation includes: shrubs such as Pimelea linifolia subsp. Linifolia, Narrow-leaved Geebung (<i>Persoonia linearis</i>), <i>Pultenaea retusa</i> and Pine- leaved Bottlebrush (<i>Callistemon pinifolius</i>) and; sedges such as <i>Juncus usitatus</i> , <i>Schoenus</i> sp., <i>Lomandra multiflora</i> subsp. <i>multiflora</i> ; herbs such as Indian Pennywort (<i>Centella asiatica</i>), Poverty Raspwort (<i>Gonocarpus tetragynus</i>) and A Sundew (<i>Drosera peltata</i>); and scramblers such as <i>Glycine microphylla</i> .		
Exotic species	Patches of Whiskey Grass and Broad-leaved Carpet Grass dominate gaps between native shrubs. There are also occasional wind borne environmental weeds such as Fireweed and Comon Sowthistle throughout.		

Table 10 Zone 7 - Coastal freshwater wetland

Coastal freshwater wetland			
РСТ (ОЕН, 2016с)	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion		
PCT ID	1071		
NSW Veg Type ID	HN630		
Equivalent Map Units	n/a		
Survey effort	Plot/transects 16		
Conservation significance	This vegetation zone does not comprise an occurrence of an EEC because it is clearly an artificial feature. Nonetheless it has considerable habitat value in its current form and so there would be no justification for treating it as cleared land in a future development or attempting to restore it to a forest vegetation zone in a future biobank. Therefore for the purposes of the application of the BBAM to the site, it has been treated as the vegetation type closest to its current state rather than the vegetation type that is likely to have occurred prior to disturbance. This approach is supported by OEH (Seidel, J., OEH, pers. comm.).		
Condition	Moderate/good. Predominantly native vegetation with moderate cover and species richness of characteristic wetland plant species.		
Landscape position	Associated with dammed portions of drainage lines within the site.		
Structure	Artificial closed wetland.		
Over storey	Occasional Narrow fringe of Flax-leaved Paperbark (Melaleuca linariifolia) or Tantoon around its margins.		
Mid storey	Occasional Tantoon.		
Groundcover	Dominated by the sedge <i>Sc</i> paniculata, Common Couch	hoenoplectus validus. Herbs of wetland margins include Goodenia (Cynodon dactylon) and Indian Pennywort (Centella asiatica).	
Exotic species	Relatively low and include s madagascariensis), Lamb's oleraceus). No aquatic noxio or Water Hyacinth (<i>Eichorni</i>	becies around the margins of the wetland such as Fireweed (<i>Senecio</i> Tongues (<i>Plantago lanceolata</i>) and Common Sowthistle (<i>Sonchus</i> bus weed species such as Alligator Weed (<i>Alternanthera philoxeroides</i>) a crassipes) were observed.	



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4.2.2 Environmental weeds

The *Biosecurity Act 2015* provides for the declaration of priority weeds in local government areas. Priority weeds have been identified for the Greater Sydney region, which includes the Penrith LGA. Plant species identified as priority weeds for the Greater Sydney region and recorded in the site are listed in Table 11. These species occur in low densities in woodland and forest throughout the site and as moderate infestations in cleared land and exotic grassland.

Scientific Name	Common Name	Duty
<i>Rubus fruticosus</i> aggregate species	Blackberry	Mandatory Measure Must not be imported into the State or sold All species in the <i>Rubus fruiticosus</i> species aggregate have this requirement, except for the varietals Black Satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smooth Stem, and Thornfree
<i>Olea europaea</i> subspecies <i>cuspidata</i>	African Olive	Regional Recommended Measure An exclusion zone is established for all lands in Blue Mountains City Council and Central Coast local government areas. The remainder of the region is classified as the core infestation area. Whole region: The plant or parts of the plant are not traded, carried, grown or released into the environment. Exclusion zone: The plant is eradicated from the land and the land kept free of the plant. Core infestation area: Land managers prevent spread from their land where feasible.
Senecio madagascariensis	Fireweed	Mandatory Measure Must not be imported into the State or sold
Lycium ferocissimum	African Boxthorn	Mandatory Measure Must not be imported into the State or sold
Asparagus asparagoides	Bridal Creeper	Mandatory Measure Must not be imported into the State or sold
Lantana camara	Lantana	Mandatory Measure Must not be imported into the State or sold

Table 11 Priority weeds recorded during the field survey

Wetlands and water bodies in the site appear to be free of serious aquatic weeds such as Alligator Weed (*Alternanthera philoxeroides*) and Water Hyacinth (*Eichhornia crassipes*).

4.3 Fauna and habitats

4.3.1 Fauna species

A total of 113 fauna species were recorded within the site or surrounds, include 84 species of bird, 11 species of mammals, 10 species of amphibian, six reptiles and two gastropods. Six exotic species were recorded were including five mammal species and one bird species. One threatened species was recorded within the site: the Cumberland Plain Land Snail (*Meridolum corneovirens*), which is listed as an endangered species under the TSC Act.

The fauna species that were recorded, habitat associations and additional species of fauna that may occur based on the habitat resources present are described below.

Infra-red cameras recorded a variety of common woodland mammal and bird species. Mammal species including the Eastern Grey Kangaroo (*Macropus giganteus*) and Swamp Wallaby (*Wallabia bicolor*) as well as opportunistic fauna species of open woodland such as the Laughing Kookaburra (*Dacelo novaeguineae*), Australian Raven (*Corvus coronoides*) and Magpie Lark (*Grallina cyanoleuca*) were observed. One feral species, the European Red Fox (*Vulpes vulpes*) was also recorded. Infra-red cameras did not detect the target species Rosenbergs Goanna.

4.3.2 Terrestrial habitats

Three broad fauna habitat types were recorded within the site:

- Partially cleared areas.
- Native woodland and forest.
- Drainage line and wetland habitats.

The development footprint contains only partially cleared areas and native woodland and forest.

The suitability of these habitats for native fauna is discussed below, with particular emphasis on habitat resources of relevance to threatened fauna. Native fauna species which have been sighted opportunistically are also mentioned. A list of opportunistic fauna sightings from the Fernhill Estate is included in Appendix A.

Partially cleared areas

Partially cleared areas occur on the western parcel of the site, and are present as small patches in other areas. As discussed in Section 4.2.1, these areas would have historically supported native woodland vegetation but have been extensively modified by previous clearing and agriculture.

Cleared land contains few habitat resources of relevance to most native species. Grasses and herbs provide foraging resources for relatively mobile and opportunistic native fauna, including birds such as the Australian Magpie (*Cracticus tibicen*) and Galah (*Eolophus roseicapillus*) and mammals such as the Eastern Grey Kangaroo which were observed in the site.

Regrowth trees and shrubs provide foraging resources for native woodland birds such as Thornbills (*Acanthiza* spp.) and Red-browed Finches (*Neochmia temporalis*) which were observed in these areas during the survey. Some native reptile and frog species would also forage, shelter or bask in areas of grassland particularly where they adjoin woodland or water bodies.

Most of these species would use these areas as an adjunct to the higher quality, more extensive areas of suitable habitat available to the west in the Fernhill Estate and other rural residential blocks with limited clearing. It is unlikely that any local populations of native fauna would be reliant on the exotic grassland on the site for their survival.

These areas contain few habitat features of relevance to threatened fauna. The edges of forest and woodland habitats may be used for foraging by raptors and less agile microbats, potentially including threatened species such as the Square-tailed Kite (*Lophoictinia isura*), Eastern Freetail-bat (*Mormopterus norfolkensis*) or Greater Broad-nosed Bat (*Scoteanax rueppellii*). Given the lack of foraging or shelter habitat (such as woody debris), the Cumberland Plain Land Snail (*Meridolum corneovirens*) or threatened birds would be considered unlikely to occur within cleared areas.

Native woodland and forest

Native woodland and forest communities within the site are more structurally and floristically diverse and provide good quality habitats for a wide range of native fauna. Habitat resources include:

- mature canopy trees that provide nectar, fruits, leaves and foraging, roosting or nesting substrates;
- habitat trees with hollows and/or decorticating bark;
- abundant woody debris and leaf litter;
- patches of dense understorey shrubs;
- a range of fruiting and flowering small trees and shrubs;
- connectivity with wetland and aquatic habitats.

As discussed in Section 4.3.2, this vegetation also has good connectivity with extensive protected areas of native vegetation protected within the Blue Mountains National Park, as well as large patches of vegetation in adjacent rural residential land and the rest of the Fernhill Estate (see Figure 1). There is minimal noise and light disturbance from Fairlight Road and rural residences to the south and south-east of the site. Based on these attributes this vegetation would be expected to support a diverse suite of native fauna, including a number of threatened species.

Pre-European age trees and habitat trees containing hollows of varying size, fissures or decorticating bark were observed scattered throughout forest and woodland within the site. These resources may be used by a range of native fauna, including threatened birds, microbats and arboreal mammals, particularly given the continuity of vegetation with similar habitats within the Blue Mountains National Park. Examples of threatened species which may use such nesting or roosting sites include threatened birds such as Little Lorikeets (*Glossopsitta pusilla*), Turquoise Parrot (*Neophema pulchella*), Gang-gang Cockatoos (*Callocephalon fimbriatus*) and Glossy Black-cockatoos (*Calyptorhynchus lathami*) and microbats such as the Eastern Freetailbat (*Mormopterus norfolkensis*), Southern Myotis (*Myotis macropus*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*). There are also four threatened forest owls which may occur within the site.

Eucalypts in the site represent known or preferred feed trees for a number of fauna species, including threatened birds, the Koala and the Grey-headed Flying-fox. The canopy species Coastal Grey Box and Forest Red Gum are nectar and seed-bearing and would provide a food resource for native fauna, including the Grey-headed Flying Fox and arboreal mammals. Eucalypt species within the site are summer and autumn-flowering (Brooker and Koenig, 2006) and so would not provide winter foraging resources for the Swift Parrot (*Lathamus discolor*) or Grey-headed Flying-fox. Winter-flowering acacias at the site would help provide year-round foraging resources for a range of native birds, bats and mammals. Arboreal mammal species are also likely to feed on the sap of these Acacias. The site is continuous with an extensive patch of vegetation which contains large, mature trees in an intact corridor and so would provide good concentrations of these foraging resources in a context that is suitable for migratory use. Forest Red Gum is a Koala food tree listed under Schedule 2 of SEPP 44 and is a regional primary food tree identified in the Koala Recovery Plan (DECC 2008d).

Woodland and forest at the site contains good quantities of woody debris and thick leaf litter which would provide shelter and foraging substrate for native reptiles, frogs and invertebrates including the Cumberland Plain Land Snail. Woody debris and flaking bark on mature-age trees within the site would also provide potential foraging habitat for a number of threatened insectivorous birds, such as the Hooded, Flame and Scarlet Robins (*Melanodryas cucullata*)

cucullata, Petroica phoenica and P. boodang), Speckled Warbler (Chthonicola sagittata), Varied Sittella (Daphoenositta chrysoptera) and Diamond Firetail (Stagonopleura guttata).

Areas of dense shrubs within the Castlereagh Scribbly Gum woodland and regenerating areas would also provide good foraging and shelter habitats for small woodland birds such as the Eastern Spinebill (*Acanthorhynchus tenuirostris*) and Rufous Whistler (*Pachycephala rufiventris*), which were observed throughout the site. These areas may also provide potential shelter habitat for the threatened insectivorous bird species listed above, and could provide shelter or foraging habitat for the threatened Eastern Pygmy-possum (*Cercartetus nanus*).

Other habitat resources

The site is situated on shale-derived colluvium and alluvial sediments on lower slopes and flats. There are no caves, cliffs, rock outcrops or substantial surface rock fragments within the site, which would therefore not support fauna that rely on rocky substrate for shelter. There are a number of threatened reptile and frog species known or predicted to occur in the locality (OEH 2013a; DotE 2013a), including the Broad-headed Snake (*Hoplocephalus bungaroides*), Giant Burrowing Frog (*Heleioporus australiacus*), and Littlejohns Treefrog (*Litoria littlejohni*). Records of these species within the locality are from Hawkesbury Sandstone substrates at higher elevations. These species depend on specific habitat resources from these environments (OEH 2014c; Ehman, 1997) and would not occur in the site.

There are significant cave and cliff formations in the Blue Mountains National Park to the west of the site. Cave-roosting microbats such as the Little Bentwing-bat (*Miniopterus australis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensisi*) and Large-eared Pied Bat (*Chalinolobus dwyeri*) may roost and breed in these areas but would only use aerial foraging habitat in the site.

Patch size and connectivity

Although there has been extensive modification and thinning of vegetation within the site, forest and woodland areas at the site are relatively continuous with only the south-eastern portion heavily cleared and fragmented. There are currently light grazing levels from cattle pastured within the site, but other disturbances are limited to periodic slashing for asset protection zones near residences in the south and minimal light and noise spill from these residences.

Habitat value of vegetation within the site is further increased by its connectivity with extensive areas of high quality habiat in adjacent areas. Vegetation within the site is continuous with forest and woodland contained within the Blue Mountains National Park, and within the proposed North West and South West biobank areas of Fernhill Estate (refer Figure 1). It also provides links to patches of native vegetation retained within rural residential properties to the south and south east. As such, the site forms part of a vegetated corridor between higher elevation forest and habitats in the Blue Mountains and lowland grassy woodlands of the Cumberland Plain. Habitats within the site are therefore likely to represent high value habitat for a variety of native fauna, including mobile threatened fauna with large home ranges such as the Spotted-tailed Quoll (*Dasyurus maculatus*). *Eucalyptus* species within the site may also provide migratory habitat and seasonal nectar resources for migratory bird species, including the threatened Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*), although the site does not support the productive forests or winter flowering eucalypts preferred by these species in coastal areas.

4.3.3 Aquatic and riparian habitats

Drainage line and wetland habitats

Drainage lines within the site consist of unnamed, ephemeral first and second order drainage lines. As discussed in Section 4.1.3, these waterways have been highly modified through the creation of relatively large dams at intervals along their length. Sections of the drainage lines linking the dams are poorly defined and typically devoid of aquatic vegetation and habitats. Based on this lack of aquatic habitat and through consultation with the Office of Hawkesbury Nepean, drainage lines within the site were classified by ELA as 3rd and 2nd order watercourses using the Riparian Corridor Management Study (RCMS) methodology (DIPNR 2004; ELA 2010). According to the DPI classification of fish habitat in NSW waterways (DPI 2013), these drainage lines would represent Class 3 (Minimal fish habitat) or Class 4 (Unlikely fish habitat).

There are at least two moderate to large dams mapped within the site, which contain healthy populations of native wetland plant and aquatic plants, including emergent Tall Spikerush (*Eleaocarpus sphacelatus*) and Frogsmouth (*Phylidrum lanuginosum*). There are also a number of smaller dams and depressions with varying levels of habitat complexity. These wetlands would provide habitat for native fish and aquatic invertebrates and potential breeding habitat for a number of pool breeding frogs, potentially including the Green and Golden Bell Frog. The potential for the Green and Golden Bell Frog and other native frog species to occur and breed at the site may be limited by other factors such as the presence of predatory fish and/or Chytrid fungus. These wetlands contained common, generalist frogs and reptiles recorded during the field survey such as the Common Eastern Froglet (*Crinia signifera*), Eastern Dwarf Tree Frog (*Litoria fallax*) and Eastern Snake-necked Turtle (*Chelodonia longicollis*) and would also be likely to provide habitat for additional reptile species such as the Red-bellied Black-snake (*Pseudechis porphyriacus*), Brown-striped Frog (*Limnodynastes peronii*) and Eastern Water Skink (*Eulamprus quoyii*).

The wetlands are likely to support a moderately high diversity and abundance of native waterfowl, waders and other wetland birds, including the Purple Swamphen (*Porphyrio porphyria*), Australasian Grebe (*Tachybaptus novaehollandiae*), White-necked Heron (*Ardea pacifica*) and Pacific Black Duck (*Anas superciliosa*), all of which were observed within the site or adjacent areas of the Fernhill Estate (Appendix A). These wetlands may provide foraging habitat for threatened wetland birds such as the Australasian Bittern (*Botaurus poiciloptilus*), Black Bittern (*Ixobrychus flavicollis*) or Australian Painted Snipe (*Rostratula australis*) on occasion. The threatened Southern Myotis may also forage for small fish and insects over the surface of these waterbodies.

4.4 **Conservation significance**

4.4.1 Overview

Based on the desktop assessment the following threatened biota and MNES are known or predicted to occur in the locality:

- 28 threatened ecological communities (TECs).
- 27 threatened flora species.
- 52 threatened fauna species, comprising six frogs, 25 birds, two fish, three invertebrates, 15 mammals and one reptile
- 1 endangered flora poplulation
- 15 migratory species.
- One National and World Heritage Place.

This list does not include marine threatened and migratory species or shorebirds which were highlighted by the database searches because the locality does not contain any marine or estuarine habitats.

The occurrence and potential occurrence of these threatened biota within the site is discussed in the following sections.

4.4.2 Threatened biota

Threatened ecological communities

Two native vegetation types within the site comprise occurrences of TECs listed under the EPBC Act and/or the TSC Act:

- Narrow-leaved Ironbark Broad-leaved Ironbark Grey Gum open forest, is an
 occurrence of 'Shale Sandstone Transition Forest' community which is listed as a CEEC
 under the TSC Act. Patches with a forest or woodland structure also comprise an
 occurrence of the related CEEC listed under the EPBC Act.
- Hard-leaved Scribbly Gum Parramatta Red Gum heathy woodland, is an occurrence of 'Castlereagh Scribbly Gum Woodland' which is listed as a VEC under the TSC Act. Patches with a woodland structure also comprise an occurrence of the related EEC listed under the EPBC Act.

There are small areas of each of these TECS in the development footprint

These TECs occur as mosaics of different condition classes across the site, as shown on Figure 3. The distribution of these TECs in the site is shown in Figure 4. No other threatened ecological communities are present in the site.

Threatened flora species

No threatened flora species have been recorded within the development footprint (Figure 4).

There is one threatened plant species at the site: *Grevillea juniperina* subsp. *juniperina*, which is listed as a vulnerable species under the TSC Act. The estimated population of this species within the Fernhill estate numbers 4,308 individuals within four main patches (ELA 2010) and occurs entirely within proposed conservation areas between the two parcels of land comprising the development footprint (Figure 4). The locations of these populations were verified during the GHD 2013 and 2014 survey.

A second threatened plant species has been recorded nearby within the Fernhill estate: Micromyrtus minutiflora, which is listed as an endangered species under the TSC Act and a vulnerable species under the EPBC Act. This species has been observed to the north of the site, in association with Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland in the North west biobank. Micromyrtus minutiflora has not been detected here since the original ELA (2010) observation despite multiple rounds of targeted threatened flora surveys as part of: this assessment (see Section 3.3.1); the BioBanking assessment for the Fernhill North West biobank site in the northern portion of the Lot 1 Subdivision (GHD 2016); the BioBanking assessment of the adjoining Fernhill Central West biobank (GHD, 2013c); and site walkovers and checking of known locations of Micromyrtus spp. with OEH staff. OEH threatened plant specialists have been satisfied that each of the Micromyrtus they have observed on site were the very similar species 'Fringed Heath-myrtle (*M. ciliata*)' (Steenbeeke, G. OEH, pers. comm.). The original ELA (2010) observation may have been a mis-identification of *M. ciliata* as the two species are very similar and are indistinguishable when not flowering. Irrespective of the identity of the individual plants recorded by ELA they are located several hundred metres from the development footprint within the proposed biobank. GHD has confirmed through targeted survey of the Western Precinct during the flowering period for *M. minutiflora* that the species is not present.

Based on the assessment of habitats, soil types and vegetation occurring within the site, there is potential habitat for a further seven threatened flora species and one endangered flora population. These species are listed in Table 12.

Common Name	Scientific name	TSC Act status	EPBC Act status
Bynoe's Wattle	Acacia bynoeana	E	V
	Allocasuarina glareicola	E	E
	Dillwynia tenuifolia	V	V
Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Marsdenia viridiflora subsp. viridiflora	EP	
Hairy Geebung	Persoonia hirsuta	E	E
Rufous Pomaderris	Pomaderris brunnea	V	V
	Pultenaea parviflora	E	V
Eastern Underground Orchid	Rhizanthella slateri	V	E

Table 12 Threatened flora that may occur within the Lot 1 subdivision

The Eastern Underground Orchid is highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. A precautionary approach has been undertaken and the site is assumed to comprise habitat for a local population of the Eastern Underground Orchid.

The remaining species can be reliably discounted as occurring based on the field survey effort undertaken. These species comprise six shrubs and a climber respectively. They are not cryptic. GHD have conducted multiple rounds of targeted threatened flora surveys as part of this assessment (see Section 3.3.2). It is unlikely that they would not have been detected if they were present.

Threatened fauna species

One threatened fauna species, the Cumberland Plain Land Snail, was recorded at three locations within Shale Sandstone Transition Forest at the site during the survey. The species has also been recorded in the south of the Western Precinct (ELA 2007a, b and 2010), as well as elsewhere within the Fernhill Estate and adjacent areas (GHD 2013a,b and c, OEH 2013a). This species is listed as endangered under the TSC Act.

Nine additional threatened fauna species have previously been recorded elsewhere within or directly adjacent (within 500 m) to the Fernhill Estate, comprising:

- Gang-gang Cockatoo, which is listed as vulnerable under the TSC Act.
- Glossy Black-Cockatoo, which is listed as vulnerable under the TSC Act.
- Varied Sittella, which is listed as vulnerable under the TSC Act.
- Swift Parrot, which is listed as endangered under both the TSC and EPBC Acts, and is also listed as a migratory species under the EPBC Act.
- Hooded Robin, which is listed as vulnerable under the TSC Act
- Scarlet Robin, which is listed as vulnerable under the TSC Act.
- Grey-headed Flying-fox, which is listed as vulnerable under both the TSC and EPBC Acts.
- Eastern Freetail-bat, which is listed as vulnerable under the TSC Act.
- Large-eared Pied Bat, which is listed as vulnerable under both the TSC and EPBC Acts.

The diversity of threatened fauna previously recorded within and adjacent to the site and wider Fernhill Estate reflects the diverse range of habitats present within the estate, and excellent connectivity with adjacent conservation areas. For mobile species in particular, the intrinsic value of habitats within the site is substantially increased by their connectivity with adjacent extensive areas of native vegetation. Notwithstanding the lack of preferred habitats for highly mobile threatened species such as the Swift Parrot, these species may be expected to use habitats within the site for movement and as an adjunct to higher quality habitats in adjacent areas, and may therefore occur on an occasional or opportunistic basis.

A total of 35 threatened fauna species (including those listed above) have been assessed as having the potential to occur within the site based on the habitats present. These species are listed in Table 13 and comprise 23 threatened bird species, seven threatened bat species, three threatened arboreal and terrestrial mammal species, one threatened frog species and one threatened invertebrate species. The value of habitats within the development footprint for these species is discussed in Sections 4.3 and 4.3.3. As discussed in Section 4.3, several of these species have been assessed as having the potential to occur within the wider Fernhill estate based on the high connectivity of vegetation with large areas of high quality habitats in adjacent areas, rather than solely on the basis of the presence of specific habitat features.

Scientific name	Common Name	TSC Act status	EPBC Act status
Birds			
Anthochaera phrygia	Regent Honeyeater	CE	CE
Artarmus cyanopterus	Dusky Woodswallow	V	
Botaurus poiciloptilus	Australasian Bittern	E	E
Callocephalon fimbriatum	Gang-gang Cockatoo	V	
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	
Chthonicola sagittata	Speckled Warbler	V	
Daphoenositta chrysoptera	Varied Sittella	V	
Glossopsitta pusilla	Little Lorikeet	V	
Haliaeetus leucogaster	White-bellied Sea-eagle	V	
Ixobrychus flavicollis	Black Bittern	V	
Lathamus discolor	Swift Parrot	E	CE
Limosa limosa	Black-tailed Godwit	V	M; C,J,K

Table 13 Threatened fauna that may occur within the Lot 1 subdivision

Scientific name	Common Name	TSC Act status	EPBC Act status
Lophoictinia isura	Square-tailed Kite	V	
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	
Neophema pulchella	Turquoise Parrot	V	
Ninox connivens	Barking Owl	V	
Ninox strenua	Powerful Owl	V	
Petroica boodang	Scarlet Robin	V	
Petroica phoenicea	Flame Robin	V	
Rostratula australis	Australian Painted Snipe	E	E,M
Stagonopleura guttata	Diamond Firetail	V	
Tyto novaehollandiae	Masked Owl	V	
Tyto tenebricosa	Sooty Owl	V	
Mammals			
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Dasyurus maculatus	Spotted-tailed Quoll	V	E
Miniopterus australis	Little Bentwing-bat	V	-
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	
Mormopterus norfolkensis	Eastern Freetail-bat	V	
Myotis macropus	Southern Myotis	V	
Petauroides volans	Greater Glider		V
Phascolarctos cinereus	Koala	V	V
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Scoteanax rueppellii	Greater Broad-nosed Bat	V	
Frogs			
Litoria aurea	Green and Golden Bell Frog	E	V
Invertebrates			
Meridolum corneovirens	Cumberland Plain Land Snail	E	

Notes: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population.

The remainder of the threatened fauna species that are known or predicted to occur in the locality have a close association with specific habitat resources that are not present in the site. Notably there are a number of fauna species that are associated with shrubby, sclerophyll vegetation types on sandstone substrates or rocky escarpments that would not occur in the grassy woodlands on flat, shale landscapes that characterise the site.

The desktop review revealed two threatened fish species (Macquarie Perch *Macquaria australasica* and Australian Grayling *Prototroctes mairaena*) and two aquatic invertebrates (Adam's Emerald Dragonfly *Archaeophya adamsi* and Sydney Hawk Dragonfly *Austrocordulia leonardi*) which are predicted to occur in the locality of the site. Each of these species is associated with clear, deep streams with rocky or gravel substrates whereas the aquatic habitats in the site are shallow and turbid with clay substrate. A review of the specific habitat requirements of these species and the habitat present led to the conclusion that these aquatic species are unlikely to occur at the site or to be affected by the proposal (Appendix A).

4.4.3 EPBC Act MNES

The database searches identified 16 threatened ecological communities, 23 threatened flora species, 21 threatened fauna species and 13 migratory species listed under the EPBC Act as potentially occurring in the site (see Appendix A). One additional MNES, The Greater Blue Mountains World Heritage Area, was identified as occurring within the locality.

Threatened ecological communities

As discussed in Section 4.4.1:

- Patches of Narrow-leaved Ironbark Broad-leaved Ironbark Grey Gum open forest with a forest or woodland structure also comprise an occurrence of 'Shale Sandstone Transition Forest' community, which is listed as a CEEC under the EPBC Act; and
- Patches of Hard-leaved Scribbly Gum Parramatta Red Gum heathy woodland, with a woodland structure comprise an occurrence of 'Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion' which is listed as an EEC under the EPBC Act.

No other threatened ecological communities listed under the EPBC Act are present in the site.

Threatened flora

As stated in Section 4.4.1, *Micromyrtus minutifolia*, which is listed under the TSC Act and was recorded outside the site to the north, is also listed as vulnerable under the EPBC Act. A further eight threatened flora species listed as threatened under the EPBC Act were also assessed as having the potential to occur. These species are all also listed under the TSC Act and are addressed in Section 4.4.1.

Threatened fauna

No threatened fauna species listed under the EPBC Act have been recorded at the site. As discussed in Section 4.4.1, three fauna species listed as threatened under the EPBC Act (the Grey-headed Flying-fox, Swift Parrot and Large-eared Pied Bat) have been recorded within or immediately adjacent to the wider Fernhill Estate. Based on the habitats present, a total of nine threatened fauna species listed under the EPBC Act may occur in the site and/or be affected by the proposal. These fauna species are also listed under the TSC Act and are listed in Table 13. Relevant habitats for these species are discussed in Section 4.3.

Migratory and marine fauna

Three migratory marine bird species, four wetland birds (two of which are also listed as marine species) and seven 'terrestrial' bird species were identified by the database searches as known or having the potential to occur within the locality, comprising:

- Migratory wetland species:
 - Black-tailed Godwit (Limosa limosa)
 - Great Egret (Ardea alba; also listed as marine)
 - Latham's Snipe (Gallinago hardwickii)
 - Australian Painted Snipe (*Rostratula australis*), also listed as an endangered species under the EPBC Act.
- Migratory 'terrestrial' species
 - White-throated Needletail (*Hirundapus caudacutus*)
 - Black-faced Monarch (Monarcha melanopsis)
 - Spectacled Monarch (Monarcha trivirgatus)
 - Satin Flycatcher (Myiagra cyanoleuca)
 - Rufous Fantail (Rhipidura rufifrons)
 - Regent Honeyeater (*Xanthomyza phrygia*), also listed as an endangered species under the EPBC Act.
- Migratory 'marine' species
 - Fork-tailed Swift (Apus pacificus).

Given the habitats present and connectivity of the site to large areas of high quality habitats on three sides, each of the predicted species listed above may occur in habitats within the site on occasion.

The EPBC Act lists migratory species listed under international agreements, as well as families of birds (such as ducks, waders, eagles and hawks) that are also known to be migratory but are not listed under international agreements. A range of waterfowl and waders have been recorded within the Fernhill Estate (see Appendix A). Other seasonally migratory or nomadic species would also be likely to utilise habitats within the site on occasion.

Additional MNES

The protected matters search (DotE 2013a) identified 'The Greater Blue Mountains Area' which is listed as a declared World Heritage Property and a National Heritage Place under the EPBC Act. The Greater Blue Mountains Area includes the Blue Mountains National Park which is located directly adjacent to the west and north of the proposal. Vegetation and habitats are continuous between the park and vegetation within the site.



Point layers the inducted infinite of stells at each location.
 Approximate *Grevillea juniperina* subsp. *juniperina* locations are based on ELA (2010) survey and mapping. GHD have ground-truthed this mapping within the indicative development footprint and have not recorded the species in this area.

Angas Securities Pty. Ltd. Job Number 22-16709 Fernhill Lot 1 DP 549247 Two Lot Development Biodiversity Assessment

Threatened biota

Revision A Date 01 Sep 2017

Figure 4

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400

Shale/Sandstone Transition Forest (CEEC under

the TSC Act and EPBC Act)

Grevillea juniperina subsp juniperina (approximate location(endangered under the TSC Act))

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Version: 1, Version Date: 08/09/2017

100

Proposed Lot boundaries

Development footprint

Full vegetation removal

Paper Size A4

200

Metres Map Projection: Transverse Mercator Horizontal Datum: GDA 1994 Grid: GDA 1994 MGA Zone 56

Managed vegetation

5. Impact assessment

5.1 Proposal description

The proposal involves the subdivision of Lot 1 DP 549247 into two approximately 55 hectare allotments the majority of which will be protected in perpetuity under conservation agreements. The development footprint associated with the proposal comprises two separate two-hectare sites for detached dwelling and ancillary compliant uses, which will be constructed subject to separate Development Applications. The development footprint shown on Figure 2 comprises separate areas of:

- 'Full removal' comprising the locations of house pads and vegetation-free buffer areas within each lot and the entrance road.
- 'Managed vegetation' comprising the remainder of each two hectare lot, which would be managed as the outer protection area of an asset protection zone and would include some retained native vegetation and habitat resources.

5.2 Direct impacts

5.2.1 Removal of vegetation and habitat

The direct impacts of the proposal would be limited to the areas within the development footprint shown on Figure 1 and Figure 2. The development footprint is contained within Lot 1 DP 549247, but would not affect the entirety of this Lot.

The proposal would result in the removal or modification of approximately four hectares of native vegetation within the development footprint, as shown in Table 14. It is assumed that construction site compounds, temporary sediment management structures and any other ancillary structures would be entirely contained within the development footprint. Impacts would include 0.7 ha of complete vegetation removal for the permanent infrastructure components of the proposal such as dwellings, garages, driveways and all associated earthworks. A further 3.3 ha of vegetation would be partially cleared and managed. Native trees and some understorey vegetation will be retained and managed within asset protection zones surrounding residential dwellings.

Vegetation removal and modification would include up to 2.9 ha of Shale/Sandstone Transition Forest and 1.1 ha of Castlereagh Scribbly Gum Woodland. Impacts on these threatened ecological communities and threatened biota that may occur within the development footprint are discussed in detail in Section 7.2.

The development footprint contains 4 ha of moderate/good condition native vegetation, comprising a moderately diverse range of non-threatened native plants, with associated habitat values as discussed in Section 4.3. This includes areas of highly modified moderate/good-poor condition vegetation, however these areas have high recovery potential given the extensive regeneration of native shrubs and trees and the persistence of native understorey species. The total area of native vegetation within the development footprint (4 ha) is around 0.04 % of the estimated area of native vegetation of those vegetation communities in the locality (around 9803 ha, based on Tozer (2010) vegetation mapping¹).

¹ Note: NPWS (2002) mapping does not include vegetation within the Blue Mountains Area. This mapping was used to provide estimates of the extent of Cumberland Plain vegetation types within the locality as it provides more detailed information on condition classes, and these communities do not extend west into the Blue Mountains area. Tozer (2010) mapping was used to estimate the total area of vegetation within the locality as the NPWS (2002) mapping would severely underestimate this extent.

Approximately 107.1 ha of native vegetation, including equivalent vegetation zones and habitats, would be retained and managed for biodiversity values within the proposed conservation areas as shown in Table 14. The conservation area includes around 25.3 ha of low or poor condition vegetation that would be regenerated and managed. Overall, the proposal is likely to improve biodiversity values at the site.

5.2.2 Fauna injury and mortality

As described above, the development footprint provides habitat resources for native fauna species, including threatened fauna. More mobile native fauna such as adult birds, microbats, terrestrial and arboreal mammals are highly unlikely to be affected by construction activities. Construction may result in the injury or mortality of small terrestrial fauna that may be sheltering in vegetation within the development footprint, such as the Cumberland Land Snail, frogs and reptiles described as above. The frog and reptile species that are known or likely to occur within the development footprint are widespread and abundant and so the potential injury or mortality of individuals within a maximum of 4 ha of habitat (comprising all vegetation within the development footprint) is highly unlikely to affect an ecologically significant proportion of any local populations. Impacts on threatened fauna are discussed in detail in Section 7.3.

The proposal would increase the extent of developed land in the site and locality to a small degree and may result in a minor increase in the volume of traffic. Given the value of vegetation within the site as a fauna movement corridor (see Section 4.3), this may increase the risk of vehicle collisions with native fauna. Recommended mitigation measures to address this issue would include signposting and enforcing safe speed limits (see Section 6.1.2). Given the relatively low volumes of traffic associated with two additional residential lots, impacts associated with vehicle strike are anticipated to be minor. Safe passage for native fauna would be retained around the development footprint as described below.

5.2.3 Habitat fragmentation and isolation

As discussed in Section 4.3, the development footprint forms part of an important vegetated corridor between higher habitats within the Blue Mountains area and lowland forests and woodlands of the Cumberland Plain. At a local scale, vegetation within the site is continuous with and provides connectivity between vegetation within the Blue Mountains National Park, the North West Biobank and the Fernhill Central West biobank (see Figure 1).

Construction of dwellings in the development footprint would increase habitat fragmentation within the site through the removal of native vegetation and construction of fences, buildings and roads. It would also partially alter habitat connectivity between the Cumberland Plain and the Blue Mountains.

No areas of habitat would be completely isolated as a result of the proposal. Habitat connectivity and safe fauna passage from the Blue Mountains National Park, North West Biobank and Fernhill Central West biobank would be retained through the establishment of the proposed Fernhill Lot 1 and Fernhill Lot 2 conservation areas. Connectivity and habitat values in this area may also be improved by ongoing management of vegetation within the conservation areas for biodiversity values. Notably around 25.3 ha of low or poor condition vegetation would be regenerated and managed. The result of this management would be a continuous patch of vegetation with a forest or woodland which would provide increased fauna refuge and movement opportunities.

Table 14 Potential extent of vegetation removal or modification within the site

Zone ID	Vegetation zone	TSC Act Status	EPBC Act Status	Full vegetation removal within development footprint (hectares)	Managed vegetation within within development footprint (hectares)	Proposed conservation areas (hectares)
1	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (Low)					11.7
2	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (Moderate/good – high)	CEEC	CEEC	0.4	1.2	51.4
3	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (Moderate/good – poor)	CEEC		0.2	1.1	8.7
	Total Shale Sandstone Transition Forest			0.6	2.3	71.7
4	Red Bloodwood - Grey Gum woodland					18.2
5	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (Moderate/good – medium)	VEC	EEC	0.1	1	11.1
6	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (Moderate/good – poor)	VEC				5.0
	Total Castlereagh Scribbly Gum Woodland			0.1	1	16.0
7	Coastal freshwater wetland					1.1
	Total Native Vegetation			0.7	3.3	107.1

5.3 Indirect impacts

5.3.1 Erosion, sedimentation and contamination

There are potential sensitive receptors for indirect impacts on aquatic habitats from the proposal, including drainage lines and wetlands downstream such as Top Dam, a relatively extensive wetland area in the Fernhill Central West biobank area to the east. Potential impacts that could result in a decline in aquatic habitat value include:

- Alterations to riparian and floodplain geomorphology.
- Alterations to catchment hydrology.
- Reduced water quality through hydrocarbon contamination or through increased nutrient or sediment inputs.

The hydrology and water quality of the site is already substantially modified by clearing, damming and livestock access. The proposal would result in an increase in the proportion of hardstand surfaces within the development footprint and may also modify drainage through culverts and other engineered structures. Given the small extent of full vegetation removal and construction (0.7 ha) and the modified nature of aquatic habitats at the site, it is anticipated that these potential impacts would be minor and localised.

The majority of the development footprint (3.3 a) will be managed vegetation within asset protection zones surrounding the construction footprints. These zones would comprise retained canopy trees over a slashed grassy understorey. This area of managed vegetation would provide a buffer between any sources of sedimentation and contamination and sensitive receptors outside the development footprint.

5.3.2 Weed invasion and edge effects

'Edge effects' refers to changed environmental conditions at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Edge effects would result from clearing of vegetation within the development footprint and then continue to affect vegetation and habitats adjoining development areas for the life of the proposal. This is of concern for this proposal given the high habitat value of surrounding habitats, including relatively intact areas within conservation areas.

Construction may, in general, increase the degree of weed infestation through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via wind and water and via worker's shoes, clothing and through construction vehicles. The risk of introduction of weeds would continue during operation of the proposal through wind or water transmission of propagules from gardens, or through recreational use of retained vegetation by property owners or their pets.

As described above, managed vegetation in the development footprint would function as buffers between the construction footprints and adjoining native vegetation. Further, adjoining vegetation within the proposed conservation areas in the adjacent Lot 31 DP 237163 (North West biobank) would be managed for conservation in perpetuity. The management of these areas would include weed control and revegetation activities that would mitigate any impacts arising from the proposal.

5.3.3 Pests and pathogens

Construction activities within the development footprint have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and

Chytrid fungus (*Batrachochytrium dendrobatidis*) through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can eliminate entire populations once introduced into an area.

As a precautionary measure a 'clean on entry, clean on exit' policy should be implemented during construction activities to prevent the introduction or spread of these pathogens.

5.3.4 Light, noise and vibration

The proposal would increase the level of light, noise and vibration disturbance in retained habitats within areas adjacent to the development footprint. Given the large lot size and low density of the proposed development and the provision of buffer zones between the indicative house pads and retained areas of native vegetation, these impacts would be relatively minor.

5.4 **Positive impacts**

The proposal includes the conservation and management of 107.1 ha of the site in perpetuity under an appropriate conservation covenant. The extent of vegetation zones within the conservation area is summarised in Table 14.

Subject to confirmation of the transitional arrangements under the new BC Act, the conservation areas would be protected under either BioBanking agreements under Part 7A of the TSC Act or Biodiversity Stewardship Agreements under Part 5 of the BC Act. Both types of agreements would confer a secure covenant over the conservation areas in perpetuity and require the landowner to implement biodiversity management activities that would be funded with annual payments from the Biodiversity Conservation Trust.

The conservation areas would generate biodiversity credits that could be sold to offset the impacts of other developments and so the inclusion of these areas would not directly offset the impacts of construction within the development footprint. However, the conservation areas would help to mitigate impacts of the proposal and maintain local populations of biota at the site as follows:

- Conferring a secure conservation covenant that would ensure the maintenance of vegetation extent and habitat connectivity at the site in perpetuity.
- Fencing, installation of signage and restriction of access to avoid negative impacts.
- Conservation and continued development of habitat resources within 81.8 ha of good condition native vegetation, including occurrences of each of the threatened ecological communities and habitat for each of the threatened species potentially affected by the proposal.
- Restoration of the natural vegetation structure and development of habitat resources within 25.3 ha of poor condition native vegetation including occurrences of each of each of the threatened ecological communities and habitat for each of the threatened species potentially affected by the proposal.
- Exclusion of grazing, weed control, pest fauna control and implementation of ecological burns.

6. Impact Mitigation

6.1.1 Avoidance of impacts

The development footprint has been substantially revised compared to that referred to in the previous rezoning application (ELA 2010) and more recent planning proposals (GHD, 2015a). These revisions have aimed to reduce impacts on native (and particularly threatened) biota, by reducing impacts on Shale Sandstone Transition Forest and completely avoiding impacts on *Grevillea juniperina* subsp *juniperina*. The current proposal includes just two residential lots with a total development footprint of four hectares, which is a very minor magnitude of impacts in a 110 ha site.

Around 106 ha of the site would be formally set aside as conservation areas resulting in positive impacts on biodiversity values as described in Section 5.4.

6.1.2 Mitigation of impacts

Detailed Design Phase

The development footprint shows the maximum area to be impacted by the development. There is some potential to reduce the impacts of the proposal through retention of native biota and habitats within this footprint.

During the detailed design process, the impact of the proposal on areas with high biodiversity values should be minimised wherever possible by:

- Minimising the area of native vegetation and especially intact threatened ecological communities to be cleared.
- Retention of native vegetation within residential lots and asset protection zones wherever possible.
- Avoidance of identified habitat trees wherever possible.

Construction phase

Environmental management and impact mitigation measures would be required for the construction phase of the project, and would be described in individual DAs for house lots prior to the commencement of construction. Construction of dwellings would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures including the procedures outlined below. The proposed measures would include environmental safeguards for protection of downstream properties and waterways in accordance with relevant policy documentation and Government guidelines.

Future DAs and construction plans implemented at the site would be required to address the following as a minimum:

- Installation of erosion and sediment control measures prior to construction.
- Regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality.
- Restriction of stockpiles to identified construction compounds, in areas of cleared land and exotic grassland and management of these stockpiles to ensure no offsite impacts through dust generation or sedimentation
- Separate erosion controls for individual house sites would be established to support the building stage of the development.

- Exposed soil would be stabilised and revegetated as soon as practicable after construction of dwellings to minimise the time that bare earth is exposed to erosion.
- Delineation and protection of exclusion zones around native vegetation to be retained.
- Communication with construction personnel of the conservation value of surrounding habitats and their responsibilities with regards to protecting these habitats during construction.
- Hygiene procedures to prevent the introduction and spread of pathogens such as Phytophthora, Chytrid and Myrtle Rust in areas of native vegetation. These would include exclusion zones around retained areas of native vegetation and/or provision of machine and footwear washdown stations for all equipment and personnel working in areas of native vegetation.
- Minimising the clearing of mature trees where possible.

Operational phase

The following recommended mitigation measures are of relevance to the operational phase of the proposed development (i.e. the use of the development footprint as a residential area):

- Appropriate management of bushfire asset protection zones to prevent the spread of weeds or soil into adjacent areas of retained vegetation.
- Restriction of access into retained areas of vegetation within proposed conservation areas (particularly for livestock or domestic pets).
- Enforcement of legal obligations to control priority weeds within residential areas to prevent the spread of propagules into retained areas of native vegetation.
- Lighting should be designed to minimise light spill into adjacent areas of native vegetation within the proposed biobank areas or the Blue Mountains National Park.

7. Assessments of significance

7.1 Identification of affected threatened biota

The desktop assessment, field surveys and habitat assessments described above have been used to identify the suite of threatened biota that may be affected by the proposal, through either direct or indirect impacts. If threatened biota is potentially affected by a proposed activity then the significance of impacts must be assessed through Section 5A of the EPA Act (the seven part test) and/or the *Matters of National Environmental Significance –Assessment of significance guidelines* (DotE 2013)c.

The DECC (2007) *Threatened species assessment guidelines - the assessment of significance* and DotE (2013c) guidelines require proponents to compile a list of threatened biota which may be affected by the proposal and which require an assessment of significance.

The suite of threatened biota potentially relevant to this assessment is presented in Appendix A, along with the nature of any previous records in the locality and an assessment of the likelihood of occurrence in the study area. Based on the targeted surveys and habitat assessments undertaken, a number of the threatened biota presented in Appendix A do not occur in the study area. Given the limited scale and magnitude of impacts arising from the proposal and impact mitigation and environmental management measures described in Section 5, no additional threatened biota outside of the site are likely to be affected by off-site impacts of the proposal.

No threatened flora were recorded within the development footprint or are likely to be affected by indirect impacts. The entire local population of 4,308 *Grevillea juniperina* subsp. *juniperina* plants (ELA 2010) would be retained in the proposed conservation areas between the two house lots within the development footprint.

The proposal would remove up to four hectares of potential habitat for up to seven additional threatened flora species and one endangered population identified as having the potential to occur within the development footprint (see Section 4.4). Substantially greater areas of similar habitats would be retained within proposed conservation areas as discussed in Section 5.4. The proposal would not result in a significant impact on any threatened flora species.

Table 15 lists the threatened ecological communities and species that are known or likely to be present at the site and are considered affected threatened biota for the proposal. Where appropriate, affected threatened species have been grouped in guilds (i.e. species that have similar ecology and/or shared habitat requirements).

Several of the threatened fauna species that may possibly occur at the broader site are not potentially affected threatened biota because they would occur in wetland habitat that is not present in the development footprint or at risk of secondary impacts (see wetland bird and frog species in Table 13).

The proposal would result in direct impacts to known local occurrences of Shale Sandstone Transition Forest and Castlereagh Scribbly Gum Woodland and a known local population of the Cumberland Plain Land Snail. Specific assessments of significance for these biota are included in Appendix C and summarised below.

The other potentially affected threatened biota are relatively mobile fauna species that would only occur in the development footprint on a transitory or opportunistic basis. These species have not been recorded in the development footprint and there are no specific features or habitat resources that suggest that the four hectares of potential habitat in the development footprint supports a resident population. The development footprint would be only a small proportion of the home range of these species, and better quality habitat is present elsewhere in the locality. The proposal may remove foraging habitat and other resources for these species but would be unlikely to injure or harm any individuals or remove any specific habitat resources that would be important to local populations. A general assessment of significance with reference to Section 5A of the EPA act has been prepared for guilds of threatened fauna and their habitats that may be subject to impacts.

The results of the assessments of significance for threatened ecological communities and for guilds of affected threatened species are described below.

Table 15 Potentially affected threatened biota

Scientific name	Common Name	TSC	Impact of development			
	Common Name	Act status	Act status			
Threatened ecologica	al communities					
Shale Sandstone Transition Forest		CEC	CEC	Direct impacts within a local occurrence of the community.		
Castlereagh Scribbly Gum Woodland		VEC	EEC	Direct impacts within a local occurrence of the community.		
Woodland birds						
Artarmus cyanopterus	Dusky Woodswallow	V	E	Removal of potential habitat for possible local populations of these species.		
Chthonicola sagittata	Speckled Warbler	V				
Daphoenositta chrysoptera	Varied Sittella	V				
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V				
Petroica boodang	Scarlet Robin	V				
Petroica phoenicea	Flame Robin	V				
Neophema pulchella	Turquoise Parrot	V				
Stagonopleura guttata	Diamond Firetail	V				
Migratory and nomad	lic birds					
Lathamus discolor	Swift Parrot	E	CE	Removal of potential habitat for possible local populations of these		
Glossopsitta pusilla	Little Lorikeet	V		species.		
Anthochaera phrygia	Regent Honeyeater	CE	CE			
Callocephalon fimbriatum	Gang-gang Cockatoo	V				
Calyptorhynchus Iathami	Glossy Black- Cockatoo	V				
Large predatory birds	3					
Lophoictinia isura	Square-tailed Kite	V		Removal of potential habitat for possible local populations of these		
Ninox connivens	Barking Owl	V		species.		
Ninox strenua	Powerful Owl	V				

Scientific name	Common Name	TSC Act status	EPBC Act status	Impact of development
Tyto novaehollandiae	Masked Owl	V		
Tyto tenebricosa	Sooty Owl	V		
Microbats				
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Removal of potential foraging habitat and shorter term roost sites
Miniopterus australis	Little Bentwing-bat	V	-	for possible local populations of these species.
Miniopterus schreibersii oceanensis	Eastern Bentwing- bat	V		
Mormopterus norfolkensis	Eastern Freetail- bat	V		
Myotis macropus	Southern Myotis	V		
Scoteanax rueppellii	Greater Broad- nosed Bat	V		
Mammals of woodlan	d and forest			
Petauroides volans	Greater Glider		V	Removal of potential habitat for possible local populations of these
Phascolarctos cinereus	Koala	V	V	species.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	
Dasyurus maculatus	Spotted-tailed Quoll	V	E	
Invertebrates				
Meridolum corneovirens	Cumberland Plain Land Snail	E		Direct impacts on habitat for a local population of the species.

Notes: CE – critically endangered; E – endangered; V – vulnerable; EP – endangered population; CEEC – critically endangered ecological community; EEC – endangered ecological community; VEC – vulnerable ecological community.

7.2 Threatened ecological communities

Shale Sandstone Transition Forest

The development footprint contains a total of 2.9 ha of Shale Sandstone Transition Forest. The vegetation to be removed or modified includes up to 1.6 ha in moderate/good – high condition that comprises the EPBC Act-listed form of the community, as well as up to 1.3 ha in moderate/good- poor condition that comprises only the TSC Act-listed community. This represents a very small proportion of the local occurrence of this community. At least 71.7 ha of this community, including 51.4 ha in moderate/good – high condition that comprises the EPBC Act-listed form of the community, would be retained and actively managed for biodiversity values within the proposed conservation areas. A further 20.2 ha of continuous vegetation within the same local occurrence would be maintained in the Fernhill North West biobank and 41.4 ha in the Fernhill Central West biobank.

A 7-part test for potential impacts on Shale Sandstone Transition Forest is included in Appendix C. The outcome of this assessment of significance is that the proposal would not result in a significant impact on the local occurrence of the ecological community.

Castlereagh Scribbly Gum Forest

The development footprint contains 1.1 ha of Castlereagh Scribbly Gum Woodland, which is is in moderate/good – medium condition and comprises an occurrence of the VEC listed under the TSC Act and the EEC listed under the EPBC Act. This represents a very small proportion of the local occurrence of this community. At least 16.1 ha of this community would be retained and actively managed for biodiversity values within the proposed conservation area. A further 31.8 ha of continuous vegetation within the same local occurrence would be maintained in the Fernhill North West biobank and two hectares in the Fernhill Central West biobank.

Castlereagh Scribbly Gum Woodland is listed as a VEC under the TSC Act and therefore specific assessment of significance pursuant to section 5A of the EPA act is not required. An assessment of significance pursuant to the EPBC Act guidelines 1.1 (DotE 2013) for impacts on the EPBC Act-listed form of Castlereagh Scribbly Gum Woodland is included in Appendix C. The outcome of this assessment of significance is that the proposal would not result in a significant impact on the local occurrence of the ecological community.

7.3 Threatened fauna

Cumberland Plain Land Snail

The proposal would remove known and potential habitat for the Cumberland Plain Land Snail, which is listed as an endangered species under the TSC Act, and has previously been recorded in the south-west of the site, close to the development footprint (ELA 2007b, 2010). This species has been recorded in high numbers elsewhere within the Fernhill Estate Estate (GHD 2013a, b and c) and in the locality, and is more commonly observed in association with Cumberland Plain Woodland communities.

A 7-part test for potential impacts on the Cumberland Plain Land Snail is included in Appendix C. The outcome of this assessment of significance is that the proposal would not result in a significant impact on the local population of the Cumberland Plain Land Snail.

Woodland birds

An assessment of significance of impacts on potential local populations of threatened woodland birds (Varied Sittella, Bush Stone-curlew, Diamond Firetail, Flame Robin, Hooded Robin, Scarlet Robin, Speckled Warbler, Dusky Woodswallow and Turquoise Parrot) has been prepared with reference to Section 5 of the EPA Act. The outcome of this assessment is that the proposal is not likely to have a significant impact on the local populations of these threatened woodland birds given:

- Potential impacts of the proposal on the life cycle of these woodland bird species would be restricted to the removal or modification of habitat and potential injury or mortality of birds within the four hectares of potential foraging or nesting habitat for these species in the site (comprising intact and regrowth woodland, forest or scrub).
- The proposal would affect a very small proportion of the area of potential habitat for these woodland birds in grassy woodland and forest in the locality and this minor magnitude of impacts on any individual birds that may be resident in the site or on nest sites or other potential habitat resources would not threaten the viability or persistence of the local population of these species.

- A maximum of 0.7 ha of habitat would be removed and a further 3.3 ha would be modified, which is a very minor proportion of the habitat resources available to local populations, including within 107.1 ha of similar vegetation that would be retained and managed in conservation areas at the site. The majority of the development footprint would be managed as an asset protection zone. Retained trees and periodically slashed grass in this 3.3 ha of modified habitat would retain some habitat value for these woodland bird species.
- The proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and extent.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these woodland bird species.
- The proposal would result in positive impacts within 107.1 ha of habitat for these woodland birds that would be retained and managed in conservation areas at the site. Exclusion of grazing, restoration of derived grassland and shrubland and continued development of vegetation structure and habitat resources in woodland and forest would improve the quality of habitat.

Migratory or nomadic birds

An assessment of significance of impacts on potential local populations of threatened migratory or nomadic birds (Gang-gang Cockatoo, Glossy Black-cockatoo, Little Lorikeet, Regent Honeyeater and Swift Parrot) has been prepared with reference to Section 5 of the EPA Act. The outcome of this assessment is that the proposal is not likely to have a significant impact on the local populations of these threatened migratory or nomadic birds given:

- Potential impacts of the proposal on the life cycle of these woodland bird species would be restricted to the removal or modification of habitat and potential injury or mortality of birds within a maximum of 2.7 ha of potential foraging or resting habitat for these species in the site (comprising intact and regrowth woodland and forest). These species are highly unlikely to roost or nest in the development footprint since it: is fragmented or edge habitat without large hollow-bearing trees that could provide nest sites for the Gang-gang Cockatoo or Little Lorikeet; and is outside recognised regions that contain breeding habitat for the Swift Parrot or Regent Honeyeater. As such there is very little risk of injury or mortality of these birds.
- The proposal would affect a very small proportion of the area of potential habitat for these birds in woodland and forest in the locality and this minor reduction in the extent of foraging resources would not threaten the viability or persistence of the a population of these species.
- A maximum of 0.5 ha of habitat would be removed and a further 2.2 ha would be modified, which is a very minor proportion of the habitat resources available to local populations, including within 80 ha of woodland and forest that would be retained and managed in conservation areas at the site. The majority of the development footprint would be managed as an asset protection zone. Retained trees in this 3.3 ha of modified habitat would retain some habitat value for these bird species.
- The proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and extent.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these bird species.

 The proposal would result in positive impacts within 107.1 ha of habitat for these birds that would be retained and managed in conservation areas at the site. Exclusion of grazing, restoration of derived grassland and shrubland and continued development of vegetation structure and habitat resources in woodland and forest would improve the quality of habitat.

Large predatory birds

An assessment of significance of impacts on potential local populations of threatened large, predatory birds (Barking Owl, Masked Owl, Powerful Owl, Sooty Owl and Square-tailed Kite) has been prepared with reference to Section 5 of the EPA Act. The outcome of this assessment is that the proposal is not likely to have a significant impact on the local populations of these threatened large, predatory birds given:

- Potential impacts of the proposal on the life cycle of these woodland bird species would be restricted to the removal or modification of habitat and potential injury or mortality of birds within a maximum of four hectares of potential foraging or shorter-term roosting habitat for these species in the site. These species are highly unlikely to occupy longerterm roosts or to nest in the development footprint since it is fragmented or edge habitat without large hollow-bearing trees or stags. Local populations of these bird species would roost or nest in denser, more mature forest away from the edge of vegetated patches in other parts of the Fernhill Estate or in the Blue Mountains National Park. As such there is very little risk of injury or mortality of these birds.
- The proposal would affect a very small proportion of the area of potential habitat for these birds in woodland and forest in the locality and this minor reduction in the extent of potential habitat resources would not threaten the viability or persistence of the local population of these species.
- A maximum of 0.5 ha of habitat would be removed and a further 2.2 ha would be modified, which is a very minor proportion of the habitat resources available to local populations, including within 80 ha of woodland and forest that would be retained and managed in conservation areas at the site. The majority of the development footprint would be managed as an asset protection zone. Retained trees in this 3.3 ha of modified habitat would retain some habitat value for these bird species.
- The proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and extent.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these bird species.
- The proposal would result in positive impacts within 107.1 ha of habitat for these birds that would be retained and managed in conservation areas at the site. Exclusion of grazing, restoration of derived grassland and shrubland and continued development of vegetation structure and habitat resources in woodland and forest would improve the quality of habitat.

Microbats

An assessment of significance of impacts on potential local populations of threatened threatened microbats (Eastern Freetail-bat, Greater Broad-nosed Bat, Southern Myotis, Eastern Bentwing-bat and Large-eared Pied Bat) has been prepared with reference to Section 5 of the EPA Act. The outcome of this assessment is that the proposal is not likely to have a significant impact on the local populations of these threatened mircrobats given:

- Potential impacts of the proposal on the life cycle of these microbat species would be restricted to the removal or modification of habitat and potential injury or mortality of birds within a maximum of four hectares of potential foraging or shorter-term roosting habitat for these species in the site. These species may occupy diurnal roosts in dense vegetation or trees with fissures or decorticating bark in the development footprint. These species are highly unlikely to breed or occupy longer-term roosts in the development footprint since it is fragmented or edge habitat without caves or hollow-bearing trees or stags. Local populations of these microbat species would roost in more mature forest with hollow-bearing trees or rocky country with caves in other parts of the Fernhill Estate or in the Blue Mountains National Park. As such there is a minor risk of injury or mortality of these microbat species and the proposal would be highly unlikely to affect an ecologically significant proportion of any local populations.
- The proposal would affect a very small proportion of the area of potential habitat for these micobat species in woodland and forest in the locality and this minor reduction in the extent of potential habitat resources would not threaten the viability or persistence of the local population of these species.
- A maximum of four hectares of foraging habitat would be affected, including 0.5 ha of potential roosting habitat that would be removed and a further 2.2 ha that would be modified. This is a very minor proportion of the habitat resources available to local populations, including within 107.1 ha of similar vegetation that would be retained and managed in conservation areas at the site. The majority of the development footprint would be managed as an asset protection zone. Retained trees and aerial foraging habitat above periodically slashed grass in this 3.3 ha of modified habitat would retain some habitat value for these microbat species.
- The proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and extent.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these bird species.
- The proposal would result in positive impacts within 107.1 ha of habitat for these microbat species that would be retained and managed in conservation areas at the site. Exclusion of grazing, restoration of derived grassland and shrubland and continued development of vegetation structure and habitat resources in woodland and forest would improve the quality of habitat.

Mammals of forest and woodland

An assessment of significance of impacts on potential local populations of Grey-headed Flyingfox, Koala, Greater Glider and Spotted-tailed Quoll has been prepared with reference to Section 5 of the EPA Act. The outcome of this assessment is that the proposal is not likely to have a significant impact on the local populations of these threatened large, predatory birds given:

- Potential impacts of the proposal on the life cycle of these these large, mobile mammals of forest and woodland would be restricted to the removal or modification of up to 2.7 ha of foraging or shorter term shelter habitat, comprising intact woodland and forest.
- There are no Grey-headed Flying-fox roost camps in the study area or locality; there are no potential Spotted-tailed Quoll den sites at the site; there are no hollow-bearing trees in the development footprint and so Greater Gliders would not be present during construction in daylight hours; and onstruction personnel would be able to note and avoid

harm to any Koalas present in the small number of trees to be removed. Based on the above considerations there is little risk of injury or mortality of these large, mobile species.

- Local populations of these fauna species would be more reliant on more mature forest away from the edge of vegetated patches in other parts of the Fernhill Estate or in the Blue Mountains National Park.
- The proposal would affect a very small proportion of the area of potential habitat for these mammal species in woodland and forest in the locality and this minor reduction in the extent of potential habitat resources would not threaten the viability or persistence of the local population of these species.
- A maximum of 0.5 ha of habitat would be removed and a further 2.2 ha would be modified, which is a very minor proportion of the habitat resources available to local populations, including within 80 ha of woodland and forest that would be retained and managed in conservation areas at the site. The majority of the development footprint would be managed as an asset protection zone. Retained trees in this 3.3 ha of modified habitat would retain some habitat value for these mammal species.
- The proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and extent.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these mammal species.
- The proposal would result in positive impacts within 107.1 ha of habitat for these birds that would be retained and managed in conservation areas at the site. Exclusion of grazing, restoration of derived grassland and shrubland and continued development of vegetation structure and habitat resources in woodland and forest would improve the quality of habitat.

7.4 Migratory fauna

No migratory bird species were recorded during field surveys. A range of waterfowl and waders as described in Section 4.4.3 and other seasonally migratory or nomadic species would be likely to utilise habitats within the site on occasion.

The EPBC Act requires an assessment of the significance of potential impacts of a proposal on migratory species with reference to the criteria specified in the *Matters of National Environmental Significance –Assessment of significance guidelines 1.1* (DotE 2013).

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will (DotE 2013):

Substantially modify, destroy or isolate an area of important habitat for a migratory species

An area of 'important habitat' for a migratory species is: habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or; habitat that is of critical importance to the species at particular life-cycle stages, and/or; habitat utilised by a migratory species which is at the limit of the species range, and/or; habitat within an area where the species is declining (DotE 2013).

As described in Section 4.4.3 the site would have only moderate value for migratory species and does not comprise 'important habitat'. The four hectares of terrestrial

vegetation contained in the development footprint would have very minor value for populations of migratory species. Impacts would be restricted to the site and its immediate vicinity and so the proposal would not substantially modify any important habitat.

• Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or

As described above the site does not comprise 'important habitat'. Impacts would be restricted to the development footprint and its immediate vicinity and so the proposal would not result in an invasive species becoming established in important habitat.

• Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.

Given the limited scale of the proposal and quality of habitat for migratory species only a small number of individuals of any migratory species would ever occupy habitat within the area potentially subject to impacts. The risk of injury or mortality of any of these individuals is very slight. The development footprint contains a small proportion of the habitat resources available for migratory species in the study area and the locality. As described in Section 5.2.3, the proposal would not significantly increase the degree of fragmentation or isolation of habitat in the locality. Therefore the proposal would not seriously disrupt the lifecycle of an ecologically significant proportion of the population of any migratory species.

Based on the consideration of the criteria contained in the *Matters of National Environmental Significance –Assessment of significance guidelines* (DotE 2013c), the proposal would not be likely to have a significant impact on any migratory species.

7.5 Additional MNES

'The Greater Blue Mountains World Heritage Area' is listed as a declared World Heritage Property and a National Heritage Place under the EPBC Act. The Greater Blue Mountains World Heritage Area adjoins the western boundary of the site. Impacts of the proposal would be restricted to the development footprint. The proposed conservation areas would provide a buffer of at least 500 metres of retained native vegetation between the development footprint and the heritage area. Given the location, scale and magnitude of impacts arising from the proposal there is no risk of direct or indirect impacts of the proposal on the Greater Blue Mountains World Heritage Area.

8. Conclusions

This report has been prepared to support a Development Application (DA) for the subdivision of Lot 1 DP 549247 into two approximately 55 ha allotments. The development footprint associated with the proposal comprises two separate two-hectare sites for detached dwelling and ancillary compliant uses, which will be constructed subject to separate DAs. The remaining 107 hectares of the site will be protected in perpetuity under conservation agreements.

The majority of site contains native woodland and forest of alluvial, sandstone and shale sandstone transition environments of the Cumberland Plain. Current and historic land uses within the site include grazing, livestock keeping and timber felling and collecting. The site includes areas of near intact native forest and woodland as well derived scrubland, exotic grassland and cleared land as a result of past management. Drainage lines within site also show signs of extensive modification.

Based on the targeted surveys and habitat assessments undertaken the site contains the following threatened biota:

- 'Shale Sandstone Transition Forest' community which is listed as a CEEC under the TSC Act. Patches with a forest or woodland structure also comprise an occurrence of the related CEEC listed under the EPBC Act;
- Hard-leaved Scribbly Gum Parramatta Red Gum heathy woodland, is an occurrence of 'Castlereagh Scribbly Gum Woodland' which is listed as a VEC under the TSC Act. Patches with a woodland structure also comprise an occurrence of the related EEC listed under the EPBC Act;
- The Cumberland Plain Land Snail, which is listed as an endangered species under the TSC Act;
- Habitat for a number of bird and mammal species of woodland and forest environments that area that are listed as threatened species under the EPBC Act and/or the TSC Act; and
- Habitat for a number of bird species of woodland and forest environments that are listed as migratory species under the EPBC Act and related treaties.

The proposal would result in the removal or modification of approximately four hectares of native vegetation within the development footprint. Impacts would include 0.7 ha of complete vegetation removal for the permanent infrastructure components of the proposal such as dwellings, garages, driveways and all associated earthworks. A further 3.3 ha of vegetation would be partially cleared and managed. Native trees and some understorey vegetation will be retained and managed within asset protection zones surrounding residential dwellings.

Vegetation removal and modification would include up to 2.9 ha of Shale Sandstone Transition Forest and 1.1 ha of Castlereagh Scribbly Gum Woodland. Assessments of significance pursuant to Section 5a of the EPA Act and the EPBC Act guidelines 1.1 have been performed for impacts on these threatened ecological communities and threatened biota that may occur within the development footprint. The outcome of these assessments of significance is that the proposal is not likely to result in a significant impact on any threatened biota or on any other MNES given:

• That potential impacts of the proposal would be restricted to a maximum 4 ha development footprint which would affect a very small proportion of local populations and their habitat;

- That given the small scale of the development footprint and proposed mitigation measures it would be unlikely to result in any substantial indirect impacts on any habitat beyond the immediate development footprint;
- A small proportion of the habitat available to local populations of these biota would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has low value given its extent, attributes, condition and context;
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these biota; and
- The proposal would result in positive impacts to up to 107 ha of habitat for these biota through the protection and management of the proposed conservation areas.

A Species Impact Statement is not required for the proposal.

The subject contains a number of Matters of National Environmental Signficance (MNES) and/or their habitat and so a referral of the proposal will be prepared and submitted to the Commonwealth. Based on the impact assessments and assessments of significance included in this report, the proposal is not likely to result in a significant impact on any MNES. The proposal is not likely to require any further assessment or approval under the EPBC Act.



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The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

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Appendices

Document Set ID: 7829405 Version: 1, Version Date: 08/09/2017 Appendix A – Threatened biota assessment

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Acacia bynoeana	Bynoe's Wattle	E	V	This species is endemic to central eastern NSW, and is currently known from only 34 locations, many of which are only 1-5 plants. This species occurs mainly in heath and dry sclerophyll forest on sandy soils, seeming to prefer open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. This species flowers from September to March, and fruit matures in November.	Predicted to occur within 10km (DotE 2015a)	Possible	Suitable habitat present, but a large and readily detectable species that may be reliably excluded based on survey effort conducted.
Acacia gordonii		E	E	Disjunct populations in the lower Blue Mountains and the South Maroota/Glenorie areas, within the Hawkesbury, The Hills and Blue Mountains LGAs. Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops.	Predicted to occur within 10km (DotE 2015a)	Unlikely	Suitable soil types and geomorphology not present.
Allocasuarina glareicola		E	E	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Predicted to occur within 10km (DotE 2015a)	Possible	Suitable habitat present. Not recorded despite targeted field surveys.
Asterolasia elegans		E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. 7 known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	Predicted to occur within 10km (DotE 2015a)	Unlikely	Suitable soil types and geomorphology not present.
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly	Predicted to occur within 10km (DotE 2015a)	Unlikely	Suitable soil types and geomorphology not present.

Appendix Table 1 Threatened flora known or predicted from the locality, habitat association and likelihood of occurring at the site.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
				in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with <i>Cryptostylis subulata</i> and the <i>Cryptostylis erecta</i> . Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.			
Cynanchum elegans	White-flowered Wax Plant	E	E	Occurs from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Most common near Kempsey. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and Melaleuca scrub. Soil and geology types are not limiting.	Predicted to occur within 10km (DotE 2015a)	Unlikely	Typical vegetation associations not present and not previosuly recorded in the locality.
Dillwynia tenuifolia		V	V	Occurs in western Sydney, predominately the Cumberland Plain as well as the Lower Blue Mountains and north to Yengo. Grows in scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and associated transitional communities including Castlereagh Scribbly Gum Woodland.	4 records within 10km (OEH 2015a)	Unlikely	Limited habitat present, but may be reliably excluded based on survey effort conducted.
Eucalyptus benthamii	Camden White Gum	V	V	Occurs on the alluvial flats of the Nepean River and its tributaries. Known distribution from The Oaks (south) to Grose Wold (north) and Kedumba Valley (west). 2 major subpopulations: in Kedumba Valley and Bents Basin State Recreation Area. Occurs in wet open forest on alluvial flats, in well drained alluvial sands and gravels to 1 m deep.	5 records within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Unlikely	Broadly suitable habitat present, but a large and readily detectable species that may be reliably excluded based on survey effort conducted.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Eucalyptus nicholii	Narrow-leaved Peppermint, Narrow- leaved Black Peppermint	V	V	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Predicted to occur within 10km (DotE 2015a)	Nil	Suitable soil types and geomorphology not present and outside of known range.
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V		Occurs only within western Sydney in an area bounded by Blacktown, Erskine Park, Londonderry and Windsor. Outlier populations also at Kemps Creek and Pitt Town. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium, typically containing lateritic gravels. Occurs in association with Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forests.	2 records within 10km (OEH 2015a) including a substantial population in the Lot 1 Subdivision of the Fernhill estate (EcoLogical, 2010).	Present	Suitable habitat present and was recorded in the site.
Marsdenia viridiflora subsp. viridiflora	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP		Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. A climber that grows in vine thickets and open shale woodland.	17 records within 10km (OEH 2015a)	Unlikely	Recorded nearby within the Fernhill East Biobank. Suitable habitat not present and a small, cryptic species that may not have been detected in field surveys.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Melaleuca deanei	Deane's Paperbark	V	V	Occurs from Nowra- St Albans and west to the Blue Mountains, with most records in Ku-ring-gai / Berowra and Holsworthy/Wedderburn areas. Mostly grows on broad flat ridgetops, dry ridges and slopes and strongly associated with low nutrient sandy loam soils, sometimes with ironstone. Grows in heath- open forest, often in sandstone ridgetop woodland communities.	1 record within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Unlikely	Suitable soil types and geomorphology not present.
Micromyrtus minutiflora		E	V	Occurs in Richmond and Penrith areas in western Sydney. Grows in open forest on sandy clay or gravelly soils from Tertiary alluvium. Associated with Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, and other open forest types.	1 record within 10km (OEH 2015a)	Unlikely	Suitable soil types and geomorphology present, however not recorded despite targeted surveys.
Pelargonium sp. Striatellum (G.W.Carr 10345)	Omeo Stork's-bill	Е	Ε	Omeo Storksbill <i>Pelargonium</i> sp. (G.W. Carr 10345), syn. <i>P. striatellum</i> , is a tufted perennial forb known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Predicted to occur within 10km (DotE 2015a)	Nil	Suitable soil types and geomorphology not present and outside of known range.
Persoonia acerosa	Needle Geebung	V	V	Recorded on central coast and in Blue Mountains, from Mt Tomah to Hill Top (though now believed extinct in Hill Top). Mainly in Katoomba, Wentworth Falls and Springwood areas. Inhabits dry sclerophyll forest, scrubby low woodland and heath on sandstone. Occurs in well-drained soils including sands, laterite and gravels between 550- 1000m asl. May occur in disturbed areas eg roadsides.	Predicted to occur within 10km (DotE 2015a)	Unlikely	Suitable soil types and geomorphology not present.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Persoonia hirsuta	Hairy Geebung	Е	E	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600m above sea level.	2 records within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Unlikely	Suitable habitat present, but a readily detectable species that may be reliably excluded based on survey effort conducted.
Pimelea curviflora var. curviflora		V	V	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Predicted to occur within 10km (DotE 2015a)	Unlikely	Suitable soil types and geomorphology not present.
Pimelea spicata	Spiked Rice-flower	E	Ε	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (OEH 2013).	1 record within 10km (OEH 2015a); Predicted within 10km (DotE 2015).	Unlikely	Suitable habitat not present.
Pomaderris brunnea	Rufous Pomaderris	V	V	Mainly occurs in SW Sydney (Wollondilly and Camden LGAs), with other populations in the Hawkesbury-Wollemi region, near Walcha in the New England tablelands and Gippsland in VIC. In NSW, grows in moist woodland or open forest on clay and alluvial	Predicted to occur within 10km (DotE 2015a)	Unlikely	Suitable habitat present, but a large and readily detectable species that may be reliably excluded

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
				soils on flood plains and creek lines. Near Sydney occurs in open woodland dominated by <i>E. amplifolia</i> with <i>Allocasuarina</i> sp. and <i>Bursaria</i> sp. understorey, or on alluvial flats with eucalypts including <i>E. elata, E. piperita</i> and <i>E. punctata</i> (Sutter 2011).			based on survey effort conducted.
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Predicted to occur within 10km (DotE 2015a)	Unlikely	Suitable soil types and geomorphology not present.
Pultenaea glabra	Smooth Bush-pea, Swamp Bush-pea	V	V	In NSW restricted to higher Blue Mountains in the Katoomba-Hazelbrook and Mt Victoria areas. Unconfirmed sightings in Mt Wilson and Mt Irvine areas. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone.	Predicted to occur within 10km (DotE 2015a)	Nil	Suitable soil types and geomorphology not present and outside of known range.
Pultenaea parviflora		Ε	V	Occurs on the Cumberland Plain, with core distribution from Windsor to Penrith and east to Dean Park, and outliers in Kemps Creek and Wilberforce. Grows in dry sclerophyll woodlands, forest or in grasslands on Wianamatta Shale, laterite or Tertiary alluvium, on infertile sandy to clay soils. Associated communities include Castlereagh Ironbark Forest, Shale Gravel transition Forest and intergrade with Castlereagh Scribbly Gum Woodland.	2 records within 10km (OEH 2015a); Predicted within 10km (DotE 2015).	Unlikely	Suitable habitat present, but a large and readily detectable species that may be reliably excluded based on survey effort conducted.
Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
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Pultenaea villifera	Pultenaea villifera Sieber ex DC. population in the Blue Mountains local government area	E		Patchy distribution across NSW. The known population of P. vilifera occurs in the Blue Mountains LGA from a few small sites in the Springwood-Woodford Area including the Blue Mountains National Park (OEH 2013). Grows in dry sclerophyll forest and woodlands on sandy soil, preferring sheltered spots (OEH 2013).	1 record within 10km (OEH 2015a)	Unlikely	Suitable soil types and geomorphology not present.
Rhizanthella slateri	Eastern Underground Orchid	V	Е	The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available (OEH 201). Currently known only from 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Flowers during October and November (Harden 1993).	Predicted to occur within 10km (DotE 2015a)	Possible	Suitable habitat present and a small, cryptic species that may not have been detected in field surveys
Streblus pendulinus	Siah's Backbone, Sia's Backbone, Isaac Wood		E	On the Australian mainland, Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well- developed rainforest, gallery forest and drier, more seasonal rainforest (ATRP 2010).On Norfolk Island, the species is found in a variety of forest types, though it is rare (DNP 2010).	Predicted to occur within 10km (DotE 2015a)	Unlikely	Suitable soil types and geomorphology not present.
Tetratheca glandulosa	Glandular Pink-bell	V	V	Restricted to The Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong LGAs. Associated with shale-sandstone transition habitat (shale-cappings over sandstone). Occupies ridgetops, upper- slopes and to a lesser extent mid-slope sandstone benches. Soils generally shallow, yellow, clayey/sandy loam, commonly with lateritic fragments. Vegetation varies from	Predicted to occur within 10km (DotE 2015a)	Unlikely	Suitable soil types and geomorphology not present.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
				heath to open forest and is broadly equivalent to Sydney Sandstone Ridgetop Woodland community.			
Thelymitra sp. Kangaloon (D.L.Jones 18108)	Kangaloon Sun-orchid		CE	Only known from three locations near Robertson in the Southern Highlands. Grows in seasonally swampy sedgeland on grey silty clay loam at 600–700 m above sea level. Flowers in late October and early November.	Predicted to occur within 10km (DotE 2015a)	Nil	Suitable soil types and geomorphology not present and outside of known range.
Zieria murphyi	Velvet Zieria	V	V	Found in the Blue Mountains at Mt Tomah and on the southern tablelands where it has been recorded in Morton National Park in the Bundanoon area. Grows in gullies in dry sclerophyll forest with sandy soil. Associated species include <i>Eucalyptus</i> <i>stricta</i> , <i>Dillwynia sericea</i> and <i>Lomandra</i> <i>longifolia</i> .	1 record within 10km (OEH 2015a)	Unlikely	Suitable soil types and geomorphology not present.

All information in this table is taken from NSW OEH and Commonwealth DotE Threatened Species profiles (OEH, 2013a; DotE 2013a) unless otherwise stated. The codes used in this table are: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population; CEEC – Critically Endangered Ecological Community; EEC – Endangered Ecological Community.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Birds							
Anthochaera phrygia	Regent Honeyeater	CE	CE	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra- Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	3 records within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Possible	Suitable habitat present within site
Artarmus cyanopterus	Dusky Woodswallow	V		The Dusky Woodswallow is widespread from the coast to inland, including the western slopes of the Great Dividing Range and farther west. It is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. Dusky Woodswallows prefer larger remnants over smaller remnants.	Recent listing under the TSC Act.	Possible	Suitable habitat present within site
Botaurus poiciloptilus	Australasian Bittern	E	E	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly Typha spp.and Eleocharis spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at	1 record within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Possible	Suitable habitat present within the site but not within the development footprint.

Appendix Table 2 Threatened fauna known or predicted from the locality, habitat association and likelihood of occurring at the site.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
				night on frogs, fish, yabbies, spiders, insects and snails.			
Burhinus grallarius	Bush Stone- curlew	E		Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory (OEH 2013).	1 record within 10km (OEH 2015a), last recorded 1996	Unlikely	Suitable habitat not present within the site
Callocephalon fimbriatum	Gang-gang Cockatoo	V		This species is nomadic, spending summer in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests and winter at lower altitudes in drier more open eucalypt forest and woodlands, particularly in coastal areas. This species nests in hollow-bearing trees close to water with breeding taking place between October and January. Breeding usually occurs in tall mature sclerophyll forests that have a dense understorey, and occasionally in coastal forests.	12 records within 10km (OEH 2015a)	Likely	Recorded in habitat adjoining the site. Suitable habitat present at the site.
Calyptorhynchus Iathami	Glossy Black- Cockatoo	V		Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).	1 record within 10km (OEH 2015a)	Likely	Recorded in habitat adjoining the site. Suitable habitat present at the site.
Chthonicola sagittata	Speckled Warbler	V		Within NSW most frequently reported from the hills and tablelands of the Great Dividing Range, rarely from the coast. Inhabits a wide	2 records within 10km (OEH 2015a)	Possible	Suitable habitat present within site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
				range of Eucalyptus-dominated communities with a grassy understorey, a sparse shrub layer, often on rocky ridges or in gullies. Sedentary and requires large, relatively undisturbed remnants to persist in an area. Forages on the ground for seeds and insects, and nests in a slight hollow in the ground or at the base of a low dense plant.			
Daphoenositta chrysoptera	Varied Sittella	V		Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	13 records within 10km (OEH 2015a); Recorded within site (Birdata 2013)	Likely	Recorded in habitat adjoining the site. Suitable habitat present at the site.
Ephippiorhynchus asiaticus	Black-necked Stork	Ε		In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north- east. Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. Breeds during summer, nesting in or near a freshwater swamp.	1 record within 10km (OEH 2015a), last recorded 1994	Unlikely	Infrequently occurs in the Sydney region.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Glossopsitta pusilla	Little Lorikeet	V		Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands Eucalyptus albens and E. melliodora are particularly important food sources for pollen and nectar respectively. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts, especially Eucalyptus viminalis, E. blakelyi and E. dealbata. Most breeding records are from the western slopes.	1 record within 10km (OEH 2015a), last recorded 2005	Possible	Suitable habitat present within site
Haliaeetus Ieucogaster	White-bellied Sea-eagle	V		Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	Recent listing under the TSC Act	Possible	Suitable habitat present within site
Ixobrychus flavicollis	Black Bittern	V		Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	1 record within 10km (OEH 2015a), last recorded 1995	Possible	Suitable habitat present within site but not within the development footprint.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Lathamus discolor	Swift Parrot	E	E	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box- ironbark communities on the inland slopes and plains. <i>Eucalyptus robusta, Corymbia</i> <i>maculata</i> and <i>C. gummifera dominated</i> coastal forests are also important habitat.	6 records within 10km (OEH 2015a); Predicted within 10km(DotE 2015)	Possible	Suitable habitat present within site
Limosa limosa	Black-tailed Godwit	V	M; C,J,K	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.	1 record within 10km (OEH 2015a), last recorded 1982	Possible	Suitable habitat present within the site
Lophoictinia isura	Square-tailed Kite	V		Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box- ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature	5 records within 10km (OEH 2015a)	Possible	Suitable habitat present within site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
				living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km ² .			
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V		Considered a sedentary species, but local seasonal movements are possible. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Nests on low, live or dead forks or branches of trees or stumps, or occasionally on fallen trees or limbs.	1 record within 10km (OEH 2015a)	Likely	Recorded in habitat adjoining the site. Suitable habitat present at the site.
Neophema pulchella	Turquoise Parrot	V		Occurs from coast to inland slopes. In coastal area, most common between Hunter and Northern Rivers, and further south in S Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat. Nests in tree hollows, logs or posts from August to December.	1 record within 10km (OEH 2015a), last recorded 1982	Possible	Suitable habitat present within site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Ninox connivens	Barking Owl	V		Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including Eucalyptus camaldulensis, Eucalyptus albens, Eucalyptus polyanthemos and Eucalyptus blakelyi. Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	1 record within 10km (OEH 2015a), last recorded 2002	Possible	Suitable habitat present within site
Ninox strenua	Powerful Owl	V		Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas.	8 records within 10km (OEH 2015a)	Possible	Suitable foraging habitat in the site
Petroica boodang	Scarlet Robin	V		In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.	1 record within 10km (OEH 2015a), last recorded 1998	Possible	Suitable habitat present within site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Petroica phoenicea	Flame Robin	V		Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.	3 records within 10km (OEH 2015a)	Possible	Suitable habitat present within site
Rostratula australis	Australian Painted Snipe	E	V,M	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Predicted within 10km (DotE 2015)	Possible	Suitable habitat present within site
Stagonopleura guttata	Diamond Firetail	V		Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in shrubby understorey or higher up under nests of other species.	1 record within 10km (OEH 2015a), last recorded 1990	Possible	Suitable habitat present within site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Tyto novaehollandiae	Masked Owl	V		Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.	12 records within 10km (OEH 2015a)	Possible	Suitable foraging habitat in the site
Tyto tenebricosa	Sooty Owl	V		Occurs in the coastal, escarpment and tablelands regions of NSW. More common in the north and absent from the western tablelands and further west. Inhabits tall, moist eucalypt forests and rainforests, and are strongly associated with sheltered gullies, particularly those with tall rainforest understorey. Roosts in tree hollows, amongst dense foliage in gullies or in caves, recesses or ledges of cliffs or banks. Nest in large (>40cm wide, 100cm deep) tree hollows in unlogged/unburnt gullies within 100m of streams or in caves.	1 record within 10km (OEH 2015a), last recorded 2003	Possible	Suitable foraging habitat in the site
Mammals							
Cercartetus nanus	Eastern Pygmy- possum	V		Occurs along the east coast of NSW, and inland to the Pillaga, Dubbo, Parkes and Wagga Wagga. Inhabits range of habitats from coastal heath and woodland though open and closed forests, subalpine heath and rainforest (Tulloch and Dickman 1995). Inhabits rainforest, sclerophyll forests and heath. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting development footprints in drier habitats. Diet mostly pollen and nectar from Banksia spp., Eucalyptus spp., Callistemon spp. and insects (Ward and Turner 2008). Nests in hollows in trees, under the bark of	1 record within 10km (OEH 2015a), last recorded 2004	Unlikely	Limited foraging habitat in the site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
				Eucalypts, forks of tea-trees, abandoned bird nests and Xanthorrhoea bases (Ward and Turner 2008, Tulloch and Dickman 2006).			
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Hoye and Schulz 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds (Churchill 2008). In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	5 records within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Possible	Suitable foraging habitat in the site
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub- alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.	7 records within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Possible	Suitable foraging habitat in the site
Miniopterus australis	Little Bentwing- bat	V		Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats (Churchill 2008, Hoye and Hall 2008)	1 record within 10km (OEH 2015a), last recorded 2012	Possible	Suitable foraging habitat in the site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man- made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).	11 records within 10km (OEH 2015a)	Possible	Suitable foraging habitat in the site
Mormopterus norfolkensis	Eastern Freetail-bat	V		Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark (Churchill 2008).	6 records within 10km (OEH 2015a)	Possible	Suitable foraging habitat and potential roost sites in site
Myotis macropus	Southern Myotis	V		Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow- bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008)	9 records within 10km (OEH 2015a)	Possible	Suitable foraging habitat and potential roost sites in the site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Petauroides volans	Greater Glider		V	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Recent listing under the TSC Act	Possible	Suitable foraging habitat and breeding habitat in site
Petaurus australis	Yellow-bellied Glider	V		Occurs along the east coast to the western slopes of the Great Dividing Range. Inhabits a variety of forest types but prefers tall mature eucalypt forest with high rainfall and rich soils. Relies on large hollow-bearing trees for shelter and nesting, with family groups of 2-6 typically denning together. In southern NSW its preferred habitat at low altitudes is moist gullies and creek flats in mature coastal forests. Mostly feeds on sap, nectar and honeydew.	7 records within 10km (OEH 2015a)	Unlikely	Preferred tall, moist forest foraging habitat not present and probably too few hollow-bearing trees to maintain a local population.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	1 record within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Nil	No suitable rocky escarpment habitat
Phascolarctos cinereus	Koala	V	V	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat guality, from < 2 to several hundred hectares.	19 records within 10km (OEH 2015a); Predicted within 10km (DotE 2015a	Possible	Suitable foraging habitat in the site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE mainland)	V	V	Restricted to east of the Great Dividing Range, with annual rainfall >760 mm. Inhabits coastal heath and dry and wet sclerophyll forests. Requires relatively thick ground cover and appears restricted to areas of light and sandy soil (Johnston 2008). Feeds on fungi, roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.	Predicted within 10km (DotE 2015)	Unlikely	No suitable coastal forest with sandy soils
Pseudomys novaehollandiae	New Holland Mouse, Pookila		V	Restricted to east of the Great Dividing Range, with annual rainfall >760 mm. Inhabits coastal heath and dry and wet sclerophyll forests. Requires relatively thick ground cover and appears restricted to areas of light and sandy soil (Johnston 2008). Feeds on fungi, roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.	Predicted within 10km (DotE 2015)	Unlikely	Preferred forest on sandy soils with thick groundcover are not present
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	14 records within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Possible	Suitable foraging habitat in the site.
Scoteanax rueppellii	Greater Broad- nosed Bat	V		Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable	3 records within 10km (OEH 2015a)	Possible	Suitable foraging habitat and potential roost sites in the site

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
				hollow trees (Hoye and Richards 2008, Churchill 2008).			
Reptiles							
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Predicted within 10km (DotE 2015)	Nil	Preferred rocky escarpment habitat not present.
Frogs							
Heleioporus australiacus	Giant Burrowing Frog	V	V	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	Predicted within 10km (DotE 2015)	Unlikely	Preferred ridgetop habitats on sandy soils not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Litoria aurea	Green and Golden Bell Frog	E	V	Formerly occurred from Brunswick Heads to victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (Typha spp.) or spike rushes (Eleocharis spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. Gambusia holbrooki is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.	1 record within 10km (OEH 2015a); Predicted within 10km (DotE 2015)	Possible	Suitable foraging habitat and potential breeding habitat in the site
Litoria littlejohni	Littlejohn's Tree Frog, Heath Frog	V	V	Occurs on plateaus and eastern slopes of the Great Dividing Range south from Watagan State Forest. Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops, hunting either in shrubs or on the ground.	Predicted within 10km (DotE 2015)	Unlikely	Preferred rocky stream habitats on slopes and plateaus not present
Mixophyes balbus	Stuttering Frog, Southern Barred Frog (in Victoria)	E	V	Occurs along the east coast of Australia. Has undergone a massive range reduction particularly in the south of its range: within the Sydney Basin, White (2008a) located only 3 populations south of Sydney (Macquarie Pass and Mt Werong) and Daly et al. (2002, in White 2008a) found only 2 extant populations between Macquarie Pass and Victoria. Inhabits rainforest and wet, tall, open forest. Shelter in deep leaf litter and thick understorey vegetation on the forest floor. Feeds on insects and smaller frogs, breeding in streams during summer after heavy rain. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts (Mahony et al 1997).	Predicted within 10km (DotE 2015)	Unlikely	Preferred rocky stream habitats in rainforest not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Mixophyes iteratus	Giant Barred Frog, Southern Barred Frog	E	Ε	Occurs on the coast and ranges from south- eastern QLD to the Hawkesbury River in NSW, particularly in Coffs Harbour - Dorrigo area. Forage and live amongst deep, damp leaf litter in rainforest, moist eucalypt forest and nearby dry eucalypt forest. Breed in shallow, flowing rocky streams. Within Sydney Basin, confined to small populations in tall, wet forest in the Watagan Mountains north of the Hawkesbury and the lower Blue Mountains (White 2008b).	Predicted within 10km (DotE 2015)	Unlikely	Preferred rocky stream habitats in rainforest not present
Pseudophryne australis	Red-crowned Toadlet	V		Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	14 records within 10km (OEH 2015a)	Unlikely	Preferred ridgetop habitats on sandy soils not present
Fish							
Macquaria australasica	Macquarie Perch	V	E	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas.Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	Predicted within 10km (DotE 2015); Found in the Hawkesbury/Nepean CMA	Unlikely	Preferred clear, deep, rocky streams are not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Prototroctes maraena	Australian Grayling		V,M	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse et al 2008).	Predicted within 10km (DotE 2015)	Unlikely	Preferred clear, rocky streams are not present
Invertebrates							
Archaeophya adamsi	Adam's emerald dragonfly	E (FM Act)		The species is only known from a few sites in the greater Sydney region. Larvae have been found in small creeks with gravel or sandy bottoms, in narrow, shaded riffle zones with moss and rich riparian vegetation. Adult dragonflies generally fly away from the water to mature before returning to breed. Males congregate at breeding sites and often guard a territory. Females probably lay their eggs into the water.	Found in the Hawkesbury/Nepean CMA (DPI 2015)	Unlikely	Preferred shady, gravel streams are not present
Austrocordulia leonardi	Sydney Hawk Dragonfly	E (FM Act)		The Sydney hawk dragonfly has a very restricted distribution. The known distribution of the species includes three locations in a small area south of Sydney, from Audley to Picton. The species is known from the Hawkesbury-Nepean, Georges River, Port Hacking and Karuah drainages. The Sydney hawk dragonfly has specific habitat requirements, and has only ever been collected from deep and shady riverine pools with cooler water. Larvae are found under rocks where they co-exist with Austrocordulia refracta.	Found in the Hawkesbury/Nepean CMA (DPI 2015)	Unlikely	Preferred deep, clear streams are not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site	Notes
Meridolum corneovirens	Cumberland Plain Land Snail	E		Occurs within a small area of the Cumberland Plain, from Richmond and Windsor to Picton. Found primarily under litter of bark, leaves and logs, or in loose soil around grass clumps within Cumberland Plain Woodland. Has also been found under rubbish. Feeds on fungus. During periods of drought can burrow into the soil to escape the dry conditions.	51 records within 10km (OEH 2015a)	Present	Live individuals and shells recorded at the site and in adjacent habitat.

Notes:

Marine and littoral threatened species (particularly shorebirds) which are restricted to coastal or estuarine environments were excluded from the threatened biota table. Wildlife Atlas records: only records from 1980 or later were considered. The date of the last record is included for any species which have not been recorded within the last 20 years.

All information in this table is taken from NSW OEH and Commonwealth DotE Threatened Species profiles (OEH, 2013a; DotE 2013b) unless otherwise stated. The codes used in this table are: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population; CEEC – Critically Endangered Ecological Community; EEC – Endangered Ecological Community.

Appendix Table 3	Candidate	threatened	species a	nd survey	time matrix
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									GHD survey					GHD surve		GHD surve		GHD surve			
														У		У		У			
Kingdom	Common name	Scientific name	Credit type	Predict ed by Credit calculat or	BioNe t recor ds in localit y	Date of most BioNet recent record	Predi cted by PMS T	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Poten tial habita t at site ?	Rec orde d at site ?
Flora	Acacia gordonii	Acacia gordonii	Species	Y	0	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Ancistrachne maidenii	Ancistrachne maidenii	Species	Y	0	n/a	N	Yes	Yes										Yes	No	
Fauna-birds	Black Bittern	lxobrychus flavicollis	Species	Y	0	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-frogs	Booroolong Frog	Litoria booroolongen sis	Species	Y	0	n/a	N	Yes	Yes									Yes	Yes	No	
Fauna-reptiles	Broad-headed Snake	Hoplocephalu s bungaroides	Species	Y	0	n/a	Y			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		No	
Flora	Brown Pomaderris	Pomaderris brunnea	Species	Y	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Brush-tailed Phascogale	Phascogale tapoatafa	Species	Y	0	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Flora	Bynoe's Wattle	Acacia bynoeana	Species	Y	0	n/a	Y	Yes	Yes	Yes						Yes	Yes	Yes	Yes	Yes	
Fauna-insects	Cumberland Plain Land Snail	Meridolum corneovirens	Species	Y	83	25/09/20 15	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Flora	Deane's Paperbark	Melaleuca deanei	Species	Y	3	12/08/20 12	Y	Yes	Yes										Yes	No	
Flora	Dillwynia tenuifolia	Dillwynia tenuifolia	Species	Y	4	8/09/200 8	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Downy Wattle	Acacia pubescens	Species	Y	0	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Fauna- mammals	Eastern Pygmy- possum	Cercartetus nanus	Species	Y	1	23/01/20 04	N													No	
Flora	Flockton Wattle	Acacia flocktoniae	Species	Y	0	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Fauna-frogs	Giant Burrowing Frog	Heleioporus australiacus	Species	Y	1	n/a	Y	Yes	Yes	Yes	Yes	Yes				Yes	Yes	Yes	Yes	No	
Fauna-frogs	Green and Golden Bell Frog	Litoria aurea	Species	Y	0	n/a	Y	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes	Yes	
Flora	Hairy Geebung	Persoonia hirsuta	Species	Y	0	n/a	Y	Yes	Yes	Yes	Yes	Yes							Yes	Yes	

									GHD					GHD		GHD		GHD			
									Survey					y y		y y		y y			
Flora	Hibbertia puberula	Hibbertia puberula	Species	Y	0	n/a	N	Yes	Yes							Yes	Yes	Yes	Yes	No	
Fauna- mammals	Koala	Phascolarctos cinereus	Species	Y	6	27/04/20 16	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Flora	Leucopogon fletcheri subsp. fletcheri	Leucopogon fletcheri subsp. fletcheri	Species	Y	0	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Marsdenia viridiflora subsp. viridiflora - endangered population	Species	Y	17	23/03/20 15	Ν	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Flora	Micromyrtus minutiflora	Micromyrtus minutiflora	Species	Y	2	15/07/20 14	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Flora	Olearia cordata	Olearia cordata	Species	Y	0	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Pultenaea villifera population in the Blue Mountains Local Government Area	Pultenaea villifera - endangered population	Species	Y	0	n/a	Ν	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Fauna-frogs	Red-crowned Toadlet	Pseudophryne australis	Species	Y	21	7/12/201 5	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Fauna-birds	Regent Honeyeater	Anthochaera phrygia	Species	Y	1	17/12/20 09	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-reptiles	Rosenberg's Goanna	Varanus rosenbergi	Species	Y	0	n/a	N	Yes	Yes									Yes	Yes	Yes	
Flora	Slaty Leek Orchid	Prasophyllum fuscum	Species	Y	0	n/a	Ν									Yes	Yes	Yes	Yes	No	
Flora	Small Pale Grass-lily	Caesia parviflora subsp. minor	Species	Y	0	n/a	Ν	Yes	Yes							Yes	Yes	Yes	Yes	No	
Flora	Small-flower Grevillea	Grevillea parviflora subsp. parviflora	Species	Y	0	n/a	Ν	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

									GHD					GHD		GHD		GHD			
									survey					surve v		surve v		surve v			
Fauna- mammals	Squirrel Glider	Petaurus norfolcensis	Species	Y	0	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Flora	Velleia perfoliata	Velleia perfoliata	Species	Y	0	n/a	Ν									Yes	Yes	Yes		No	
Flora	Woronora Beard- heath	Leucopogon exolasius	Species	Y	0	n/a	Ν	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Australasian Bittern	Botaurus poiciloptilus	Species	Ν	1	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Grey-headed Flying-fox	Pteropus poliocephalus	Species	Ν	15	11/12/20 13	Y	Yes	Yes	Yes	Yes	Yes				Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Little Bentwing- bat	Miniopterus australis	Species	Ν	1	13/03/20 12	Ν	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Eastern Bentwing-bat	Miniopterus schreibersii oceanensis	Species	N	13	29/03/20 16	N	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Southern Myotis	Myotis macropus	Species	Ν	11	29/04/20 14	Ν	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes	
Flora	Pultenaea parviflora	Pultenaea parviflora	Species	Ν	3	12/09/20 08	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Camden White Gum	Eucalyptus benthamii	Species	Ν	20	1/10/201 5	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Flora	Juniper-leaved Grevillea	Grevillea juniperina subsp. juniperina	Species	Ν	2	8/09/200 8	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Flora	Spiked Rice- flower	Pimelea spicata	Species	Ν	1	6/01/200 5	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Fauna-birds	Speckled Warbler	Chthonicola sagittata	Ecosyste m	Y	5	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Square-tailed Kite	Lophoictinia isura	Ecosyste m	Y	5	28/01/20 16	Ν	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Dusky Woodswallow	Artamus cyanopterus cyanopterus	Ecosyste m	N	4	29/04/20 14	Ν	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Gang-gang Cockatoo	Callocephalon fimbriatum	Ecosyste m	Y	7	29/12/20 15	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Glossy Black- Cockatoo	Calyptorhynch us lathami	Ecosyste m	Y	8	11/12/20 13	Ν	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Diamond Firetail	Stagonopleura guttata	Ecosyste m	Y	1	n/a	Ν	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Varied Sittella	Daphoenositta chrysoptera	Ecosyste m	Y	18	5/06/201 5	Ν	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	Ecosyste m	Y	1	9/11/200 4	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

									GHD					GHD		GHD		GHD			
									survey					surve		surve		surve			
Fauna-birds	Scarlet Robin	Petroica	Ecosyste	V	1	n/a	N	Vos	Ves	Ves	Ves	Ves	Ves	y Vos	Ves	y Vos	Vos	y Ves	Ves	Ves	
T auria-birus	Scallet Robin	boodang	m	1	1	n/a	IN	165	165	165	165	165	165	165	165	165	165	165	165	165	
Fauna-birds	Flame Robin	Petroica phoenicea	Ecosyste m	Y	3	4/06/200 1	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Little Lorikeet	Glossopsitta pusilla	Ecosyste m	Y	1	12/01/20 05	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Swift Parrot	Lathamus discolor	Ecosyste m	Y	5	16/09/20 08	Y						Yes	Yes	Yes					Yes	
Fauna-birds	Barking Owl	Ninox connivens	Ecosyste m	Y	1	n/a	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Powerful Owl	Ninox strenua	Ecosyste m	Y	11	9/09/201 5	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Masked Owl	Tyto novaehollandi ae	Ecosyste m	Y	10	4/06/200 1	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Sooty Owl	Tyto tenebricosa	Ecosyste m	Y	3	9/09/201 5	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Spotted-tailed Quoll	Dasyurus maculatus	Ecosyste m	Y	6	3/10/201 0	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Eastern Freetail- bat	Mormopterus norfolkensis	Ecosyste m	Y	6	17/12/20 13	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Yellow-bellied Glider	Petaurus australis	Ecosyste m	Y	8	12/10/20 04	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Greater Glider	Petauroides volans	Species	Ν	2	12/10/20 04	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Large-eared Pied Bat	Chalinolobus dwyeri	Ecosyste m	Ν	4	24/03/20 03	Y	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Eastern False Pipistrelle	Falsistrellus tasmaniensis	Ecosyste m	Y	1	29/03/20 16	Ν	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes	
Fauna- mammals	Greater Broad- nosed Bat	Scoteanax rueppellii	Ecosyste m	Y	4	29/04/20 14	N	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes	No	
Fauna-birds	Curlew Sandpiper	Calidris ferruginea	n/a	N	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Fauna-birds	Eastern Bristlebird	Dasyornis brachypterus	n/a	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Fauna-birds	Painted Honeyeater	Grantiella picta	n/a	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Fauna-birds	Eastern Curlew	Numenius madagascarie nis	n/a	N	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-birds	Australian Painted Snipe	Rostratula australis	n/a	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Fauna-frogs	Littlejohn's Tee Frog	Litoria littlejohni	n/a	Ν	0	n/a	Y	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes	No	
Fauna-frogs	Stuttering Frog	Mixophyes balbus	n/a	Ν	0	n/a	Y	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes	No	

									GHD					GHD		GHD		GHD			
									survey					surve		surve		surve			
														У		У		У			
Fauna- mammals	New Holland Mouse	Pseudomys novaehollandi ae	n/a	N	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fauna-insects	Dural Land Snail	Pommerhelix duralensis	n/a	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Flora	Allocasuarina glareicola	Allocasuarina glareicola	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Asterolasia elegans	Asterolasia elegans	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Leafless Tongue Orchid	Cryptostylis hunteriana	Species	Ν	0	n/a	Y	Yes	Yes									Yes	Yes	No	
Flora	White-flowered Wax Plant	Cynanchum elegans	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Black Gum	Eucalyptus aggregata	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Yellow Gnat Orchid	Genoplesium baueri	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Wingless Raspwort	Haloragis exalata subsp. exalata	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Omeo Stork's-bill	Pelargonium sp. Striatellum	Species	N	0	n/a	Y									Yes	Yes	Yes	No	No	
Flora	Needle Geebung	Persoonia acerosa	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Pimelea curviflora var. curviflora	Pimelea curviflora var. curviflora	Species	N	0	n/a	Y									Yes	Yes	Yes		No	
Flora	Sydney Plains Greenhood	Pterostylis saxicola	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Smooth Bush- pea	Pultenaea glabra	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Flora	Eastern Underground Orchid	Rhizanthelal slateri	Species	Ν	0	n/a	Y		Yes	Yes										No	
Flora	Magenta Lilly Pilly	Syzygium paniculatum	Species	Ν	0	n/a	Y		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	
Flora	Kangaloon Sun Orchid	Thelymitra kangaloonica	Species	Ν	0	n/a	Y	Yes	Yes	Yes	Yes	Yes				Yes	Yes	Yes	Yes	Yes	
Flora	Austral Toadflax	Thesium australe	Species	Ν	0	n/a	Y										Yes	Yes		Yes	

Appendix B – Field survey data

Appendix Table 4 Flora species recorded in the Fernhill Western Precinct plot/transects

Family name	Scientific name	Common Name	Plot 9 Cover Abundance	Plot 15 Cover Abundance	Plot 25 Cover	Plot 25 Abundance
Acanthaceae	Brunoniella australis	Blue Trumpet			1	1
Adiantaceae	Cheilanthes sieberi subsp. sieberi	Rock Fern	2	2		
Anthericaceae	Laxmannia gracilis	Slender Wire Lily			1	1
Apiaceae	Centella asiatica	Indian Pennywort		2		
Asteraceae	Cirsium vulgare	Spear Thistle			1	1
Asteraceae	Conyza bonariensis	Flaxleaf Fleabane		1	1	10
Asteraceae	Gamochaeta americana	Cudweed	2			
Asteraceae	Hypochaeris radicata	Catsear	1	2		
Asteraceae	Senecio madagascariensis	Fireweed	1	2	1	20
Asteraceae	Sonchus oleraceus	Common Sowthistle		1		
Clusiaceae	Hypericum gramineum	Small St John's Wort		2		
Convolvulaceae	Polymeria calycina				1	1
Cyperaceae	Gahnia aspera	Rough Saw-sedge			1	10
Cyperaceae	Schoenus sp.			2		
Dilleniaceae	Hibbertia aspera	Rough Guinea Flower	2	2	10	20
Dilleniaceae	Hibbertia diffusa	Wedge Guinea Flower			1	5
Dilleniaceae	Hibbertia pedunculata		2			
Droseraceae	Drosera peltata	A Sundew		2		
Droseraceae	Drosera spatulata		1			
Fabaceae (Faboideae)	Glycine microphylla	Small-leaf Glycine		2	1	10
Fabaceae (Faboideae)	Glycine tabacina	Variable Glycine			1	20
Fabaceae (Faboideae)	Pultenaea retusa			2		
Fabaceae (Mimosoideae)	Acacia elongata	Swamp Wattle		1		
Fabaceae (Mimosoideae)	Acacia longissima	Long-leaf Wattle		1		
Fabaceae (Mimosoideae)	Acacia parramattensis	Parramatta Wattle	1	2	1	5
Gentianaceae	Centaurium erythraea	Common Centaury		1	1	5
Goodeniaceae	Goodenia bellidifolia		3	1		
Haloragaceae	Gonocarpus tetragynus	Poverty Raspwort		2	1	5
Juncaceae	Juncus usitatus			2	1	5
Lobeliaceae	Pratia purpurascens	Whiteroot			1	10

Family name	Scientific name	Common Name	Plot 9 Cover Abundance	Plot 15 Cover Abundance	Plot 25 Cover	Plot 25 Abundance
Lomandraceae	Lomandra longifolia	Spiny-headed Mat-rush		1		
Lomandraceae	Lomandra multiflora subsp. multiflora	Many-flowered Mat-rush		1	1	5
Malvaceae	Sida rhombifolia	Paddy's Lucerne			1	10
Myrtaceae	Callistemon pinifolius	Pine-leaved Bottlebrush		2		
Myrtaceae	Eucalyptus crebra	Narrow-leaved Ironbark		1	10	1
Myrtaceae	Eucalyptus punctata	Grey Gum	1		5	10
Myrtaceae	Eucalyptus sclerophylla	Hard-leaved Scribbly Gum		3		
Myrtaceae	Eucalyptus sp.			1		
Myrtaceae	Kunzea ambigua	Tick Bush			5	10
Myrtaceae	Leptospermum polygalifolium	Tantoon	4	5	60	100
Myrtaceae	Melaleuca linariifolia	Flax-leaved Paperbark		4		
Myrtaceae	Melaleuca thymifolia	Thyme Honey-myrtle		3		
Oxalidaceae	Oxalis perennans			1		
Plantaginaceae	Plantago lanceolata	Lamb's Tongues	1		1	20
Poaceae	Andropogon virginicus	Whisky Grass		2		
Poaceae	Aristida ramosa	Purple Wiregrass		1		
Poaceae	Aristida vagans	Threeawn Speargrass	1			
Poaceae	Axonopus compressus	Broad-leaved Carpet Grass	5	3		
Poaceae	Cymbopogon refractus	Barbed Wire Grass		2	1	5
Poaceae	Cynodon dactylon	Common Couch	2			
Poaceae	Dichelachne crinita	Longhair Plumegrass	1	2		
Poaceae	Entolasia stricta	Wiry Panic		2	10	100
Poaceae	Eragrostis brownii	Brown's Lovegrass	1	1	20	100
Poaceae	Imperata cylindrica	Blady Grass	2	2		
Poaceae	Microlaena stipoides var. stipoides	Weeping Grass	2	3	30	100
Poaceae	Panicum simile	Two-colour Panic		1		
Poaceae	Setaria parviflora				10	50
Poaceae	Themeda australis	Kangaroo Grass	3	1	20	100
Poaceae	<i>Setaria</i> sp.		1			
Poaceae	Briza subaristata		1			
Proteaceae	Persoonia lanceolata	Lance Leaf Geebung		1		

Family name	Scientific name	Common Name	Plot 9 Cover Abundance	Plot 15 Cover Abundance	Plot 25 Cover	Plot 25 Abundance
Proteaceae	Persoonia linearis	Narrow-leaved Geebung		2		
Ranunculaceae	Ranunculus sp.			1		
Rubiaceae	<i>Opercularia</i> sp.			1		
Rubiaceae	Opercularia aspera	Coarse Stinkweed	1			
Thymelaeaceae	Pimelea linifolia subsp. Linifolia		1	2		
Verbenaceae	Verbena bonariensis	Purpletop			1	10
Xanthorrhoeaceae	Xanthorrhoea minor			2		
Rutaceae	Boronia polygalifolia	Dwarf Boronia	2			
Orchidaceae	Microtis sp.		1			

Notes:

Cover abundance data was recorded using the Braun-Blanquet scale. Cover abundance rankings:

Foliage sparsely or very sparsely present, cover less than 5%
2- 1-5% Plentiful, foliage cover 1-5 %
3- 5-25% foliage cover
4- 26-50% foliage cover
5 51-75% foliage cover

Cover and abundance were recorded separately in accordance with the BBAM 2014.

Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5% Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only.

Appendix Table 5 Flora species recorded at the site

Family	Scientific Name	Common Name	Exotic
Acanthaceae	Brunoniella australis	Blue Trumpet	
Adiantaceae	Cheilanthes sieberi subsp. sieberi	Rock Fern	
Apiaceae	Centella asiatica	Indian Pennywort	
Apiaceae	Hydrocotyle tripartita	Pennywort	
Apiaceae	Hydrocotyle sp.		*
Apiaceae	Hydrocotyle laxiflora	Stinking Pennywort	
Asteraceae	Bidens pilosa	Cobbler's Pegs	*
Asteraceae	Cassinia uncata	Sticky Cassinia	
Asteraceae	Cirsium vulgare	Spear Thistle	*
Asteraceae	Hypochaeris radicata	Catsear	*
Asteraceae	Senecio madagascariensis	Fireweed	*
Asteraceae	Sonchus oleraceus	Common Sowthistle	*
Asteraceae	Vittadinia cuneata	A Fuzzweed	
Asteraceae	Lagenifera stipitata	Blue Bottle-daisy	
Asteraceae	Gamochaeta americana	Cudweed	*
Asteraceae	Euchiton sphaericus	Star Cudweed	
Asteraceae	Gamochaeta sp.		*
Asteraceae	Glossocardia bidens	Cobbler's Tack	
Asteraceae	Hypochaeris glabra	Smooth Catsear	*
Campanulaceae	Wahlenbergia gracilis	Sprawling Bluebell	
Casuarinaceae	Allocasuarina littoralis	Black She-Oak	
Casuarinaceae	Allocasuarina torulosa	Forest Oak	
Clusiaceae	Hypericum gramineum	Small St John's Wort	
Convolvulaceae	Dichondra repens	Kidney Weed	
Convolvulaceae	Polymeria calycina		
Cyperaceae	Eleocharis sphacelata	Tall Spike Rush	
Cyperaceae	Gahnia aspera	Rough Saw-sedge	
Cyperaceae	Carex inversa	Knob Sedge	
Cyperaceae	Cyperus haspan		
Dilleniaceae	Hibbertia aspera	Rough Guinea Flower	
Dilleniaceae	Hibbertia pedunculata		
Dilleniaceae	Hibbertia diffusa	Wedge Guinea Flower	
Droseraceae	Drosera peltata	A Sundew	
Droseraceae	Drosera spatulata		
Ericaceae	Leucopogon muticus	Blunt Beard-heath	
Ericaceae	Lissanthe strigosa	Peach Heath	
Fabaceae (Faboideae)	Daviesia ulicifolia	Gorse Bitter Pea	
Fabaceae (Faboideae)	Glycine clandestina	Twining glycine	
Fabaceae (Faboideae)	Glycine microphylla	Small-leaf Glycine	
Fabaceae (Faboideae)	Glycine tabacina	Variable Glycine	
Fabaceae (Faboideae)	Gompholobium glabratum	Dainty Wedge Pea	
Fabaceae (Faboideae)	Gompholobium pinnatum	Pinnate Wedge Pea	
Fabaceae (Faboideae)	Hardenbergia violacea	False Sarsaparilla	
Fabaceae (Faboideae)	Mirbelia rubiifolia	Heathy Mirbelia	

Family	Scientific Name	Common Name	Exotic
Fabaceae (Faboideae)	Podolobium scandens	Netted Shaggy Pea	
Fabaceae (Faboideae)	Pultenaea tuberculata		
Fabaceae (Faboideae)	Medicago sp.	A Medic	*
Fabaceae (Faboideae)	Pultenaea retusa		
Fabaceae (Faboideae)	Pultenaea linophylla		
Fabaceae (Mimosoideae)	Acacia decurrens	Black Wattle	
Fabaceae (Mimosoideae)	Acacia elongata	Swamp Wattle	
Fabaceae (Mimosoideae)	Acacia implexa	Hickory Wattle	
Fabaceae (Mimosoideae)	Acacia linifolia	White Wattle	
Fabaceae (Mimosoideae)	Acacia parramattensis	Parramatta Wattle	
Fabaceae (Mimosoideae)	Acacia terminalis subsp. angustifolia		
Fabaceae (Mimosoideae)	Acacia ulicifolia	Prickly Moses	
Fabaceae (Mimosoideae)	Acacia falcata		
Fabaceae (Mimosoideae)	Acacia falciformis	Broad-leaved Hickory	
Fabaceae (Mimosoideae)	Acacia brownii	Heath Wattle	
Gentianaceae	Centaurium sp.		*
Gentianaceae	Centaurium erythraea	Common Centaury	*
Goodeniaceae	Goodenia hederacea	Ivy Goodenia	
Goodeniaceae	Goodenia paniculata		
Goodeniaceae	Goodenia bellidifolia		
Haloragaceae	Gonocarpus tetragynus	Poverty Raspwort	
Haloragaceae	Myriophyllum aquaticum	Parrots Feather	*
Juncaceae	Juncus usitatus		
Juncaceae	Juncus sp.	A Rush	
Juncaginaceae	Triglochin microtuberosa		
Lauraceae	Cinnamomum camphora	Camphor Laurel	*
Lobeliaceae	Pratia purpurascens	Whiteroot	
Lomandraceae	Lomandra cylindrica		
Lomandraceae	Lomandra filiformis subsp. coriacea	Wattle Matt-rush	
Lomandraceae	Lomandra filiformis subsp. filiformis		
Lomandraceae	Lomandra longifolia	Spiny-headed Mat-rush	
Lomandraceae	Lomandra multiflora subsp. multiflora	Many-flowered Mat-rush	
Lomandraceae	Lomandra obliqua		
Malvaceae	Sida rhombifolia	Paddy's Lucerne	*
Myrsinaceae	Anagallis arvensis	Scarlet Pimpernel	*
Myrtaceae	Angophora bakeri	Narrow-leaved Apple	
Myrtaceae	Angophora costata	Sydney Red Gum	
Myrtaceae	Corymbia gummifera	Red Bloodwood	
Myrtaceae	Eucalyptus crebra	Narrow-leaved Ironbark	
Myrtaceae	Eucalyptus eugenioides	Thin-leaved Stringybark	
Myrtaceae	Eucalyptus fibrosa	Red Ironbark	
Myrtaceae	Eucalyptus globoidea	White Stringybark	
Myrtaceae	Eucalyptus oblonga		
Myrtaceae	Eucalyptus punctata	Grey Gum	
Myrtaceae	Eucalyptus resinifera subsp. resinifera		
Myrtaceae	Eucalyptus sclerophylla	Hard-leaved Scribbly Gum	
Myrtaceae	Leptospermum polygalifolium	Tantoon	

Family	Scientific Name	Common Name	Exotic
Myrtaceae	Leptospermum trinervium	Slender Tea-tree	
Myrtaceae	Callistemon pinifolius	Pine-leaved Bottlebrush	
Myrtaceae	Melaleuca thymifolia	Thyme Honey-myrtle	
Myrtaceae	Callistemon sp.		
Myrtaceae	Kunzea ambigua	Tick Bush	
Myrtaceae	<i>Eucalyptus</i> sp.		
Myrtaceae	Eucalyptus parramattensis subsp. parramattensis		
Myrtaceae	Callistemon salignus	Willow Bottlebrush	
Myrtaceae	<i>Eucalptus</i> sp.	(blank)	
Myrtaceae	Eucalyptus tereticornis	Forest Red Gum	
Oleaceae	Ligustrum sinense	Small-leaved Privet	*
Orchidaceae	Microtis sp.		
Orchidaceae	Prasophyllum sp.		
Oxalidaceae	Oxalis perennans		
Philydraceae	Philydrum lanuginosum	Frogsmouth	
Phormiaceae	Dianella caerulea var. producta		
Phormiaceae	Dianella revoluta var. revoluta	A Blue Flax Lily	
Phyllanthaceae	Phyllanthus hirtellus	Thyme Spurge	
Phyllanthaceae	Poranthera microphylla	Small Poranthera	
Pittosporaceae	Billardiera scandens	Hairy Apple Berry	
Pittosporaceae	Bursaria spinosa	Native Blackthorn	
Plantaginaceae	Plantago lanceolata	Lamb's Tongues	*
Plantaginaceae	Veronica plebeia	Trailing Speedwell	
Plantaginaceae	Plantago varia		
Poaceae	Andropogon virginicus	Whisky Grass	*
Poaceae	Aristida ramosa	Purple Wiregrass	
Poaceae	Aristida vagans	Threeawn Speargrass	
Poaceae	Austrostipa sp.	A Speargrass	
Poaceae	Briza subaristata		*
Poaceae	Chloris gayana	Rhodes Grass	*
Poaceae	Cymbopogon refractus	Barbed Wire Grass	
Poaceae	Cynodon dactylon	Common Couch	
Poaceae	Dichelachne micrantha	Shorthair Plumegrass	
Poaceae	Echinopogon caespitosus	Bushy Hedgehog-grass	
Poaceae	Echinopogon ovatus	Forest Hedgehog Grass	
Poaceae	Entolasia stricta	Wiry Panic	
Poaceae	Eragrostis brownii	Brown's Lovegrass	
Poaceae	Eragrostis curvula	African Lovegrass	*
Poaceae	Eragrostis leptostachya	Paddock Lovegrass	
Poaceae	Imperata cylindrica	Blady Grass	
Poaceae	Microlaena stipoides var. stipoides	Weeping Grass	
Poaceae	Panicum effusum	Hairy Panic	
Poaceae	Panicum simile	Two-colour Panic	
Poaceae	Setaria sp.		*
Poaceae	Themeda australis	Kangaroo Grass	
Poaceae	Sporobolus creber	Slender Rat's Tail Grass	
Poaceae	Axonopus compressus	Broad-leaved Carpet Grass	*

Family	Scientific Name	Common Name	Exotic
Poaceae	Bothriochloa macra	Red Grass	
Poaceae	Dichelachne crinita	Longhair Plumegrass	
Poaceae	Pennisetum clandestinum	Kikuyu Grass	*
Poaceae	Sporobolus elongatus	Slender Rat's Tail Grass	
Poaceae	Aristida warburgii		
Poaceae	Axonopus fissifolius	Narrow-leafed Carpet Grass	*
Poaceae	Setaria parviflora		*
Proteaceae	Hakea sericea	Needlebush	
Proteaceae	Isopogon anemonifolius	Broad-leaf Drumsticks	
Proteaceae	Persoonia lanceolata	Lance Leaf Geebung	
Proteaceae	Persoonia levis	Broad-leaved Geebung	
Proteaceae	Persoonia linearis	Narrow-leaved Geebung	
Proteaceae	Grevillea mucronulata		
Proteaceae	Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	
Ranunculaceae	Ranunculus muricatus	Sharp Buttercup	*
Restionaceae	Lepyrodia muelleri		
Rhamnaceae	Pomaderris ferruginea		
Rosaceae	Rubus fruticosus sp. agg.	Blackberry complex	*
Rubiaceae	Opercularia aspera	Coarse Stinkweed	
Rubiaceae	Opercularia varia	Variable Stinkweed	
Rubiaceae	Pomax umbellata	Pomax	
Rubiaceae	Opercularia diphylla	Stinkweed	
Santalaceae	Leptomeria acida	Sour Currant Bush	
Sapindaceae	Dodonaea triquetra	Large-leaf Hop-bush	
Stackhousiaceae	Stackhousia sp.		
Thymelaeaceae	Pimelea linifolia subsp. Linifolia		
Verbenaceae	Lantana camara	Lantana	*
Verbenaceae	Verbena bonariensis	Purpletop	*
Verbenaceae	<i>Verbena</i> sp.		*
Xanthorrhoeaceae	Xanthorrhoea media		
Xanthorrhoeaceae	Xanthorrhoea minor		
Sterculiaceae	Lasiopetalum ferrugineum		
Zamiaceae	Macrozamia spiralis		
Polygonaceae	Persicaria decipiens	Slender Knotweed	

Appendix Table 6 Plot/transect data

	Veg Zone ID	Veg Type ID	Condition	Plot ID	Native plant species richnes s	Native over- storey cover	Native mid- storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exoti c plant cove
	1	HN556		Benchmar k	36	18.5- 23.5	13-23	15-21	0-10	15-21	0
	1		Low	6	8	0	0	22	4	0	90
	1		Low	8	14	0	25.5	22	4	6	80
	2	HN556		Benchmar k	36	18.5- 23.5	13-23	15-21	0-10	15-21	0
	2		Moderate/ good - high	2	27	24	0	64	2	8	0
	2		Moderate/ good - high	5	32	19	3	92	8	14	0
	2		Moderate/ good - high	18	24	10	4.5	70	40	12	0
	2		Moderate/ good - high	20	25	10.5	21	100	2	4	18
	2		Moderate/ good - high	21	30	68	17	62	2	26	14
	2		Moderate/ good - high	22	35	43	61.5	88	42	10	10
	2		Moderate/ good - high	23	23	20	31.5	86	14	14	24
	2		Moderate/ good - high	29	32	16	22.5	84	4	20	18
	3	HN556		Benchmar k	36	18.5- 23.5	13-23	15-21	0-10	15-21	0
	3		Moderate / good - poor	7	15	0	8	40	2	8	60
	3		Moderate / good - poor	9	19	0	7.5	40	34	10	46
	3		Moderate / good - poor	17	20	0	34.5	58	54	12	14
	3		Moderate / good - poor	25	22	0	46	46	8	12	60
	3		Moderate / good - poor	31	16	0	28.5	66	0	26	30
	4	HN564		Benchmar k	40	27.5- 32.5	35-45	1-10	8.5- 12.5	14.5- 18.5	0
	4		Moderate/ good	1	34	27	5.5	56	2	18	0
	4		Moderate/ good	10	38	5.5	35	88	22	26	0
	4		Moderate/ good	11	32	26	17	68	16	8	26
	4		Moderate/ good	12	43	10.5	6.5	48	2	16	16
	4		Moderate/ good	26	19	35.5	2	58	2	6	22
	4		Moderate/ good	28	39	33.5	15.5	58	2	14	12
6	5	HN542		Benchmar k	40	10-20	23-33	12-24	0-10	12-24	0

Veg Zone ID	Veg Type ID	Condition	Plot ID	Native plant species richnes s	Native over- storey cover	Native mid- storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exot c plant cove
5		Moderate/ good - medium	19	41	20	27.5	60	92	16	0
5		Moderate/ good - medium	15	38	12.5	17.5	40	50	10	32
5		Moderate/ good - medium	14	24	10.5	28	32	20	6	38
5		Moderate/ good - medium	13	18	0	27.5	6	10	4	78
6	HN542		Benchmar k	40	10-20	23-33	12-24	0-10	12-24	0
6		Moderate / good - poor	4	14	0	1	26	10	18	64
6		Moderate / good - poor	24	24	0	24.5	42	8	4	70
6		Moderate / good - poor	27	14	3	2.5	34	4	6	78
7	HN630		Benchmar k	12	3-37	15-68	19-55	0-20	10-30	0
7		Moderate/ good	16	4	0	0	0	0	26	0
7		Moderate/ good	30	12	0.5	0	10	6	86	34

Notes: Dark highlighted cells represent plots in the development footprint.

Appendix Tabl	e 7 Fai	ina species	recorded	in th	e Fernhill	Estate
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Class	Family	Exo tic	Scientific Name	Common Name	TSC Status	EPBC Status	Observatio n Type
Aves	Podicipedid ae		Tachybaptus novaehollandiae	Australasian Grebe			0
Aves	Psittacidae		Alisterus scapularis	Australian King- Parrot			0
Aves	Artamidae		Cracticus tibicen	Australian Magpie			W
Aves	Corvidae		Corvus coronoides	Australian Raven			W
Aves	Alcedinidae		Ceyx azureus	Azure Kingfisher			0
Aves	Meliphagida e		Manorina melanophrys	Bell Miner			W
Aves	Phasianida e		Coturnix ypsilophora	Brown Quail			0
Aves	Acanthizida e		Acanthiza pusilla	Brown Thornbill			WO
Amphib ia	Myobatrachi dae		Limnodynastes peronii	Brown-striped Frog			W
Aves	Ardeidae		Ardea ibis	Cattle Egret			0
Amphib ia	Myobatrachi dae		Crinia signifera	Common Eastern Froglet			W
Aves	Psittacidae		Platycercus elegans	Crimson Rosella			WO
Gastro poda	Camaenida e		Meridolum corneovirens	Cumberland Plain Land Snail	E		0
Aves	Estrildidae		Taeniopygia bichenovii	Double-barred Finch			0
Aves	Rallidae		Gallinula tenebrosa	Dusky Moorhen			0
Mamm alia	Macropodid ae		Macropus giganteus	Eastern Grey Kangaroo			0
Reptilia	Scincidae		Eulamprus quoyii	Eastern Water- skink			W
Aves	Psophodida e		Psophodes olivaceus	Eastern Whipbird			W
Aves	Petroicidae		Eopsaltria australis	Eastern Yellow Robin			0
Aves	Turdidae	*	Turdus merula	Eurasian Blackbird			0
Aves	Rallidae		Fulica atra	Eurasian Coot			W
Aves	Cacatuidae		Eolophus roseicapillus	Galah			0
Aves	Pachyceph alidae		Pachycephala pectoralis	Golden Whistler			WO
Aves	Artamidae		Cracticus torquatus	Grey Butcherbird			W
Aves	Rhipidurida e		Rhipidura albiscapa	Grey Fantail			0
Aves	Pachyceph alidae		Colluricincla harmonica	Grey Shrike-thrush			W
Aves	Anatidae		Aythya australis	Hardhead			0
Aves	Petroicidae		Microeca fascinans	Jacky Winter			0
Aves	Monarchida e		Myiagra rubecula	Leaden Flycatcher			W
Aves	Cacatuidae		Cacatua sanguinea	Little Corella			0
Aves	Phalacrocor acidae		Microcarbo melanoleucos	Little Pied Cormorant			0
Aves	Monarchida e		Grallina cyanoleuca	Magpie-lark			W
Class	Family	Exo tic	Scientific Name	Common Name	TSC Status	EPBC Status	Observatio n Type
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Aves	Charadriida e		Vanellus miles	Masked Lapwing			W
Aves	Meliphagida e		Manorina melanocephala	Noisy Miner			W
Aves	Oriolidae		Oriolus sagittatus	Olive-backed Oriole			WO
Aves	Anatidae		Anas superciliosa	Pacific Black Duck			0
Aves	Artamidae		Strepera graculina	Pied Currawong			0
Aves	Rallidae		Porphyrio porphyrio	Purple Swamphen			W
Aves	Psittacidae		Trichoglossus haematodus	Rainbow Lorikeet			W
Aves	Meliphagida e		Anthochaera carunculata	Red Wattlebird			W
Aves	Estrildidae		Neochmia temporalis	Red-browed Finch			W
Aves	Psittacidae		Psephotus haematonotus	Red-rumped Parrot			WO
Aves	Monarchida e		Myiagra inquieta	Restless Flycatcher			W
Aves	Petroicidae		Petroica rosea	Rose Robin			0
Mamm alia	Cervidae	*	Cervus timorensis	Rusa deer			0
Aves	Ptilonorhyn chidae		Ptilonorhynchus violaceus	Satin Bowerbird			0
Aves	Timaliidae		Zosterops lateralis	Silvereye			0
Aves	Pardalotida e		Pardalotus punctatus	Spotted Pardalote			W
Aves	Threskiornit hidae		Threskiornis spinicollis	Straw-necked Ibis			0
Aves	Pardalotida e		Pardalotus striatus	Striated Pardalote			W
Aves	Pardalotida e		Pardalotus striatus	Striated Pardalote			W
Aves	Acanthizida e		Acanthiza lineata	Striated Thornbill			W
Aves	Cacatuidae		Cacatua galerita	Sulphur-crested Cockatoo			W
Aves	Maluridae		Malurus cyaneus	Superb Fairy-wren			W
Aves	Neosittidae		Daphoenositta chrysoptera	Varied Sittella	V		0
Aves	Acanthizida e		Smicrornis brevirostris	Weebill			0
Aves	Hirundinida e		Hirundo neoxena	Welcome Swallow			0
Aves	Meliphagida e		Melithreptus lunatus	White-naped Honeyeater			W
Aves	Ardeidae		Ardea pacifica	White-necked Heron			0
Aves	Meliphagida e		Lichenostomus penicillatus	White-plumed Honeyeater			OW
Aves	Rhipidurida e		Rhipidura Ieucophrys	Willie wagtail			0
Aves	Acanthizida e		Acanthiza nana	Yellow Thornbill			0
Aves	Meliphagida e		Lichenostomus chrysops	Yellow-faced Honeyeater			OW

Class	Family	Exo tic	Scientific Name	Common Name	TSC Status	EPBC Status	Observatio n Type
Mamm alia	Bovidae	*	Bos taurus	European cattle			0
Amphib ia	Hylidae		Litoria verreauxii verreauxii	Verreaux's Tree Frog (subsp)			O, W
Mamm alia	Rhinolophid ae		Rhinolophus megaphyllus	Eastern Horseshoe-bat			W
Mamm alia	Molossidae		Mormopterus "Species 2"	Undescribed Freetail Bat			W

Key: E – endangered, M – migratory, V – vulnerable. O – observed, W - heard

Appendix C – Assessments of significance

Assessment of Significance for Shale Sandstone Transition Forest (a critically endangered community)

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

Not applicable to this threatened ecological community.

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

Not applicable to this threatened ecological community.

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

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

The development footprint contains a total of 2.9 ha of Shale Sandstone Transition Forest. The vegetation to be removed or modified includes up to 1.6 ha in moderate/goodhigh condition forest and up to 1.3 ha of moderate/good- poor condition scrub or grassland. A maximum of 0.6 ha of the community would be removed and a further 2.3 hectares would be modified through the removal of mid storey vegetation and periodic slashing of the groundcover. This represents a very small proportion of the local occurrence of this community. At least 71.7 ha of this community, including 51.4 ha in moderate/good – high condition, would be retained and actively managed for biodiversity values within the proposed conservation areas. A further 20.2 ha of continuous vegetation within the same local occurrence would be maintained in the Fernhill North West biobank and 41.4 ha in the Fernhill Central West biobank.

The reduction in the extent of the community within the development fooprint is minor and would not place the remaining area at risk of extinction, especially since the remainder of the local occurrence would be securely titled and purposefully managed in conservation areas.

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

All native plant and animal species would be removed or displaced from 0.6 ha of the development fooprint. A further 2.3 ha of the development footprint would only be subject to partial removal. The species composition in these areas would change through selective removal of the majority of shrubs and mid storey plants. The overall changes to vegetation structure would have secondary effects such has promoting understorey plants that favour more exposed microclimates and animals of more open vegetation types. This is likely to result in additional negative impacts such as favouring exotic plants or competitive, overabundant native fauna such as the Noisy Miner. Native species richness of the local occurrence of Shale Sandstone Transition Forest is likely to decline slightly. This decline would be restricted to the development footprint.

The total 2.9 ha of Shale Sandstone Transition Forest that would be affected in this way is a very small proportion of the known local occurrence, which comprises all equivalent vegetation in the Fernhill Estate. This minor proportion of the local occurrence is unlikely to contain an ecologically significant proportion of any of the species that make up the ecological community. The extensive areas of floristically similar vegetation in the Fernhill Estate and locality are likely to be sufficient to maintain viable local populations of the species that comprise the TEC. Localised changes in species richness within 2.9 ha of the local occurrence is unlikely to have a significant effect on overall ecosystem function. As such, the proposal is not likely to modify the composition of the CEEC in the locality such that it would become locally extinct.

d) In relation to the habitat of a threatened species, population or ecological community: (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Assessment of Significance for Shale Sandstone Transition Forest (a critically endangered community)

A maximum of 2.9 ha of the community would be affected comprising 0.6 ha of the community that would be completely removed and a further 2.3 ha that would be modified through the removal of mid storey vegetation and periodic slashing of the groundcover.

The majority of the development footprint (2.3 ha) will be managed vegetation within asset protection zones surrounding the construction footprints for dwellings and associated infrastructure. These zones would comprise retained canopy trees over a slashed grassy understorey. This area of managed vegetation would provide a buffer between any sources of indirect impacts such as sedimentation and contamination and sensitive receptors outside the development footprint. This buffer area and standard environmental management measures are likely to mitigate against any substantial effects on the local population of the CEEC during construction, outside of the immediate disturbance footprint.

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

The development footprint forms part of an important vegetated corridor between higher habitats within the Blue Mountains area and lowland forests and woodlands of the Cumberland Plain. At a local scale, vegetation within the site is continuous with and provides connectivity between vegetation within the Blue Mountains National Park, the North West Biobank and the Fernhill Central West biobank (see Figure 1).

Construction of dwellings in the development footprint would increase habitat fragmentation within the site through the removal of native vegetation and construction of fences, buildings and roads. It would partially alter habitat connectivity between the Cumberland Plain and the Blue Mountains but at an insignificant scale compared to the width of the connecting link through the Fernhill Estate and connected vegetation to the north.

No areas of habitat would be completely isolated as a result of the proposal (i.e. vegetated habitat corridors would be maintained around the development fooprint). Habitat connectivity and safe fauna passage from the Blue Mountains National Park, North West Biobank and Fernhill Central West biobank would be retained through the establishment of the proposed Fernhill Lot 1 and Fernhill Lot 2 conservation areas. Connectivity and habitat values in this area may also be improved by ongoing management of vegetation within the conservation areas for biodiversity values. Notably around 25.3 ha of low or poor condition vegetation would be regenerated and managed. The result of this management would be a continuous patch of forest and woodland which would provide increased fauna refuge and movement opportunities.

In this context, the proposal would not have an adverse effect on habitat connectivity.

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

The development footprint contains a very minor proportion of the local occurrence of the ecological community and of the habitat resources available to local populations of constituent species. 71.7 ha of this community would be retained and actively managed for biodiversity values within the proposed conservation areas and further 20.2 ha of continuous vegetation within the same local occurrence would be maintained in the Fernhill North West biobank and 41.4 ha in the Fernhill Central West biobank. The remainder of the site and locality is likely to contain sufficient amounts of both individuals and habitat resources to maintain the local occurrence of the community. In this context the habitat to be removed or modified is of little importance to the survival of the community in the locality.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly) There is no recommended or declared critical habitat of relevance to this community.

Assessment of Significance for Shale Sandstone Transition Forest (a critically endangered community)

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

There is no recovery plan for this CEEC. OEH identifies a number of priority actions intended to abate threats to this CEEC and ensure its long term conservation (OEH, 2011b), including the protection of habitat by minimising further clearing of the community. The removal or modification of up to 2.9 ha of this community from the development footprint is inconsistent with identified priority actions. This would affect a minor proportion of the local occurrence of Shale Sandstone Transition Forest and would not affect the overall recovery of the community in the locality.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process The proposal would contribute to the operation of the following Key Threatening Processes (KTPs) of relevance to CPW:

- Clearing of native vegetation through the removal or permanent modification of four hectares of native vegetation, including 2.9 ha of Shale Sandstone Transition Forest.
- Removal of dead wood and dead trees.

The proposal would include measures to at least partially mitigate against the operation of these KTPs including retention of large trees in open space within residential lots as far as possible within design and bushfire risk management constraints.

The proposal also has the potential to indirectly cause or increase the operation of the following KTPS that are of potential relevance to this ecological community:

- Invasion of plant communities by perennial exotic grasses the proposal would create disturbed edges through native vegetation and potentially transfer exotic grass propagules.
- Infection of native plants by *Phytophthora cinnamomi* the proposal would disturb soil within and adjoining native vegetation and potentially transfer fungi spores.
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis the proposal would disturb soil within and adjoining native vegetation and periodically flooded depressions and potentially transfer fungi spores.

The proposal would include environmental management measures including specific consideration of potential impacts on soil, water and native vegetation (refer Section 6). These measures would at least partially mitigate against the operation of these KTPs. 107.1 ha of vegetation within the proposed conservation area would be purposefully managed to improve biodiversity values. Overall the proposal would result in a net reduction in the operation of these KTPs.

Conclusion of Assessment of Significance

Based on the consideration of the above factors, the proposal is not likely to have a significant effect on the local occurrence of Shale Sandstone Transition Forest.

Assessment of Significance for Cumberland Plain Land Snail (Meridolum corneovirens) (endangered species)

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

The site contains a local population of the Cumberland Plain Land Snail based on direct observations of live snails and shells during the GHD site surveys (see Figure 4).

The Cumberland Land Snail probably reproduces year round, where conditions are suitable. It lays clutches of eggs in moist and dark areas such as under logs. It is a fungal feeder and is generally active at night. Nothing is currently known about rates of fecundity, length of life span, dispersal patterns and over what distances individuals can move (OEH 2013b).

Based on the above, potential risks to the life cycle of a local population of the species include: removal, modification or fragmentation of important areas of habitat; injury or mortality to an ecological significant proportion of the local population; or removal of suitable shelter sites.

A total of eight live individuals or shells were recorded at the site in the most recent surveys, in loose leaf litter or under woody debris within Shale Sandstone Transition Forest. Additional Cumberland Plain Land Snails are likely to be present, buried in loose soil or leaf litter. The 2.9 ha of habitat in Shale Sandstone Transition Forest within the development footprint is contiguous with a large area of habitat at the site and within the broader Fernhill Estate (see Figure 1). This species has been recorded in high numbers elsewhere within the Fernhill Estate Estate (GHD 2013a, b and c) and in the locality, and is more commonly observed in association with Cumberland Plain Woodland communities. Around 28 live individuals or shells were recorded in Cumberland Plain Woodland in the eastern portion of the Fernhill Estate (GHD 2013a). There are 72 previous records of the species in the locality (OEH, 2015a) and around 2100 ha of suitable habitat in shale woodlands or forest based on Tozer (2010) mapping. On this basis, the proposal is unlikely to remove an ecologically significant proportion of either individuals or habitat resources due to the limited area directly affected (2.9 ha). The habitat available within the other parts of the study area and the wider locality is likely to contain sufficient amounts of both individuals and habitat resources to maintain the local population.

As described in part d) ii) the proposal would not isolate any habitat for the species or have a notable effect on the ability of local populations to move between patches of habitat.

Therefore the proposed action is unlikely to have adverse effect on the life cycle of local population of the Cumberland Plain Land Snail.

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

Not applicable to this threatened species.

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

Not applicable to this threatened species.

d) In relation to the habitat of a threatened species, population or ecological community: (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and The proposal will remove or modify approximately 1.6 ha of native woodland and forest that would comprise suitable shelter and foraging habitat for the species. The proposal will remove or modify a further 1.3 ha of derived scrub or grassland with minimal suitable shelter sites or foraging substrate that would comprise poorer quality potential habitat for the species.

The proposed construction would disturb some important shelter resources associated with woody debris in the development footprint.

Provided recommended impact mitigation measures are adopted the proposal is highly unlikely to significantly modify any habitat for the species outside of construction footprints.

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

Assessment of Significance for Cumberland Plain Land Snail (Meridolum corneovirens) (endangered species)

The development footprint forms part of an important vegetated corridor between higher habitats within the Blue Mountains area and lowland forests and woodlands of the Cumberland Plain. At a local scale, vegetation within the site is continuous with and provides connectivity between vegetation within the Blue Mountains National Park, the North West Biobank and the Fernhill Central West biobank (see Figure 1).

Construction of dwellings in the development footprint would increase habitat fragmentation within the site through the removal of native vegetation and construction of fences, buildings and roads. . It would partially alter habitat connectivity between the Cumberland Plain and the Blue Mountains but at an insignificant scale compared to the width of the connecting link through the Fernhill Estate and connected vegetation to the north.

No areas of habitat would be completely isolated as a result of the proposal (i.e. vegetated habitat corridors would be maintained around the development fooprint). Habitat connectivity and safe fauna passage from the Blue Mountains National Park, North West Biobank and Fernhill Central West biobank would be retained through the establishment of the proposed Fernhill Lot 1 and Fernhill Lot 2 conservation areas. Connectivity and habitat values in this area may also be improved by ongoing management of vegetation within the conservation areas for biodiversity values. Notably around 25.3 ha of low or poor condition vegetation would be regenerated and managed. The result of this management would be a continuous patch of forest and woodland which would provide increased fauna refuge and movement opportunities.

In this context, the proposal would not have an adverse effect on habitat connectivity.

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

A total of eight live individuals or shells were recorded at the site in the most recent surveys, which suggests that this area of habitat has value to the local population of the species. No evidence of the species was recorded in the immediate development footprints though the 1.6 ha of native woodland and forest in these areas would comprise suitable shelter and foraging habitat for the species. The remaining 1.3 ha of derived scrub or grassland has minimal suitable shelter sites or foraging substrate and would comprise poorer quality potential habitat for the species.

A further 28 live individuals or shells were recorded in the eastern portion of the Fernhill Estate in 2013. These areas contain Cumberland Plain Woodland with good quantities of habitat resources of relevance to the snail, such as woody debris and leaf litter. There are 72 previous records of the species in the locality (OEH, 2013b) and around 2100 ha of suitable habitat in shale woodlands or forest based on Tozer (2010) mapping. The habitat within the development footprint would have minor importance to the long term survival of the species in the locality due to the limited area directly affected and its limited quality. The remainder of the study area and locality is likely to contain sufficient amounts of both individuals and habitat resources to maintain the local population.

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

There is no recommended or declared critical habitat of relevance to this species (OEH, 2013b).

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

There is no recovery plan for the Cumberland Land Snail. OEH (2015b) identifies eight strategies and associated priority actions to help recover this threatened species. These strategies involve community consultation, research and habitat management. While the removal of habitat is not consistent with these actios, the loss and disturbance of four hectares of habitat is unlikely to interfere with the recovery of the species.

107.1 ha of vegetation within the proposed conservation area would be purposefully managed to improve biodiversity values. Overall the proposal would make a net positive contribution to the recovery of the species.

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

Assessment of Significance for Cumberland Plain Land Snail (Meridolum corneovirens) (endangered species)

The development would contribute to the operation of the following KTPs of relevance to the Cumberland Plain Land Snail:

- Clearing of native vegetation through the removal of four hectares of native vegetation, including up to 2.9 ha of potential habitat
- Removal of dead wood and dead trees, through the removal of two stags and moderate quantities of fallen woody debris.

The proposal would include environmental management measures including specific consideration of potential impacts on soil, water and native vegetation (refer Section 6). These measures would at least partially mitigate against the operation of these KTPs. 107.1 ha of vegetation within the proposed conservation area would be purposefully managed to improve biodiversity values. Overall the proposal would result in a net reduction in the operation of these KTPs.

Conclusion of Assessment of Significance

Based on the consideration of the above factors, the proposal is not likely to have a significant effect on the local population of the Cumberland Plain Land Snail.

Assessment of Significance for Castlereagh Scribbly Gum Woodland (EEC)

According to the DotE (2013c) 'significant impact criteria' for endangered or critically endangered ecological communities, an action is likely to have a significant impact on a community species if there is a real chance or possibility that it will:

Reduce the extent of an ecological community

The development footprint contains a total of 1.1 ha of Castlereagh Scribbly Gum Woodland . A maximum of 0.1 ha of the community would be removed and a further one hectare would be modified through the removal of mid storey vegetation and periodic slashing of the groundcover. This represents a very small proportion of the local occurrence of this community. At least 16.1 ha of similar vegetation, including 11.1 ha in moderate/good – high condition that is consistent with the EPBC Act-listed form of the community, would be retained and actively managed for biodiversity values within the proposed conservation areas. A further 31.8 ha of continuous vegetation within the same local occurrence would be maintained in the Fernhill North West biobank and two hectares in the Fernhill Central West biobank.

The reduction in the extent of the community within the development fooprint is minor and would not place the remaining area at risk of extinction, especially since the remainder of the local occurrence would be securely titled and purposefully managed in conservation areas.

Fragment of increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The development footprint forms part of an important vegetated corridor between higher habitats within the Blue Mountains area and lowland forests and woodlands of the Cumberland Plain. At a local scale, vegetation within the site is continuous with and provides connectivity between vegetation within the Blue Mountains National Park, the North West Biobank and the Fernhill Central West biobank (see Figure 1).

Construction of dwellings in the development footprint would increase habitat fragmentation within the site through the removal of native vegetation and construction of fences, buildings and roads.

No areas of habitat would be completely isolated as a result of the proposal (i.e. vegetated habitat corridors would be maintained around the development fooprint). Habitat connectivity and safe fauna passage from the Blue Mountains National Park, North West Biobank and Fernhill Central West biobank would be retained through the establishment of the proposed Fernhill Lot 1 and Fernhill Lot 2 conservation areas. Connectivity and habitat values in this area may also be improved by ongoing management of vegetation within the conservation areas for biodiversity values. Notably around 25.3 ha of low or poor condition vegetation would be regenerated and managed. The result of this management would be a continuous patch of forest and woodland which would provide increased fauna refuge and movement opportunities.

In this context, the proposal would not have an adverse effect on habitat connectivity.

Adversely affect habitat critical to the survival of an ecological community

The community occurs on specific soil types within a restricted distribution that coincides with the Sydney region. The natural extent of the community has been extensively cleared and is subject to ongoing development pressure. All occupied habitat other than the smallest or most degraded remnants would be critical to the survival of the community. The local occurrence at the site is in medium condition and part of a continuous patch of vegetation greater than 100 ha in area and as such comprises habitat critical to the survival of the community.

The project would have minor adverse effects on habitat critical to the survival of the community through The development footprint contains a very minor proportion of the local occurrence of the ecological community and of the habitat resources available to local populations of constituent species. At least 16.1 ha of similar vegetation, including 11.1 ha in moderate/good – high condition that is consistent with the EPBC Act-listed form of the community, would be retained and actively managed for biodiversity values within the proposed conservation areas. A further 31.8 ha of continuous vegetation within the same local occurrence would be maintained in the Fernhill North West biobank and two hectares in the Fernhill Central West biobank. The remainder of the site and locality is likely to contain sufficient amounts of both individuals and habitat resources to maintain the local occurrence of the community. In this context the habitat to be removed or modified is of little importance to the survival of the community in the locality.

Modify or destroy abiotic (non-living) factors (such as water, nutrients of soil) necessary for an ecological community's survival, including reduction of groundwater levels or substantial alteration of surface water drainage patterns

The project would include excavation of soil within a total of 0.7 ha of full vegetation removal and construction, including 0.1 ha of this community. This would alter surface water drainage patterns in the vicinity of the development footprint. Any such impacts would be minor and localised. The majority of the development footprint (3.3 ha) will be managed vegetation within asset protection zones surrounding the construction footprints for dwellings and associated infrastructure. These zones would comprise retained canopy trees over a slashed grassy understorey and would experience little or no modification of abiotic factors. This area of managed vegetation would provide a buffer between any sources of indirect impacts such as sedimentation and contamination and sensitive receptors outside the development footprint. This buffer area and standard environmental management measures are likely to mitigate against any substantial effects on the local population of the CEEC during construction, outside of the immediate disturbance footprint.

Any alterations as a result of the proposal are unlikely to result in destruction of abiotic conditions necessary for the ecological communities' survival in the locality.

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

All native plant and animal species would be removed or displaced from 0.1 ha of the development fooprint. A further one hectare of the development footprint would only be subject to partial removal. The species composition in these areas would change through selective removal of the majority of shrubs and mid storey plants. The overall changes to vegetation structure would have secondary effects such has promoting understorey plants that favour more exposed microclimates and animals of more open vegetation types. This is likely to result in additional negative impacts such as favouring exotic plants or competitive, overabundant native fauna such as the Noisy Miner. Native species richness of the local occurrence of Castlereagh Scribbly Gum Woodland is likely to decline slightly. This decline would be restricted to the development footprint.

The total 1.1 ha of Castlereagh Scribbly Gum Woodland that would be affected in this way is a very small proportion of the known local occurrence, which comprises all equivalent vegetation in the Fernhill Estate. This minor proportion of the local occurrence is unlikely to contain an ecologically significant proportion of any of the species that make up the ecological community. The extensive areas of floristically similar vegetation in the Fernhill Estate and locality are likely to be sufficient to maintain viable local populations of the species that comprise the TEC. Localised changes in species richness within 1.1 ha of the local occurrence is unlikely to have a significant effect on overall ecosystem function. Given the scale and context of the project it is unlikely to modify the composition of any vegetation beyond the development footprint and immediately adjoining areas. As such, the project is not likely to cause a substantial change in the composition of the community.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:

Assisting invasive species, that are harmful to the listed ecological community, to become established, or

No invasive species that may cause the Castlereagh Scribbly Gum Woodland to decline are likely to become established in the study area as a result of the proposal.

Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community

The proposal does not directly involve production or transport of any fertilisers, herbicides or other chemicals or pollutants into the community. Construction vehicles and equipment would cause a minor localized increase in the risk of hydrocarbon contamination for the duration of construction activities. This would not be 'regular' (if at all) and is highly unlikely to kill or inhibit the growth of any species in the ecological community.

Interfere with the recovery of an ecological community

A recovery plan has not yet been prepared for Castlereagh Scribbly Gum Woodland (DotE, 2015c).

The main threats to Castlereagh Scribbly Gum Woodland are clearance and fragmentation due to increased urbanisation, inappropriate fire regimes, weed invasion, hydrological changes, predation and displacement of native fauna by domestic pets and other species, climate change and disease (Threatened Species Scientific Committee, 2015b)

Assessment of Significance for Castlereagh Scribbly Gum Woodland (EEC)

The approved conservation advice lists priority recovery and threat abatement actions that can be taken to support the recovery of the Castlereagh Scribbly Gum Woodland Forest CEEC (Threatened Species Scientific Committee, 2015). The following are relevant to the project:

- Avoid disturbances to native vegetation.
- Protect the soil seedbank.

The project would remove or modify up to 1.1 ha of vegetation and the associated soil seed bank within the local occurrence of the community. As described above, given the context and limited extent of the development footprint these impacts would not affect its species composition, have any notable adverse effects on habitat for the community or otherwise interfere with the recovery of the community.

At least 16.1 ha of similar vegetation, including 11.1 ha in moderate/good – high condition that is consistent with the EPBC Act-listed form of the community, would be retained and actively managed for biodiversity values within the proposed conservation areas. Overall the proposal would assist the recovery of the community.

Conclusion of Assessment of Significance:

The project is not likely to have a significant impact on the local occurrence of Castlereagh Scribbly Gum Woodland at the site.

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