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15/05/2020

Our ref: 18SYD_9907

Landcom c/o APP Corporation Pty Limited
Level 14,
60 Station Street
Parramatta NSW 2150

Attention: Georgia Welsh

Dear Georgia,

Re: Kellyville Station Precinct BDAR – Response to Submissions

In August 2019, Eco Logical Australia (ELA) submitted a Biodiversity Development Assessment Report (BDAR) (version 4, dated 19/08/2019) for the State Significant Development Application (SSDA) the proposed Kellyville Station Precinct. In late 2019 the SSDA was placed on public exhibition.

An updated BDAR (version 7, dated 15/05/2020) has been prepared incorporating requested amendments from agency submissions. Agency submissions relating to the BDAR and ELA responses are summarised in Table 1.

Regards,

Mike Lawrie
Ecologist

Table 1: ELA response to BDAR submissions

Agency	Comment	ELA Response	Amended Section in Report
Department of Planning Industry and Environment (DPIE)	Investigate options to retain the Cumberland Plain Woodland concentrated to the south of the Kellyville Station Precinct including consideration of relocating the 'neighbourhood park' (KV2) to minimise biodiversity impacts.	The majority of native vegetation on the site is retained, principally in the riparian corridor. Residual impacts to moderate condition Cumberland Plain Woodland are due to the limitations of the size of the site and the need to meet government housing and employment targets. The 'neighbourhood park (KV2)' was unable to be relocated if distance to open space targets were to be met within the precinct. Residual impacts to Cumberland Plain Woodland will be appropriately offset and opportunities will be explored during the detailed design phase to retain trees and patches where possible within the scope of the development. Opportunities may exist within open space areas for retention and rehabilitation. Additional information has been provided in the updated BDAR.	Section 1.1.2 Section 2.1.1
	Respond to the biodiversity assessment requirements/issues identified in the agency comments.	Addressed in this table and in the updated BDAR.	N/A
Office of Environment and Heritage (OEH)	It is noted that the proposal will lead to the loss of 2.05 ha of the critically endangered ecological community (CEEC), Cumberland Plain Woodland. In accordance with the *Biodiversity Conservation Act 2016*, all attempts must first be made to avoid impacts. Section 8.1.2 of the Biodiversity Assessment Method (BAM) requires the assessor to describe how the proposal has been designed to avoid and minimise impacts. This includes describing how the clearing of native vegetation has been avoided by reducing the clearing footprint of the project. In response to this requirement, Table 18 of the BDAR states that the footprint has not been reduced.	See response above.	Section 1.1.2 Section 2.1.1

Agency	Comment	ELA Response	Amended Section in Report
	EES considers that the BDAR has not provided a justification for why the footprint cannot be reduced to avoid clearing a CEEC.		
	The following inconsistencies in the credit requirements within the BDAR report have been identified as follows: • section 3 and table 39 say 25 ecosystem credits are required for PCT 835 but the credit summary report: says 27 credits are required • table 39 says 106 ecosystem credits are required, whereas the text above the table says 107 credits are required • table 40 says 105 species credits are required for *Myotis macropus*, but section 3 and BAM credit summary report say 106 credits are required.	The report has been amended to ensure consistency with respect to the number of credits required. The following credits are required to be offset: <u>Ecosystem credits</u> • PCT 835: 25 credits • PCT 849: 80 credits • PCT 1071: 1 credit **Total: 106 ecosystem credits** <u>Species credits</u> *Myotis macropus* (Southern Myotis) – **105 credits**	Executive Summary Table 39 Table 40 Conclusion Appendix E
	It is recommended that the following conditions are included as a condition of consent. • Prior to the commencement of works for development that will impact on biodiversity values, the number and classes of ecosystem and species credits must be retired to offset the residual biodiversity impacts of the development. • The requirement to retire like-for-like ecosystem and species credits may be satisfied by payment to the Biodiversity Conservation Fund of an amount equivalent to the number and classes of ecosystem credits, as calculated by the Biodiversity Offsets Payment Calculator.	Noted. The appropriate number of credits (described above) will be purchased and retired prior to the commencement of works. Section 7.13(5) of the BC Act states: *A condition to retire biodiversity credits is required to be complied with before any development is carried out that would impact on biodiversity values. However, a consent to a concept development application may provide for a corresponding staged retirement of biodiversity credits before each stage of development is carried out and without the need for a further biodiversity development assessment report in connection with development applications for the subsequent stages of the development.* If a staged DA approach is taken, a report detailing the corresponding number of credits required for each stage will be submitted.	N/A

Agency	Comment	ELA Response	Amended Section in Report
	• Evidence of the retirement of credits or payment to the Biodiversity Conservation Fund must be provided to the Secretary of the Department of Planning, Industry and Environment for approval prior to commencement of works that will impact on biodiversity values.		
The Hills Shire Council	The proposed developments in Bella Vista and Kellyville Precincts will impact on 1.57 ha and 2.05 ha respectively of Cumberland Plain Woodland, of which 0.42 ha and 1.85 ha respectively meets the criteria for listing under the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). Clearing of this woodland may result in serious and irreversible impact.	Information required for the consent authority to determine Serious and Irreversible Impacts has been provided in the BDAR in accordance with the Biodiversity Assessment Method.	Table 30
	Within the Kellyville Precinct, it is not clear that the proposal has been designed to attempt to avoid impacts to Cumberland Plain Woodland or minimise its impact, with 98% of the Cumberland Plain Woodland present within the study area to be impacted.	See responses above.	Section 1.1.2 Section 2.1.1
	Before approval, consideration should be given to exploring options to retain additional Cumberland Plain Woodland or if the proposal does not change, mitigating the loss of Cumberland Plain Woodland via offsets in the Blacktown or Hills Shire LGA. Additional offsets may be required to address indirect impacts such as increases in sedimentation or change in surface flow of water and evidence of this should be demonstrated in the BDAR.	See response above. The purchase and retirement of credits under the BAM does not require the credits to be purchased from a particular local government area The BAM does not provide a mechanism for offsetting potential indirect impacts resulting from sedimentation change. Mitigation measures, as detailed in the BDAR, will be implemented in order to minimise indirect impacts and protect the retained vegetation adjacent to the development site.	N/A

Kellyville Precinct - Biodiversity Development Assessment Report

Landcom

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DOCUMENT TRACKING

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Template 2.8.1

Executive Summary

Eco Logical Australia Pty Ltd (ELA) were engaged by Landcom to prepare a Biodiversity Development Assessment Report under the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Biodiversity Assessment Methodology (BAM) of Kellyville Station Precinct. The proposed development includes residential development, mixed use development, open space, carparks and associated infrastructure (internal roads and services).

The State Significant Development Assessment area (SSDA area) is located in The Hills Local Government Area (LGA) and is approximately 18.5ha. The development site is currently zoned B2 – Local Centre, R1 – General Residential, R4 – High Density Residential and SP2 – Infrastructure under The Hills Local Environmental Plan (LEP).

This report has been prepared to meet the requirements of the Biodiversity Assessment Method (BAM) established under Section 6.7 of the NSW BC Act.

The following Plant Community Types (PCTs) were mapped in the development site in various condition (totalling six vegetation zones):

- *PCT 849 – Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion*
- *PCT 835 – Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*
- *PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion*

PCT 849 is consistent with the Threatened Ecological Community (TEC) Cumberland Plain Woodland in the Sydney Basin Bioregion, listed as critically endangered under both the BC Act and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). PCT 835 is consistent with the TEC River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, listed as endangered under the BC Act. PCT 1071 is consistent with the TEC Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Two threatened microchiropteran bat species were positively identified (*Mormopterus norfolkensis* (East Coast Freetail Bat), *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)) and four were potentially identified during the bat call survey (*Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Myotis macropus* (Southern Myotis), *Saccolaimus flaviventris* (Yellow-bellied sheath-tailed Bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat)). Several species could only be potentially identified due to similar call frequencies between microchiropteran bats. Southern Myotis is a species credit species which was potentially identified. A conservative approach has been taken for this species which has been assumed present for the purposes of the assessment. No additional threatened flora or fauna species were recorded during the survey.

This BDAR outlines the measures taken to avoid, minimise and mitigate impacts on the vegetation and species habitat present within the development footprint and measures to minimise impacts during

construction and operation of the development. Following consideration of the above aspects, the residual unavoidable impacts of the project were calculated in accordance with BAM by utilising the Biodiversity Assessment Method Credit Calculator (BAMC).

A total of 106 ecosystem credits are required to offset the residual impacts of the proposed project:

PCT ID	PCT Name	Condition	Vegetation Zone	Area (ha)	Vegetation Integrity Score	Credits
Ecosystem Credits						
849	*Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion*	Degraded	1	0.22	45.4	6
849	*Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion*	Moderate	2	1.83	64.9	74
849	*Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*	Planted	3	2.1	14.6	0
835	*Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*	Moderate	4	0.75	63.2	24
835	*Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*	Revegetated	5	0.07	40.8	1
1071	*Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion*	Moderate	6	0.05	44.3	1
					Total Ecosystem Credits	**106**

*Under BAM (Section 10.3.1.1), an assessor is required to determine an offset for all impacts of development on PCTs that are associated with:

- a vegetation zone that has a vegetation integrity score ≥15 where the PCT is representative of an endangered or critically endangered ecological community, or
- a vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or
- a vegetation zone that has a vegetation integrity score ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

Following BAM, no ecosystem credits are required to be offset for the removal of 2.09 ha of vegetation zone 3. With a vegetation integrity score of 14.6, this is lower than the offsetting threshold of 15 for a critically endangered ecological community.

A total of 105 species credit species are required to offset Southern Myotis, with a total impact of 5.06 ha on this species.

Serious and Irreversible Impacts (SAII) values have been considered as part of this assessment. Cumberland Plain Woodland is a listed candidate entity. 2.05 ha of Cumberland Plain Woodland will be removed as a result of the development and 0.17 ha will be retained within the riparian corridor. The 2.05 ha of CPW will be offset in accordance with the Biodiversity Offsets Scheme (BOS). The proposed footprint was selected to utilise suitable lands for development to meet the required state government housing and employment targets. Impacts to Cumberland Plain Woodland were minimised as far as possible while still meeting the required government objectives for housing and employment. Opportunities for retention of CPW within streetscape and open space areas will be investigated during the detailed design phase. It is noted that the threshold for what is considered a SAII is yet to be published by OEH and therefore whether the development will have a SAII cannot be determined. A SAII assessment has been undertaken in accordance with the BAM.

1.85 ha of Cumberland Plain Woodland within the development site met the condition criteria for listing under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is considered that the proposed development has the potential to have a significant impact on this Critically Endangered Ecological Community (CEEC) in accordance with the EPBC Significant Impact Guidelines 1.1 – Matters of National Environmental Significance. Therefore, it is recommended that the development is referred to the Commonwealth Minister for the Environment to determine if the project is to be considered a Controlled Action. Landcom is referring the development to the commonwealth concurrently with the SSDA.

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Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Credit Calculator
BC Act	NSW Biodiversity Conservation Act 2016
BDAR	Biodiversity Development Assessment Report
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically Endangered Ecological Community
DNG	Derived Native Grassland
DoEE	Commonwealth Department of Environment and Energy
DPE	NSW Department of Planning and Environment
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
FM Act	NSW Fisheries Management Act 1994
GIS	Geographic Information System
GPS	Global Positioning System
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
LLS	Local Land Service
NSW	New South Wales
NOW	NSW Office of Water
NWRL	North West Rail Link
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SAII	Serious and Irreversible Impact
SEPP	State Environmental Planning Policy
SMNW	Sydney Metro Northwest
SSDA	State Significant Development Application
SSI	State Significant Infrastructure
TEC	Threatened Ecological Community
VIS	Vegetation Information System
WM Act	NSW Water Management Act 2000

1. Stage 1: Biodiversity Assessment

This Biodiversity Development Assessment Report (BDAR) has been prepared by Mike Lawrie, who is an Accredited Person (BAAS18162) under the NSW Biodiversity Conservation Act 2016 (BC Act). The contents of this BDAR complies with the minimum requirements outlined in Table 25 of the Biodiversity Assessment Methodology (BAM: OEH, 2017).

1.1 Introduction

Under the Sydney Metro Northwest Places program, Landcom and Sydney Metro are working collaboratively with the Department of Planning and Environment, local councils, other government organisations and key stakeholders to develop the long-term vision and delivery program to guide the redevelopment and urban renewal of surplus government owned or controlled land around new SMNW station precincts.

SMNW Places will deliver vibrant and integrated precincts surrounding the new Bella Vista and Kellyville metro stations that will facilitate the renewal and delivery of a greater supply and diversity of housing, new employment opportunities and new public and community facilities.

This Riparian Assessment is required to support a State Significant Development (SSD) application for the Kellyville Station Precinct concept design and to determine potential impacts on riparian and aquatic ecology as part of the proposed development and make recommendations to mitigate those impacts.

1.1.1 Kellyville Station Precinct description

The Kellyville Station Precinct forms part of a network of eight station precincts along the corridor of the NSW Government's $8.4 billion SMNW. The Kellyville Station Precinct was identified by the NSW Government as a Priority Precinct to support and drive the urban renewal of rural residential land into a new urban environment.

The Kellyville Station Precinct is envisaged to provide for up to 1,000 new jobs and the delivery of up to 8,400 new homes, shared between Kellyville and Bella Vista Station Precincts.

The Precinct spans the alignment of the SMNW corridor that consists of an approximate 900 m stretch of government owned land, extending from Samantha Riley Drive in the north towards Memorial Avenue in the south, and bound by Old Windsor Road to the west, existing Roads and Maritime Services land to the south and Elizabeth Macarthur Creek to the east.

Lands south of Wuban Avenue to the southern extent of the precinct remain largely undeveloped and in their existing rural residential state.

Land south of construction works, between the southern edge of the precinct and Wuban Avenue, contains stands of existing mature vegetation, particularly along the western bank of the Elizabeth Macarthur Creek riparian corridor.

1.1.2 Strategic Context

The location of the project has been selected based on several strategic planning decisions dating back to 2005. A summary of the strategic context of the project is provided below.

On 9 June 2005, the then NSW Government announced that it was to invest in expanding the existing metropolitan rail network to meet future planned and projected population and employment growth, including the delivery of a new railway line from Cheltenham via Castle Hill to Rouse Hill, known then as the North West Rail Link (NWRL).

Between 2008 and 2012, the then Minister for Planning granted several critical state infrastructure approvals consenting to the construction of the NWRL, now referred to as Sydney Metro Northwest (SMNW), to support future planned population growth in the north-west growth centre and Rouse Hill and Balmoral Road Release Area.

The NSW Government's infrastructure approvals were further supported by the release of the North West Rail Link Corridor Strategy 2013, jointly prepared by the Department of Planning, Industry and Environment (Department) and Transport for NSW (TNSW). The NWRL Corridor Strategy provided a strategic planning framework to guide future development around the eight new SMNW station precincts, including the Kellyville and Bella Vista Station Precincts.

Under the NWRL Corridor Strategy, structure plans were developed for each station and provided an integrated land use and transport planning approach to address projected residential and employment growth. The NWRL Corridor Strategy identified the potential for approximately 28,000 new homes and 40,000 new jobs in the north-west metro corridor.

Both the Kellyville and Bella Vista Station Precincts were identified as new transit oriented development mixed use communities that would comprise a range of commercial, mixed use and high density residential land uses. Future urban development was envisaged between Windsor Road and Elizabeth Macarthur Creek riparian corridor, with the existing riparian corridor envisaged to accommodate new green links connecting between Rouse Hill and Bella Vista/Norwest.

The then Minister for Planning concurrently issued a local planning direction under section 9.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act) requiring future planning in the identified precincts to be consistent with the strategy, including projected population growth and future desired character.

In October 2013, and following the release of the NWRL Corridor Strategy, Council unanimously voted in support of a recommendation nominating the Kellyville and Bella Vista Station Precincts as Priority Precincts.

In August 2014, Council's Priority Precinct nominations (now referred to as Planned Precincts) were endorsed by the NSW Government as a means of implementing the land use and transport planning strategies identified in the NWRL Corridor Strategy.

The NSW Government's Planned Precinct program was developed as the mechanism to deliver the goals of the former A Plan for Growing Sydney, released in December 2014, which the vision for Sydney's future, including measures to address one of Sydney's biggest challenges in accommodating predicted demands for housing and employment. The key objectives of the Planned Precinct program were to provide for new housing and jobs in centres with good transport connections to make it easier for people to get to and from home and work and to ensure that supporting infrastructure is provided to meet predicted housing and employment demands.

In November 2017, the Department published its finalisation reports on the proposed planning amendments to the Kellyville and Bella Vista Station Precincts. The Department's Precinct Finalisation Reports outlined that the recommended rezonings would:

- maximise the use of the SMNW and other public transport infrastructure
- provide more jobs closer to homes, promote public transport to employment areas, whereby reducing the need for private vehicle trips
- respond to the strong current and future predicted demand for additional employment and housing.

The Department's finalisation reports did not recommend additional site-specific environmental conservation land use controls to protect existing native vegetation nor did it recommend that any land identified within the concept SSD application sites be added to The Hills Local Environmental Plan 2012 (THLEP 2012) biodiversity (terrestrial) map. The Department noted in its finalisation reports that:

- most of the mapped ecological community occurred within riparian corridors that would retain their existing RE1 Public Recreation or SP2 Infrastructure land use zoning
- future development would need to minimise potential CPW impacts and conditions of consent may be required to mitigate against potential ecological impacts
- future development control plans (DCP) should incorporate provisions to ensure vegetation impacts were minimised and mitigated.

On 1 December 2017, the then Minister for Planning subsequently approved State Environmental Planning Policy Amendment (Bella Vista and Kellyville Station Precincts) 2017, effecting an amendment to the State Environmental Planning Policy (State and Regional Development) 2011 and The Hills LEP 2012, which:

- amended Schedule 2 of the SRD SEPP to identify Bella Vista and Kellyville Station Precincts as sites for which specified development was declared to be State Significant Development
- amended The Hills LEP 2012 by rezoning the station precinct and inserting new statutory controls, including the introduction of a dwelling yield, limiting the maximum number of residential dwellings on land identified with both the Bella Vista and Kellyville Station Precincts to 8,400 dwellings.

The draft DCP (unendorsed) prepared for the combined station precinct locations included objectives and controls to project and enhance ecology and riparian corridors in accordance with the Department's finalisation report recommendation. This included controls requiring:

- development, where possible, to be sited to retain areas of significant native vegetation, particularly larger areas and better-quality areas of Cumberland Plain Woodland
- a vegetation management plan (VMP) to be prepared that included measures to address weed control, management of bushfire hazards and to ensure the rehabilitation and regeneration of riparian corridors, including the Elizabeth Macarthur Creek riparian corridor.

The proposed street hierarchy and site layouts detailed for each station precinct have been developed in accordance with the NSW Government's housing and employment targets for the station precincts and would result in unavoidable impacts on existing CPW vegetation located outside of the Elizabeth Macarthur Creek riparian corridor. Combined residential yields projected within the boundaries of both

the Kellyville and Bella Vista concept SSD application sites fall short of the projected NSW Government housing targets due to existing site constraints. Restricting envisaged and planned development within areas of existing vegetation would further compromise the attainment of the housing and employment targets for the locality.

1.1.3 Concept State Significant Development site description

The Kellyville Station Precinct concept SSD application site is defined as land owned by, or under the control of, Sydney Metro within the boundary of the Kellyville Station Precinct as defined by the Schedule 2 State Significant Development Sites Map of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

The site is made up of 16 allotments and has a total area of approximately 18.8 hectares. The legal description of the site is outlined below in Table 1**.**

Table 1: Kellyville Station Precinct Property Description

No.	Lot No.	Plan No.	House No.	Street	Owner	Ownership
1	1	DP1066762	N/A	Old Windsor Road	Sydney Metro	Government
2	2-3	DP1201591	N/A	Lewis Jones Drive	Sydney Metro	Government
3	1-8	DP1184376	N/A	Old Windsor Road	Sydney Metro	Government
4	12-13	DP1184376	N/A	Old Windsor Road	Sydney Metro	Government
5	11	DP1063682	N/A	Old Windsor Road	Sydney Metro	Government
6	11	DP1201592	N/A	Lewis Jones Drive	Sydney Metro	Government
7	181	DP1248401	N/A		Sydney Metro	Government

1.1.4 Concept State Significant Development application scope

The Concept SSD Application will set out the concept proposal for the future development of the station precinct. The application is only required to demonstrate and consider the likely impacts associated with concept proposal, not the likely impact of any development, as that would be subject to a separate development application.

Development consent will be sought for a concept development application pursuant to section 4.22(1) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) that sets out the concept proposal for the station precinct that comprises the following components:

- Land use strategy that identifies the overall allocation, quantum and location of land uses across the site including:
  - Residential dwellings comprising residential flat buildings and terraces
  - Non-residential land uses including retail and commercial
  - Public open space including public domain and parks
  - Community facilities.
- Urban Design Guidelines that includes built form design principles, guidelines and controls, including maximum building heights and street wall setbacks and heights.

- Allocation of maximum Gross Floor Area (GFA) across the site for each development block and for specific land uses, including allowable GFA transferred from roads and open space to identified development lots pursuant to clause 8.3 of *The Hills Local Environmental Plan 2012*.
- Street hierarchy and layout, including the identification of pedestrian and vehicular movement and access arrangements, and the indicative location and configuration of new streets and intersection connections to the existing road network.
- Identification of criteria or thresholds for subsequent development stages to be assessed as SSD pursuant to section 4.37 of the EP&A Act.

The Concept SSD application will not seek development consent for any physical works. All development set out in the concept proposal will be subject to a separate approval pathway.

1.1.5 General description of the development site

Kellyville Station Precinct is located within The Hills Shire Council (THSC) Local Government Area (LGA). The development site (Figure 1 and Figure 2) is located in the Cumberland IBRA subregion of the Sydney Basin region, on the Cumberland Plain Mitchell Landscape. Figure 2 shows an overview of the development site location and landscape context.

The subject land contains native Plant Community Types (PCTs) in various condition states and areas of exotic grassland. Dominant canopy species within the development site include *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum), *Eucalyptus moluccana* (Grey Box) and *Eucalyptus crebra* (Narrow-leaved Ironbark). Where present, the midstorey is dominated by *Casuarina glauca* (Swamp Oak) and *Bursaria spinosa* (Blackthorn). The ground layer is a mixture of native grasses, predominantly *Microlaena stipoides* (Weeping Meadow Grass),and exotic grasses such as *Ehrharta erecta* (Panic Veldt Grass).

The development site is predominantly located on the Blacktown – Residual soil landscape, characterised by Wianamatta Group shales. The northern portion of the development site is located on the South Creek- Alluvial soil profile. This soil type derives from Wianamatta Group shales and Hawkesbury Sandstone.

This report includes two base maps, the Site Map (Figure 1and Figure 2).

1.1.6 Development site footprint

The development footprint (the area to be impacted) occupies approximately 18.5ha. This is the total area that will be affected by the Masterplan, and includes the building envelopes, access roads, services and areas for machinery and material storage, wastewater disposal and the provision of power and water for construction.

1.1.7 Sources of information used

The following data sources were reviewed as part of this report:

- Biodiversity Assessment Methodology Calculator
- BioNet Vegetation Classification
- BioNet / Atlas of NSW Wildlife 5 km database search (OEH 2018a)
- EPBC Act Protected Matters Search Tool 5 km database search (DotEE 2018)
- The Native Vegetation of the Sydney Metropolitan Area (OEH 2016)

- Aerial mapping (SIXMaps and Nearmap)
- Additional GIS datasets including soil, topography, geology and drainage

Figure 1: Site Map

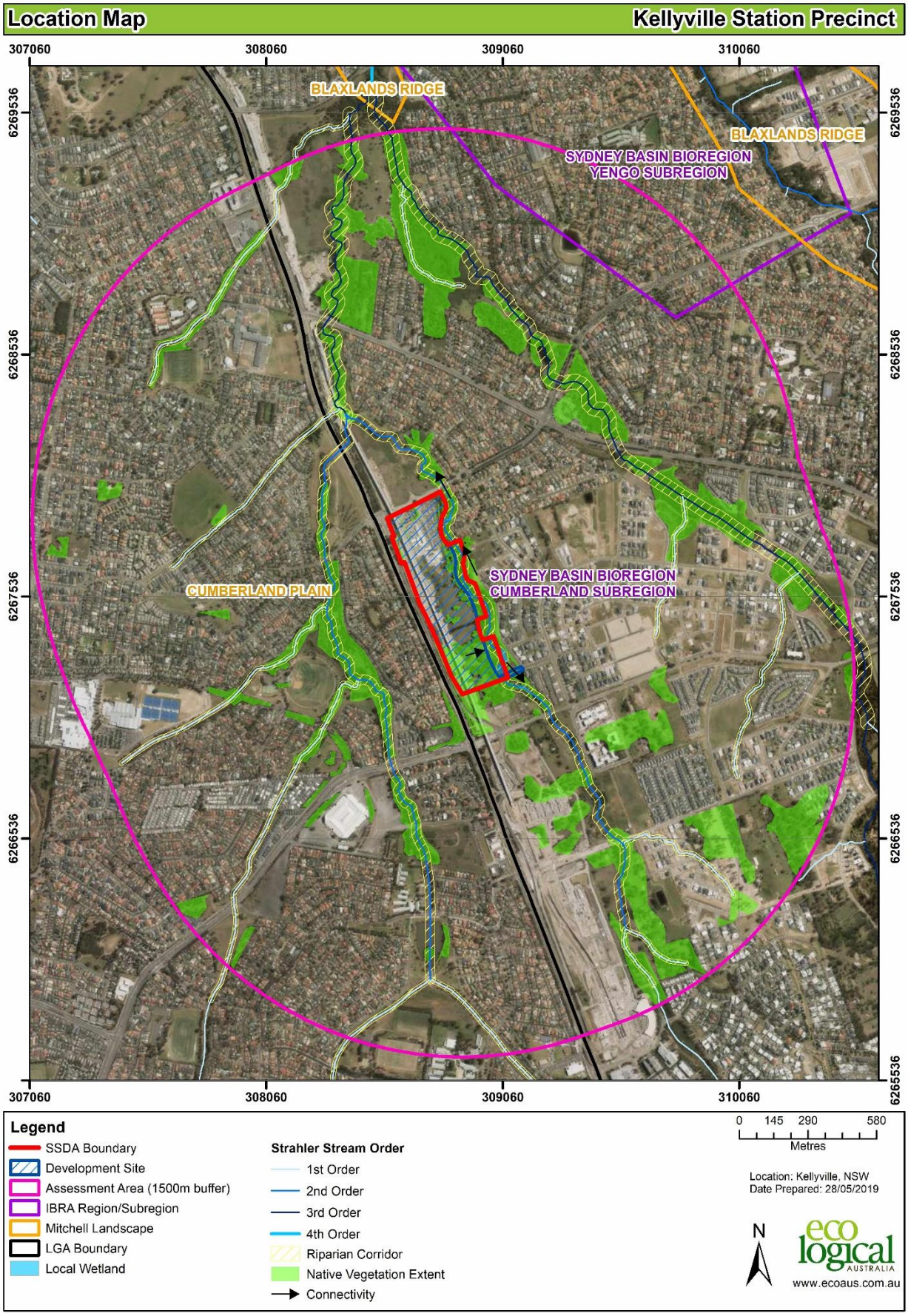

Figure 2: Location Map

1.2 Legislative context

Table 2: Legislative context

Name	Relevance to the project	Report Section
Commonwealth		
Environmental Protection and Biodiversity Conservation Act 1999	Matters of National Environmental Significance (MNES) have been identified on or near the development site. This report assesses impacts to MNES and concludes that the development is likely to have a significant impact on a MNES – Cumberland Plain Shale Woodland and Shale Gravel Transition Forest. It has been recommended that a referral is submitted to the Federal Minister for the Environment.	2.5.1
State		
Environmental Planning and Assessment Act 1979	The proposed development is State Significant Development and is to be assessed under Part 4.1 of the EP&A Act. Secretary's Environmental Assessment Requirements have been issued and require assessment of the development under the BC Act in the form of a BDAR.	All
Biodiversity Conservation Act 2016	The proposed development requires assessment under the BC Act in accordance with the SEARs.	All
Fisheries Management Act 1994	Matters relating to the *Fisheries Management Act 1994* (FM Act) have been addressed in the Riparian Assessment report.	N/A
Local land Services Amendment Act 2016	The LLS Act does not apply to this development.	N/A
Water Management Act 2000	Matters relating to the *Water Management Act 2000* (WM Act) have been addressed in the Riparian Assessment Report.	N/A
Planning Instruments		
Vegetation SEPP	The Vegetation SEPP applies to development that does not require consent. As this project requires consent under the EP&A Act, the Vegetation SEPP is not relevant.	N/A
SEPP (Coastal Management) 2018	The proposed development is not located on land subject to SEPP (Coastal Management) 2018.	N/A
SEPP 44 – Koala Habitat Protection	The proposed development is not located within a Local Government Area to which SEPP 44 applies.	N/A
The Hills Local Environment Plan 2012	Four different land zonings are in place under The Hills Local Environmental Plan (LEP) 2012: • B2 – Local Centre • R1 – General Residential • R4 – High Density Residential • SP2 – Infrastructure The development site does not contain areas mapped on The Hills LEP Terrestrial Biodiversity Map.	N/A
The Hills Development Control Plan (DCP)	No additional considerations relating to terrestrial biodiversity are required under The Hills DCP.	N/A

1.3 Landscape features

1.3.1 IBRA regions and subregions

The development site falls within the Sydney Basin IBRA region and Cumberland subregion

1.3.2 Mitchell Landscapes

The development site falls within the Cumberland Plain Mitchell Landscape as outlined in Table 3.

Table 3: Mitchell Landscapes

Mitchell Landscape	Description
Cumberland Plain	Low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones forming a down-warped block on the coastal side of the Lapstone monocline. Intruded by a small number of volcanic vents and partly covered by Tertiary river gravels and sands (Hawkesbury-Nepean Terrace Gravels ecosystem). Quaternary alluvium along the mains streams. General elevation 30 to 120m, local relief 50m and sometimes affected by salt in tributary valley floors. Pedal uniform red to brown clays on volcanic hills. Red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys Woodlands and open forest of grey box, forest red gum, narrow-leaved ironbark, thin-leaved stringybark, cabbage gum and broad-leaved apple. Grassy to shrubby understorey often dominated by blackthorn, poorly drained valley floors, often salt affected with swamp oak and paperbark.

1.3.3 Rivers and streams

The development site contains rivers and streams as outlined in Table 4.

Table 4: Rivers and streams

River/stream	Order	Riparian buffer
Elizabeth Macarthur Creek	2	20 m

1.3.4 Wetlands

The development site does not contain any mapped important wetlands, however, local wetlands have been identified where PCT 1071 is present. Local wetlands are mapped in Figure 1 and Figure 2.

1.3.5 Connectivity features

The development site contains habitat connectivity outlined in Figure 1 and Figure 2. Vegetation within the development site and riparian corridor provides connectivity across the landscape to the north and south. While vegetation in the development site is intact, vegetation to the north and site is fragmented and connectivity to larger patches of vegetation to the north from the development site would likely only be used by mobile species such as birds, microchiropteran bats (microbats) and *Pteropus poliocephalus* (Grey-headed Flying-fox).

1.3.6 Areas of geological significance and soil hazard features

The development site does not contain areas of geological significance and soil hazard features.

1.3.7 Site context

1.3.7.1 Method applied

The site-based method has been applied to this development.

1.3.7.2 Percent native vegetation cover in the landscape

The current percent native vegetation cover in the landscape was assessed in a Geographic Information System (GIS) using aerial imagery sourced from nearmap and SIXmaps using increments of 5%.

1.3.8 Native vegetation extent

The extent of native vegetation within the assessment buffer is outlined in Table 5.

Table 5: Native vegetation extent

Area within the 1,500 m buffer area (ha)	Native vegetation within the 1,500 m buffer area (ha)	Percent native vegetation within the 1,500 m buffer area
1028.77	118.99	11.57%

1.3.8.1 Patch size

Patch size was calculated using available vegetation mapping for all patches of intact native vegetation on and adjoining the development site. All native vegetation within the development site forms part of a single patch with a total area of 26.24 ha

1.4 Native vegetation

1.4.1 Survey effort

Vegetation survey was undertaken within the development site by Mike Lawrie and Toni Frecker on 7 November 2017, 19 and 25 February 2019 (Figure 4). Habitat assessment surveys were also undertaken during the vegetation surveys. Targeted threatened species surveys were also undertaken, as discussed in Section 1.6.

A total of 9 full-floristic and vegetation integrity plots were surveyed to identify PCTs and TECs on the development site (Table 6).

All field data collected at full-floristic and vegetation integrity plots is included in Appendix B.

Table 6: Full-floristic and vegetation integrity plots

Veg Zone	PCT ID	PCT Name	Condition	Area (ha)	Plots required	Plots surveyed
1	849	Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Degraded	0.22	1	2
2	849	Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate	1.83	1	2
3	849	Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Landscape Plantings	2.1	2	2

Veg Zone	PCT ID	PCT Name	Condition	Area (ha)	Plots required	Plots surveyed
4	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate	0.75	1	2
5	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Revegetation	0.07	1	1
6	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	0.05	1	1

1.4.2 Plant Community Types present

A total of 3 PCTs were identified on the development site (Table 7, Figure 3). Both of these are listed TECs under the TSC and/or EPBC Act (Table 8, Figure 5). Justification for the selection of PCTs occurring on the development site is based on a quantitative analysis of full-floristic plot data and is provided in Section 1.4.3.

Table 7: Plant Community Types

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Area	Percent cleared
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Floodplain Wetlands	Forested Wetlands	0.82	93%
849	Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Valley Grassy Woodlands	Grassy Woodlands	4.15	93%
1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands	Coastal Freshwater Wetlands	0.05	75%

Table 8: Threatened Ecological Communities

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Area (ha)	Listing status	Name	Area (ha)
849	CEEC	Cumberland Plain Woodland in the Sydney Basin Bioregion	2.05	CEEC	Cumberland Plain Woodland in the Sydney Basin Bioregion	1.85
835	EEC	River Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin	0.82	Not Listed	N/A	N/A

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Area (ha)	Listing status	Name	Area (ha)
		and South East Corner Bioregions				
1071	EEC	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.05	Not Listed	N/A	N/A

1.4.3 PCT selection justification

In determining the PCT for the Development Site, various attributes were considered in combination to assign vegetation to the best fit PCT. Attributes included dominant species in each stratum, community composition, soils and landscape position. Reference was made to the PCT descriptions in the BioNet Vegetation Classification, the final scientific determination and other published documents describing the vegetation community.

ELA considered the native vegetation within the development site comprises three native PCTs:

- PCT 849 – Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

1.4.3.1 PCT 849 – Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

PCT 849 makes up vegetation zones 1, 2 and 3 within the development site. This community generally has a grassy open woodland structure and is the dominant vegetation type within the southern half of development site. Previous vegetation mapping (THSC, 2008) classified this vegetation community as Cumberland Plain Woodland, which is equivalent to PCT 849 and PCT 850. This PCT within the development site was dominated by a canopy of *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus moluccana* (Grey Box), *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus eugenioides* (Narrow-leaved Ironbark). The midstorey was sparsely distributed consisting of *Bursaria spinosa* subsp. *spinosa* (Blackthorn) and *Acacia decurrens*. The groundcover was dominated by *Microlaena stipoides* var. *stipoides* (Weeping Meadow Grass), *Themeda triandra* (Kangaroo Grass) and other native grasses and forbs.

A quantitative analysis was undertaken for Plot 6 using the BioNet Vegetation Classification Community Identification tool. Plot 6 was used for the analysis as it was considered to be in the best condition and therefore most representative of the PCT. IBRA region (Sydney Basin Bioregion) and all native species recorded in the plot were entered into the tool. PCT 849 had a total of 6 matches. Two PCTs had nine matches and seven PCTs had seven matches, however, the majority of these PCTs were not consistent due to their location, soil type and description. PCT 835 had seven matches, however, there were no

positive matches for upper stratum species. It was therefore considered that PCT 849 most consistent with zones 1, 2 and 3.

1.4.3.2 PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

PCT 835 makes up vegetation zones 4 and 5 within the development site. This community is located along the riparian corridor running through the development site. Previous vegetation mapping (THSC, 2008) classified this vegetation community as River-Flat Eucalypt Forest, which is equivalent to PCT 835. This PCT within the development site was dominated by a canopy of are *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum) and *Angophora floribunda* (Rough-barked Apple). The mid-storey was consisted of *Bursaria spinosa* subsp. *spinosa* (Blackthorn), *Acacia decurrens* (Black Wattle), *Angophora subvelutina* (Broad-leaved Apple), *Casuarina cunninghamiana* subsp. *cunninghamiana* (River Oak) and dense stands of *Casuarina glauca* (Swamp Oak), in particular at the edge of the creek. Dominant native groundcovers included *Microlaena stipoides* var. *stipoides* and *Dichondra repens.* Zone 5 consists of revegetation works using species consistent with both PCT 849 and 835. Given the location of this zone along the riparian corridor and presence of mid-storey species less likely to be found within PCT 849, including *Casuarina glauca* and *Casuarina cunninghamiana* subsp. *cunninghamiana*, Zone 5 is more consistent with PCT 835.

1.4.3.3 PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

This PCT occurs within small sections of the riparian corridor, typically wider, more open sections of the creek. This PCT is dominated by dense stands of *Typha orientalis* (Broad-leaf Cumbungi) and lower abundance of aquatic species including *Juncus acutus* (Sharp Rush) and *Persicaria decipiens* (Slender Knotweed). This PCT has been classified based on the BioNet Vegetation Classification descriptive attributes and landscape position which describes the PCT as occurring in "man-made water bodies, drainage lines and depressions across a wide variety of environments".

1.4.4 Threatened Ecological Community Justification

1.4.4.1 Cumberland Plain Woodland

PCT 849 is listed as 'wholly a subset of' CPW in BioNet Vegetation Classification. Zone 1 (Degraded) and Zone 2 (Moderate) within PCT 849 are consistent with the TEC CPW based on the BioNet classification in addition to dominant flora species which fits the description of the TEC. These characteristic species include *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus moluccana* (Grey Box), *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus eugenioides* (Narrow-leaved Ironbark) in the canopy, *Bursaria spinosa* subsp. *spinosa* (Blackthorn) and *Acacia decurrens* in the midstorey and groundcover dominated by *Microlaena stipoides* var. *stipoides* (Weeping Meadow Grass) and *Themeda triandra* (Kangaroo Grass). Zone 3 is also within PCT 849, however, while this zone consists of recent planting of species consistent with CPW, it is not considered to be consistent with the TEC. Zone 2 is located on a modified landscape underneath and adjacent to the rail line and it is unlikely that there is a natural soil seed bank of CPW. Therefore, Zone 3 has been excluded from further assessments of CPW, however, has been included within the BAM Assessment for PCT 849.

1.4.4.2 River Flat Eucalypt Forest

PCT 835 is listed as 'largely equivalent to' the TEC River Flat Eucalypt Forest in BioNet Vegetation Classification. It was determined that both zones of PCT 835 are consistent with this TEC based on the

BioNet classification in addition to dominant flora species which fits the description of the TEC. These characteristic species are *Eucalyptus tereticornis, Eucalyptus amplifolia* subsp. *amplifolia* and *Angophora floribunda* in the canopy, *Bursaria spinosa*, *Casuarina glauca* and *Acacia decurrens* in the mid-storey and groundcovers including *Microlaena stipoides* and *Dichondra repens.*

1.4.4.3 Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

PCT 1071 is consistent with the TEC listed Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, listed as endangered under the BC Act. This TEC is described as occurring 'on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes' and dominated by herbaceous species including *Typha orientalis* and *Persicaria decipiens.* The TEC is described as sometimes forming mosaics with other floodplain communities, as occurs with River Flat Eucalypt Forest in the development site. The wetland is only somewhat modified, however, is still considered likely to occur naturally in the drainage line.

1.4.5 Vegetation integrity assessment

A vegetation integrity assessment using the Credit Calculator (BAMC) was undertaken and the results are outlined in Table 9.

Table 9: Vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha)	Composition Condition Score	Structure Condition Score	Function Condition Score	Current vegetation integrity score
1	849	Degraded	0.22	43	28.8	75.6	45.4
2	849	Moderate	1.83	46.8	73	80.1	64.9
3	849	Landscape Plantings	2.1	41	2.5	30.4	14.6
4	835	Moderate	0.75	50.2	62.1	80.9	63.2
5	835	Revegetated	0.07	49.4	21.5	63.8	40.8
6	1071	Moderate	0.05	45.9	42.8	-	44.3

1.4.6 Use of local data

Use of local data is not proposed.

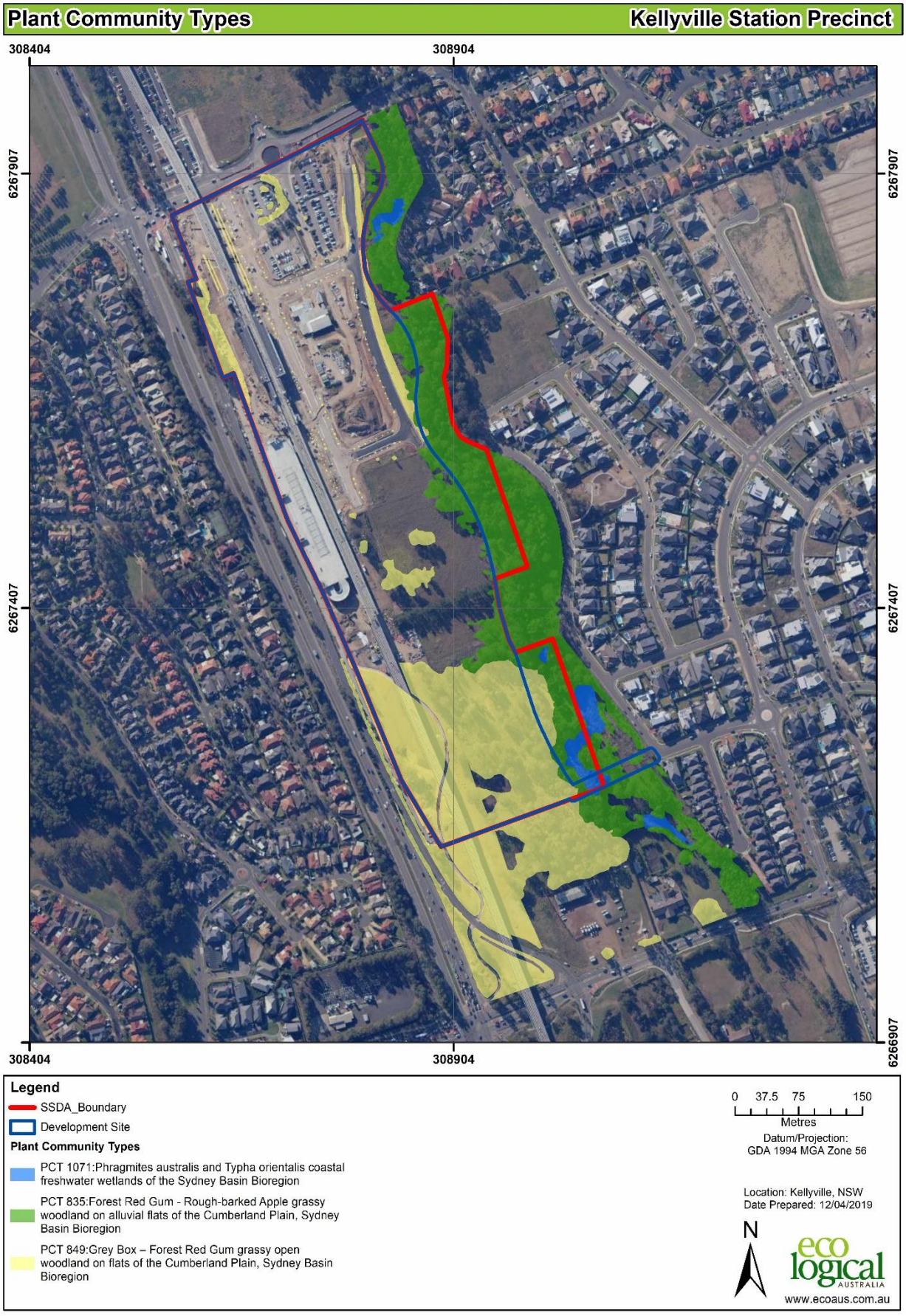

Figure 3: Plant Community Types

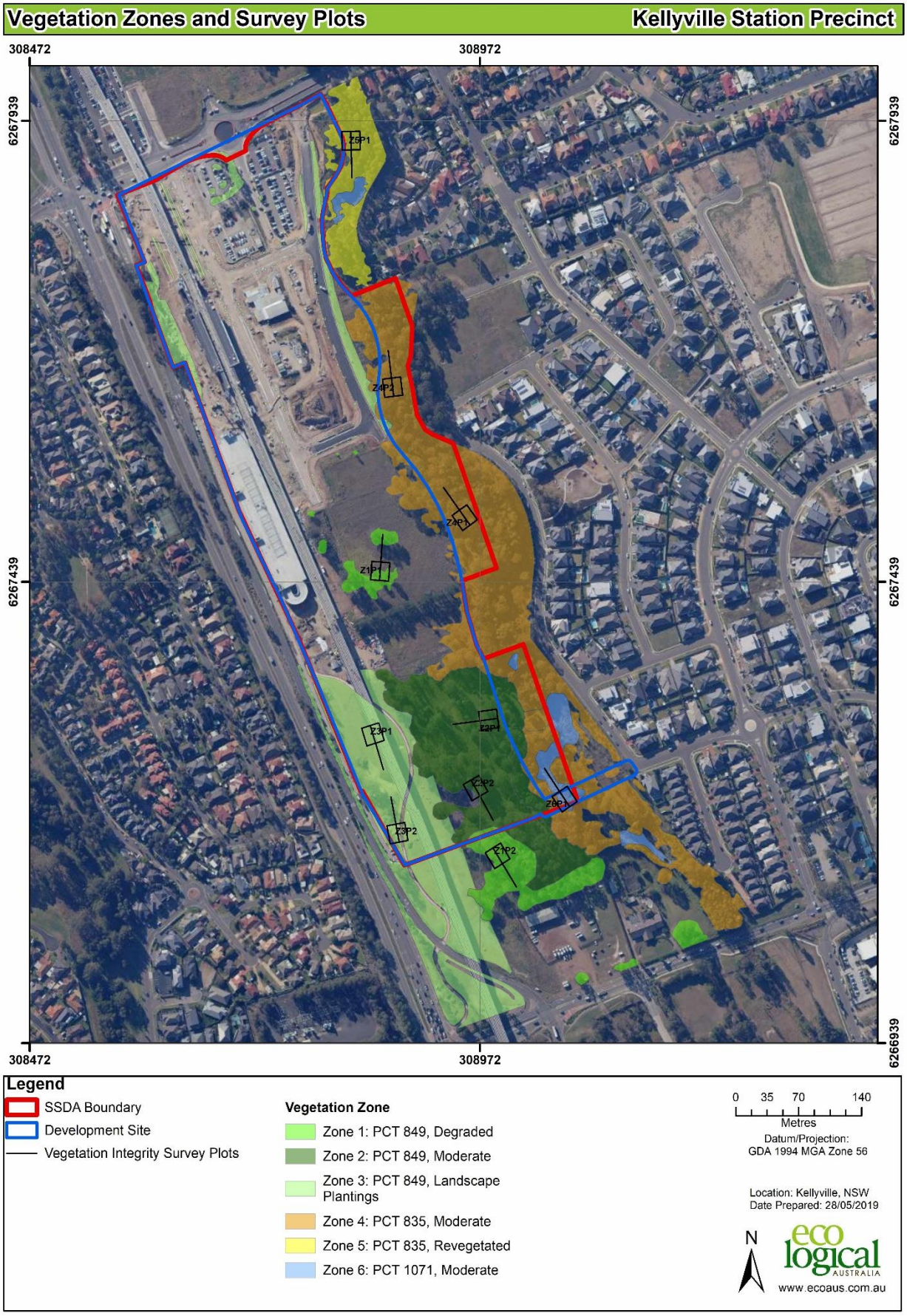

Figure 4: Plot locations

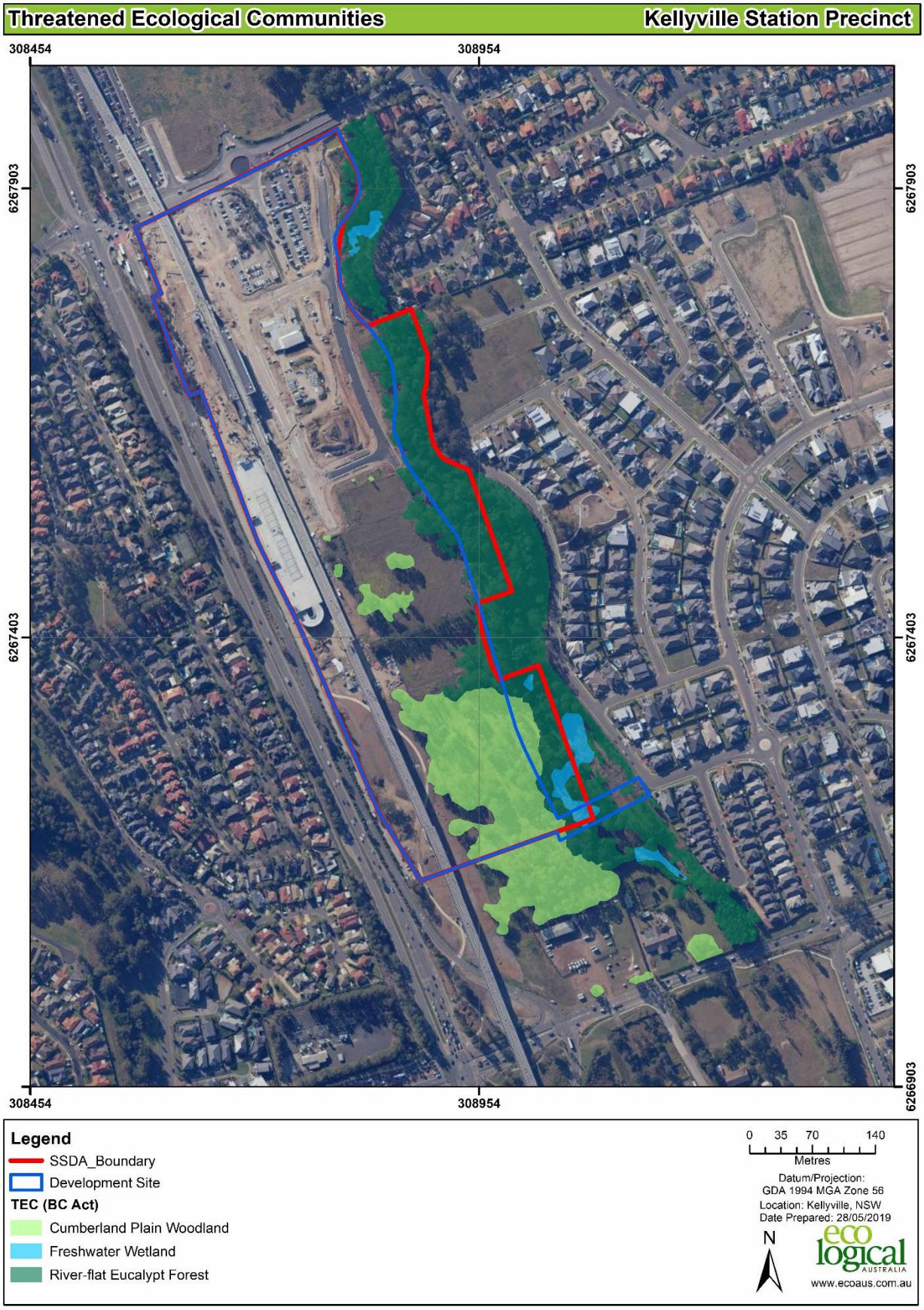

Figure 5: Threatened Ecological Communities

1.5 Threatened Species

1.5.1 Ecosystem credit species

Ecosystem credit species predicted to occur at the development site, their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 10.

Two ecosystem credit species were positively identified during the Anabat survey and three were potentially identified (see Appendix D for details):

- Positively identified:
  - *Mormopterus norfolkensis* (Eastern Coastal Free-tailed Bat)
  - *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)
- Potentially identified
  - *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
  - *Saccolaimus flaviventris* (Yellow-bellied sheath-tailed Bat)
  - *Scoteanax rueppellii* (Greater Broad-nosed Bat)

It is noted that Eastern Bentwing Bat is both an ecosystem credit species and species credit species. Species credits for this species are for impacts on breeding habitat, which is restricted to suitable caves. Suitable breeding habitat is not present within or nearby the development site and therefore Eastern Bentwing Bat is included as an ecosystem credit species only.

Table 10: Predicted ecosystem credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Anthochaera phrygia	Regent Honeyeater			High	Critically Endangered	Critically Endangered	Included Marginal transitory foraging habitat available for this species.
Artamus cyanopterus cyanopterus	Dusky Woodswallow			Moderate	Vulnerable	Not Listed	Included Potential habitat is available within the development site.
Botaurus poiciloptilus	Australasian Bittern	- Waterbodies - Brackish or freshwater wetlands		Moderate	Endangered	Endangered	Excluded This species has not been recorded within 5km of the development site. No suitable wetlands are present within the development site.
Calidris ferruginea	Curlew Sandpiper (Foraging)			High	Endangered	Critically Endangered	Excluded Suitable foraging habitat is not present for this species, which occupies estuaries, mudflats, swamps, lakes and lagoons.
Callocephalon fimbriatum	Gang-gang Cockatoo (Foraging)			Moderate	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Chthonicola sagittata	Speckled Warbler			High	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Circus assimilis	Spotted Harrier			Moderate	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Climacteris picumnus victoriae	Brown Treecreeper			High	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
	(eastern subspecies)						
Daphoenositta chrysoptera	Varied Sittella			Moderate	Vulnerable	Not Listed	Included Potential habitat is available within the development site.
Dasyurus maculatus	Spotted-tailed Quoll			High	Vulnerable	Endangered	Excluded One record only within 5km of the development site. Habitat connectivity is fragmented within the urbanised locality such that this species is unlikely to be present.
Ephippiorhynchus asiaticus	Black-necked Stork	- Swamps - Shallow, open freshwater or saline wetlands or shallow edges of deeper wetlands within 300m of these swamps - Shallow lakes, lake margins and estuaries within 300m of these waterbodies		Moderate	Endangered	Not Listed	Excluded Suitable waterbodies are not present within the development site. The small area of wetland is considered too small and closed to provide suitable habitat for this species.
Epthianura albifrons	White-fronted Chat			Moderate	Vulnerable	Not Listed	Excluded Suitable habitat is not present for this species due to the high level of disturbance of the surrounding landscape and small size of wetland habitat available. No local records.
Glossopsitta pusilla	Little Lorikeet			High	Vulnerable	Not Listed	Included Potential habitat is available within the development site.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Grantiella picta	Painted Honeyeater	- Mistletoes present at a density of greater than five mistletoes per hectare		Moderate	Vulnerable	Vulnerable	Excluded Species has not been recorded within 5km of the development site. Mistletoes not present at required density.
Haliaeetus leucogaster	White-bellied Sea-Eagle			High	Vulnerable	Not Listed	Included Secondary foraging habitat is available within the development site.
Hieraaetus morphnoides	Little Eagle (foraging)			Moderate	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Ixobrychus flavicollis	Black Bittern	- Waterbodies - Land within 40m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation		Moderate	Vulnerable	Not Listed	Excluded Species has not been recorded within 5km of the development site. Small/marginal wetland habitat available within riparian corridor unlikely to be inhabited by Black Bittern.
Lathamus discolor	Swift Parrot			Moderate	Endangered	Critically Endangered	Included Potential foraging habitat is available within the development site.
Limicola falcinellus	Broad-billed Sandpiper (Foraging)			Moderate	Vulnerable	Not Listed	Excluded Suitable waterbodies are not present in the development site.
Limosa limosa	Black-tailed Godwit (Foraging)			High	Vulnerable	Not Listed	Excluded Suitable waterbodies are not present in the development site.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Lophoictinia isura	Square-tailed Kite (Foraging)			High	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)			Moderate	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)			Moderate	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Miniopterus australis	Little Bentwing-bat (Foraging)			High	Vulnerable	Not Listed	Included Potential foraging and secondary roosting habitat is available within the development site.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat (Foraging)			High	Vulnerable	Not Listed	Included Potential foraging habitat and secondary roosting habitat is available within the development site.
Mormopterus norfolkensis	Eastern Freetail-bat			High	Vulnerable	Not Listed	Included Potential foraging and roosting habitat is available within the development site.
Neophema pulchella	Turquoise Parrot			High	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Ninox connivens	Barking Owl (Foraging)			High	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Ninox strenua	Powerful Owl (Foraging)			High	Vulnerable	Not Listed	Included

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
							Potential foraging habitat is available within the development site.
Pandion cristatus	Eastern Osprey			Moderate	Vulnerable	Not Listed	Excluded Habitat is not present in the development site for this species which inhabits coastal areas or areas with open waterbodies.
Petroica boodang	Scarlet Robin			Moderate	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Petroica phoenicea	Flame Robin			Moderate	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Phascolarctos cinereus	Koala			High	Vulnerable	Vulnerable	Excluded Species has not been recorded within 5km of the development site. Habitat connectivity is fragmented within the urbanised locality such that this species is unlikely to be present.
Pteropus poliocephalus	Grey-headed Flying-fox			High	Vulnerable	Vulnerable	Included Potential foraging habitat is available within the development site.
Rostratula australis	Australian Painted Snipe			Moderate	Endangered	Endangered	Excluded Suitable habitat is not present for this species. No local records.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat			High	Vulnerable	Not Listed	Included Potential foraging and roosting habitat is available within the development site.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Stagonopleura guttata	Diamond Firetail			Moderate	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Stictonetta naevosa	Freckled Duck			Moderate	Vulnerable	Not Listed	Excluded Suitable waterbodies not present within the development site.
Tyto novaehollandiae	Masked Owl (Foraging)			High	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.

1.6 Species credit species

Species credit species predicted to occur at the development site (i.e. candidate species), their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 11.

Table 11: Candidate species credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Acacia bynoeana	Bynoe's Wattle			High	E	V	Excluded Suitable habitat is not present within the development site due to unsuitable soil type (occurs on sandy soils) and lack of associated species (Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple)
Acacia pubescens	Downy Wattle			High	V	V	Included Potential habitat is available within the development site. Not recorded during targeted flora survey.
Anthochaera phrygia	Regent Honeyeater	- OEH mapped areas		High	CE	CE	Excluded The development site does not contain mapped important areas.
Burhinus grallarius	Bush Stone-curlew	Fallen/standing dead timber including logs		High	E	Not Listed	Excluded Habitat within the development site is substantially degraded such that the species is unlikely to utilise the subject land in accordance with Section 6.4.1.17 of the BAM.
Caladenia tessellata	Thick Lip Spider Orchid			Moderate	E	V	Excluded Species not recorded within 5km of the development site. Habitat modified/degraded such that species is unlikely to be present.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Calidris ferruginea	Curlew Sandpiper (breeding)			High	E	CE	Excluded Suitable habitat is not present for this species.
Callistemon linearifolius	Netted Bottlebrush			High	V	Not Listed	Included This species was included in the targeted survey. No individuals were recorded.
Callocephalon fimbriatum	Gang-gang Cockatoo	- Eucalypt tree species with hollows >9 cm diameter		High	V	Not Listed	Excluded Only one known population of this species in Sydney within Hornsby and Ku-ring-gai LGAs. Development site is outside of population boundary for this species.
Cercartetus nanus	Eastern Pygmy Possum			High	V	Not Listed	Excluded Habitat within the development site is substantially degraded such that the species is unlikely to utilise the subject land in accordance with Section 6.4.1.17 of the BAM. Suitable habitat (well-developed mid-storeys containing nectar-producing shrubs such as Banksia spp.) is not present.
Chalinolobus dwyeri	Large-eared Pied Bat	- Cliffs - Within 2km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices, or within 2km of old mines or tunnels		Very High	V	V	Excluded No suitable cliffs, mines or tunnels are known to be within 2km of the development site.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Commersonia prostrata	Dwarf Kerrawang						Excluded Associated soil and vegetation type not present in development site. No local records.
Cynanchum elegans	White-flowered Wax Plant			High	E	E	Excluded Associated habitat in the region (Dry Rainforest) not present within or adjacent to the development site. No records within 5km of the development site.
Dillwynia tenuifolia				Moderate	V	Not Listed	Included Marginal habitat is available for this species which is more commonly associated with Castlereagh Ironbark Forest, Shale Gravel Transition Forest and Castlereagh Scribbly Gum Woodland. No records within 5km of the development site.
Dillwynia tenuifolia – endangered population	Dillwynia tenuifolia, Kemps Creek		- The area bounded by western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool Local Government Area	N/A	E2	Not Listed	Excluded Development site outside the geographic limitation for this endangered population.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Eucalyptus benthamii	Camden White Gum			High	V	V	Excluded No records within 5km of the development site. Conspicuous species not recorded during field surveys. Known only from two populations on the Nepean River and its tributaries.
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea			High	V	Not Listed	Included Potential habitat is present for this species. Not recorded during targeted survey.
Haliaeetus leucogaster	White-bellied Sea-eagle (Breeding)	- Living or mature dead trees within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines AND the presence of a large stick nest in the canopy		High	V	Not Listed	Excluded No breeding habitat (large stick nests) present in the development site.
Haloragis exalata subsp. *exalata*	Square Raspwort			Moderate	Vulnerable	Vulnerable	Excluded No local records or known populations in the Sydney region.
Hibbertia sp. *Bankstown*				N/A	CE	CE	Excluded Species known from only one population at Bankstown. Associated vegetation type (Castlereagh Ironbark Forest/ Castlereagh Scribbly Gum Woodland) not present within development site. No records within 5 km of the development site.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Hieraaetus morphnoides	Little Eagle (Breeding)	- Nest trees – live (occasionally dead) large old trees within vegetation		Moderate	V	Not Listed	Excluded No large nests present within development site.
Lathamus discolor	Swift Parrot (Breeding)	- As per OEH mapped areas		Moderate	E	CE	Excluded Not within OEH mapped area.
Limicola falcinellus	Broad-billed Sandpiper (Breeding)			High	Vulnerable	Not Listed	Excluded Suitable habitat is not present for this species.
Limosa limosa	Black-tailed Godwit (Breeding)			High	Vulnerable	Not Listed	Excluded Suitable habitat is not present for this species.
Litoria aurea	Green and Golden Bell Frog	- Within 1km of wet areas - Within 1km of swamp - Within 1km of waterbody		High	E	V	Included This species was included in the targeted survey. No individuals were recorded.
Lophoictinia isura	Square-tailed Kite (Breeding)	- Nest trees		Moderate	V	Not Listed	Excluded No large nests present within development site.
Marsdenia viridiflora subsp. *viridiflora* – *endangered population*	*Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas		Those LGAs named in the population's listing	High	E2	Not Listed	Excluded Development site not within geographic limitation for this endangered population.
Maundia triglochinoides		- Swamps					Excluded

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
		- Swamps or shallow fresh water on clay					Limited records within the Sydney region, restricted to low lying area near the mouth of the Georges River. Associated with more coastal habitat.
Melaleuca biconvexa	Biconvex Paperbark	- Swamps - Swamp margins or creek edges		High	V	V	Included Marginal habitat available for this species
Meridolum corneovirens	Cumberland Plain Land Snail			High	E	Not Listed	Included This species was included in the targeted survey. No individuals were recorded.
Miniopterus australis	Little Bentwing-bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding		Very High	V	Not Listed	Excluded Species known only to breed in maternity caves. No breeding habitat present in the development site.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding		Very High	V	Not Listed	Excluded Species known only to breed in maternity caves. No breeding habitat present in the development site.
Myotis macropus	Southern Myotis	- Hollow-bearing trees - Within 200m of a riparian zone - Bridges, caves or artificial structures within 200m of riparian zone		High	V	Not Listed	Included This species was recorded during the targeted survey.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Ninox connivens	Barking Owl (Breeding)	Living or dead trees with hollows >20cm diameter and >4m above the ground		High	V	Not Listed	Excluded No suitable breeding hollows are present in the development site.
Ninox strenua	Powerful Owl (Breeding)	Living or dead trees with hollows >20cm		High	V	Not Listed	Excluded No suitable breeding hollows are present in the development site.
Pandion cristatus	Eastern Osprey (Breeding)	Living and dead trees (>15m) or artificial structures within 100m of a floodplain		Moderate	V	Not Listed	Excluded No large nests present in development site. No records within 5km of development site. No suitable large open waterbodies in proximity to the development site.
Persicaria elatior	Tall Knotweed	- Semi-permanent/ephemeral wet areas or within 50m - Swamps or within 50m - Waterbodies including wetlands, or within 50m		Moderate	V	V	Included This species was included in the targeted survey. No individuals were recorded.
Persoonia bargoensis	Bargo Geebung			High	E	V	Excluded Associated soil profile (sandstone or shale-sandstone transition soils) are not present in the development site. Known northern limit of the range is Douglas Park and Picton, over 50km south of the development site.
Persoonia hirsuta	Hairy Geebung			High	E	E	Excluded

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
							No habitat is present in the development site for this species which occurs in woodland on heath on sandstone.
Petaurus norfolcensis	Squirrel Glider			High	V	Not Listed	Excluded Habitat within the development site is substantially degraded such that the species is unlikely to utilise the subject land in accordance with Section 6.4.1.17 of the BAM.
Phascolarctos cinereus	Koala (Breeding)	- Areas identified as important habitat via survey		High	V	V	Excluded Habitat within the development site is substantially degraded such that the species is unlikely to utilise the subject land in accordance with Section 6.4.1.17 of the BAM. Potential foraging trees (*Eucalyptus tereticornis*) occur in low abundance.
Pilularia novae-holandiae	Austral Pillwort			High	E	Not Listed	Excluded Preferred habitat not present, only recorded in drying mud. Species has not been recorded within 5km of the development site. No known extant populations in the Sydney region.
Pimelea curviflora var. *curviflora*				High	V	V	Included This species was included in the targeted survey. No individuals were recorded.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Pimelea spicata	Spiked Rice-flower			High	E	E	Included This species was included in the targeted survey. No individuals were recorded.
Pomaderris brunnea	Brown Pomaderris			High	E	V	Included This species was included in the targeted survey. No individuals were recorded.
Pommerhelix duralensis	Dural Woodland Snail	- Leaf litter and shed bark or within 50m od litter or bark - Rocks or within 50m of rocks - Fallen/standing dead timber including logs and bark or within 50m of logs or bark		High	E	E	Included This species was included in the targeted survey. No individuals were recorded.
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	- Breeding camps		High	V	V	Excluded No camps present in development site.
Pterostylis saxicola	Sydney Plains Greenhood			High	E	E	Excluded Suitable habitat not present, typically occurs on sandstone rock shelves above cliff lines. No records within 5km of development site.
Pultenaea pedunculata	Matted Bush-pea			N/A	E	Not Listed	Included This species was included in the targeted survey. No individuals were recorded.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
Thesium australe	Austral Toadflax			High	V	V	Included This species was included in the targeted survey. No individuals were recorded.
Tyto novaehollandiae	Masked Owl (Breeding)	Living or dead trees within hollows >20cm diameter		High	V	Not Listed	Excluded Suitable breeding hollows not present in development site.
Wahlenbergia multicaulis endangered population	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	- Land situated in damp, disturbed sites		High	E2	Not Listed	Included This species was included in the targeted survey. No individuals were recorded.
Zannichellia palustris		- Waterbodies - Land containing freshwater bodies		High	E	Not Listed	Included Marginal habitat available within development site.

1.6.1 Targeted surveys

Targeted surveys for species credit species were undertaken at the development site on the dates outlined in Table 12. The location of targeted surveys are shown on Figure 6 with the results of the surveys shown as individual species polygons on Figure 7.

Table 12: Targeted surveys

Date	Surveyors	Target species
11 November 2017	Mike Lawrie and Toni Frecker	Random meander flora survey and habitat assessment
29 January 2018	Mike Lawrie and Stacey Wilson	Cumberland Plain Land Snail, threatened flora, hollow-bearing tree survey and bird of prey nest survey
27 February 2018	Mike Lawrie and Stacey Wilson	Green and Golden Bell Frog
28 February 2018	Mike Lawrie and Stacey Wilson	Green and Golden Bell Frog
1 March 2018	Mike Lawrie and Stacey Wilson	Green and Golden Bell Frog, Cumberland Plain Land Snail
15 March 2018	Mike Lawrie	Green and Golden Bell Frog
25 May 2018	Mike Lawrie	Targeted flora survey
18 - 25 February 2019	Mike Lawrie (set anabats), Rodney Armistead (analysis)	Southern Myotis, additional microchiropteran bats
19 February 2019	Mike Lawrie and Toni Frecker	Targeted flora survey
25 February 2019	Mike Lawrie	Cumberland Plain Land Snail
5 May 2019	Mike Lawrie	Random meander flora survey (southern access road)

Weather conditions during the targeted surveys are outlined in Table 13.

Table 13: Weather conditions

Date	Rainfall (mm)	Minimum temperature °C	Maximum temperature °C
11 November 2017	0	9.8	24.0
29 January 2018	0	20.7	30.8
27 February 2018	5.4	15.4	25.2
28 February 2018	0	13.6	33.8
1 March 2018	0	19.6	26.2
15 March 2018	0.2.	18.6	36.3
25 May 2018	0	11.3	19.9
18 February 2019	0	39.5	21.3
19 February 2019	0	21.2	35.5
20 February 2019	1.2	18.2	24.1
21 February 2019	3.4	18.6	24.2
22 February 2019	4.8	17.8	26.3
23 February 2019	0	16.1	24.3
24 February 2019	0	17.2	27.0

Date	Rainfall (mm)	Minimum temperature °C	Maximum temperature °C
25 February 2019	0.2	16.5	27.3
14 May 2019	0	9.4	22.3

Survey effort undertaken at the development is outlined in Table 14.

Table 14: Survey effort

Candidate species	Survey method	Dates	Survey effort	BAM survey period	Species present
Litoria aurea	Habitat search, call playback	27/02/18 28/02/18 01/03/18 15/03/18	2 hours x 2 ecologists 2 hours x 2 ecologists 2 hours x 2 ecologists 2 hours x 1 ecologist	November - March	No
Meridolum corneovirens	Targeted search	29 /01/18 01/03/18 25/02/19	1 day x 2 ecologists 1 hour x 1 ecologist Half day x 1 ecologist	All year	No
Myotis macropus	Acoustic detection	18/02/19 – 25/02/19	18 nights (3 Anabats x 6 nights)	September March	Yes (potential)
Pommerhelix duralensis	Targeted search	29 January 2018 25 February 2019	1 day x 2 ecologists, Half day x 1 ecologist	All year	No
Acacia pubescens	Parallel transect (PT), random meander survey (RM)	11/11/17 29/01/18 25/05/18 19/02/19 14/05/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT) 1 hour x 1 ecologist (RM)	All year	No
Callistemon linearifolius	Parallel transect, random meander survey	11/11/17 29/01/18 25/05/18 19/02/19 14/05/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT) 1 hour x 1 ecologist (RM)	September – March Note: 2 surveys undertaken outside BAM survey period, however, significant survey undertaken within period, conspicuous species detectable outside survey period.	No
Dillwynia tenuifolia	Parallel transect, random meander survey	11/11/17 29/01/18 25/05/18 19/02/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT)	All year	No

Candidate species	Survey method	Dates	Survey effort	BAM survey period	Species present
		14/05/19	1 hour x 1 ecologist (RM)		
Grevillea juniperina* subsp. *juniperina	Parallel transect, random meander survey	11/11/17 29/01/18 25/05/18 19/02/19 14/05/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT) 1 day x 1 ecologist	All year	No
Melaleuca biconvexa	Biconvex Paperbark	11/11/17 29/01/18 25/05/18 19/02/19 14/05/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT) 1 hour x 1 ecologist (RM)	All year	No
Persicaria elatior	Parallel transect, random meander survey	11/11/17 29/01/18 25/05/18 19/02/19 14/05/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT) 1 hour x 1 ecologist (RM)	Dec - May	No
Pimelea curviflora* var. *curviflora	Parallel transect, random meander survey	11/11/17 29/01/18 25/05/18 19/02/19 14/05/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT) 1 hour x 1 ecologist (RM)	All year	No
Pimelea spicata	Parallel transect, random meander survey	11/11/17 29/01/18 25/05/18 19/02/19 14/05/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT) 1 hour x 1 ecologist (RM)	All year	No
Pomaderris brunnea	Parallel transect, random meander survey	11/11/17 29/01/18 25/05/18 19/02/19 14/05/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT) 1 hour x 1 ecologist (RM)	All year	No
Pultenaea pedunculata	Parallel transect, random meander survey	11/11/17 29/01/18 25/05/18 19/02/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT)	Sep – Nov Note: 1 day random meander survey undertaken	No

Candidate species	Survey method	Dates	Survey effort	BAM survey period	Species present
		14/05/19	1 hour x 1 ecologist (RM)	within BAM survey period, however, significant survey undertaken outside period, conspicuous species detectable outside survey period.	
Wahlenbergia multicaulis endangered population	Parallel transect, random meander survey	11/11/17 29/01/18 25/05/18 19/02/19 14/05/19	1 day x 2 ecologists (RM) 1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 day x 2 ecologists (RM, PT) 1 hour x 1 ecologist (RM)	All year	No
Zannichellia palustris	Parallel transect, random meander survey	11/11/17 25/05/18 14/05/19	1 day x 2 ecologists (RM) 1 day x 1 ecologist (PT) 1 hour x 1 ecologist (RM)	Mar - Nov	No

Note: RM = Random Meander, PT = Parallel Transect

Following completion of targeted surveys, the species credit species included in the assessment are outlined in Table 16.

Table 15: Results of habitat tree survey

Hollow-bearing Tree No.	Hollows/Habitat present	Removal Required
NEST1	1 x Nest- likely Australian Raven	Potential
NEST2	2 x Installed Nest Box	Potential
STAG1	No hollows seen	Yes
HBT1	1 x Medium	Potential
STAG2	No hollows seen	Potential
HBT2	2 x Small, worn at entrance potential parrot nesting	No
HBT3	1 x Medium – shallow spout	No
HBT4	1 x Small – dead spout	No
STAG3	1 x Medium 1 x Small	No
HBT5	1 x Medium spout	No
HBT6	2 x Small – dead branch hollows	No
STAG4	1 x Small	No
HBT7	1 x Medium – live branch hollow	No

Hollow-bearing Tree No.	Hollows/Habitat present	Removal Required
HBT8	1 x Small (possible)	No
STAG5	Loose bark	Yes
HBT9	1 x Small (possible)	Potential
HBT10	1 x Medium (possible)	Yes
HBT11	1 x Large – Open crack trunk, shallow	Potential
HBT12	1 x Medium	Yes
HBT13	2 x Medium	Yes
HBT14	1 x Small (possible)	Yes
HBT15	1 x Medium	No
STAG6	No hollows seen	No
STAG7	No hollows seen	No
STAG8	No hollows seen	No
HBT16	1 x Medium	No
HBT17	1 x Medium	No
HBT18	1 x Large – Open dead limb, not deep cavity	No
STAG9	1 x Medium 1 x Small	No
STAG10	1 x Large – shallow, filled with litter 1 x Medium	No
HBT19	2 x Medium	Yes
HBT20	1 x Medium	Yes
STAG11	2 x Small	Yes

Note: An Arborist Assessment would be required to accurately determine which hollow-bearing trees would be required to be removed and therefore additional habitat trees may require removal.

Table 16: Species credit species included in the assessment

Species	Common Name	Species presence	Zones present	Habitat (ha)	Biodiversity Risk Weighting
Myotis macropus	Southern Myotis	Yes (surveyed) – potential calls	1,2,3,4,5,6	5.02	2.00

Figure 6: Targeted surveys (note 11/11/17 and 29/01/18 survey tracks not shown)

Figure 7: Species polygons

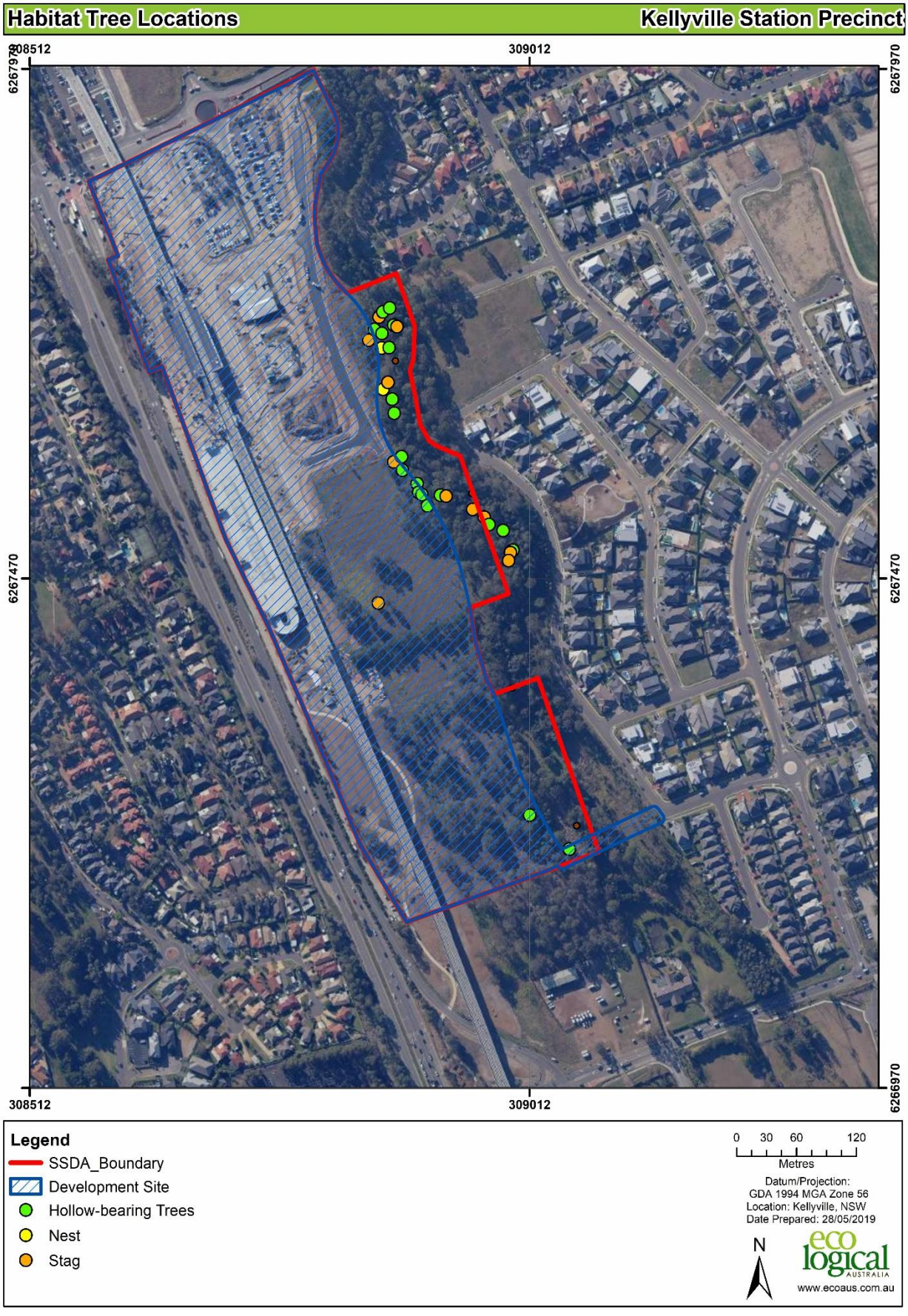

Figure 8: Location of habitat trees

1.6.2 Use of local data

Use of local data is not proposed.

1.6.3 Expert reports

Expert reports have not been used for this project.

2. Stage 2: Impact assessment (biodiversity values)

2.1 Avoiding impacts

2.1.1 Locating a project to avoid and minimise impacts on vegetation and habitat

The strategic context and rationale for the project is outlined in Section 1.1.2. The location of the Kellyville Station Precinct was determined through strategic assessment and the site layout has been developed in accordance with the NSW Government's housing and employment targets for the station precincts and would result in unavoidable impacts on existing Cumberland Plain Woodland vegetation located outside of the Elizabeth Macarthur Creek riparian corridor. Combined residential yields projected within the boundaries of the Kellyville concept SSD application sites fall short of the projected NSW Government housing targets due to existing site constraints. Restricting envisaged and planned development within areas of existing vegetation would further compromise the attainment of the housing and employment targets for the locality.

Due to the strategic context and location of the development site, further retention of larger areas of Cumberland Plain Woodland were not considered feasible by the proponent. Justification, as described by the proponent, is provided below:

"In August 2014, the NSW Government endorsed The Hills Shire Council's nomination for the Kellyville and Bella Vista Station Precincts becoming Priority Precinct (now referred to as Planned Precincts) as a means of implementing the land use and transport planning strategies identified in the North West Rail Link Corridor Strategy (2013).

The key objectives of the Planned Precinct program and NWRL Corridor Strategy were to provide for new housing and jobs in centres with good transport connections to make it easier for people to get to and from home and work and to ensure that supporting infrastructure is provided to meet predicted housing and employment demands.

The Kellyville and Bella Vista Station Precincts were identified to accommodate the housing and employment demands outlined in the NSW Government's A Plan for Growing Sydney (2014).

Both precincts were investigated by qualified ecologists to assess the biodiversity and riparian values as part of the broader precinct planning/rezoning process, including lands within the boundary of each concept SSD application site. The assessments identified areas of ecological value that should be retained and protected and identified areas of likely impact, which in turn informed the draft rezonings and accompanying precinct structure plans that were exhibited between 7 December 2015 and 28 February 2016.

At the time, the Office of Environment and Heritage advised it supported the use of E2 Environmental Conservation zones for areas of high ecological constraint that were to be retained. The Department noted in its Precinct Finalisation Reports, that:

- *most of the mapped ecological communities occurred within riparian corridors that would retain their existing RE1 Public Recreation or SP2 Infrastructure land use zoning*

- *future development would need to minimise potential Cumberland Plain Woodland impacts and conditions of consent may be required to mitigate against potential ecological impacts*
- *future development control plans should incorporate provisions to ensure vegetation impacts were minimised and mitigated.*

The Department's Precinct Finalisation Reports did not recommend additional site-specific environmental conservation land use controls to protect existing native vegetation nor did they recommend that any land identified within the concept SSD application sites be added to The Hills Local Environmental Plan 2012 (THLEP 2012) biodiversity (terrestrial) map.

On 1 December 2017, the Kellyville and Bella Vista Station Precincts were subsequently rezoned when the then Minister for Planning approved State Environmental Planning Policy Amendment (Bella Vista and Kellyville Station Precincts) 2017 that amended State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) and THLEP 2012.

The approved rezonings were made on the basis that both station precincts carried significant strategic merit and would:

- *maximise the use of the Sydney Metro North West and other public transport infrastructure*
- *provide more jobs closer to homes, promote public transport to employment areas, whereby reducing the need for private vehicle trips*
- *respond to the strong current and future predicted demand for additional employment and housing.*

The rezonings and proposed urbanisation of both precincts strongly align with the Greater Sydney Commission's housing and employment targets for The Hills Shire as set out in its Central City District Plan and associated priorities and actions. This includes the priority of accommodating the predicted growth demand of 207,500 dwellings across the district by the year 2036.

The retention of remnant Cumberland Plain Woodland patches outside of the riparian corridors and existing RE1 zoned land would compromise the NSW Government's priorities and actions for the Central City District from being realised. Areas of Cumberland Plain Woodland and other areas of native vegetation are proposed to be retained within planned open space areas and other site locations where their retention is practical.

No physical works are proposed and future applications for the detailed design and construction of civil infrastructure and built form would further investigate the potential for the retention of native vegetation within allotments and open space parkland areas. For abundant caution, all identified areas that are likely to be impacted by future development are proposed to be adequately offset through the purchase and retirement of the necessary credits."

The following key points are emphasised in the site selection and reasoning for not further reducing impacts to Cumberland Plain Woodland, whilst still achieving the state government targets for housing and employment:

- The sites were reviewed by technical experts which informed the preparation of the Kellyville and Bella Vista Structure Plans, which in turn informed the rezoning of the sites. The structure

plans identify a layout, which proposed residential development over the Cumberland Plain Woodland remnant patches.

- The sites were rezoned by DPIE on the basis that the sites carry significant strategic merit as housing and employment providers – contributing to the meeting of state government targets/objectives (GSC district plans housing and jobs targets).
- Retention of remnant CPW patches in this location, would not allow for state government priorities/policies to be realised.
- Areas of Cumberland Plain Woodland and other native vegetation are proposed to be retained where the retention of these trees is practicable. Opportunities exist in proposed open space areas to retain and rehabilitate some areas of Cumberland Plain Woodland.
- All Cumberland Plain Woodland directly impacted/cleared will be adequately offset via the purchase of appropriate credits.
- Cumberland Plain Woodland trees within the development footprint will be investigated for retention where appropriate during the detailed design phase including within development lots and parks.

The development has been located in a way which avoids and minimises impacts as outlined in Table 17.

Table 17: Locating a project to avoid and minimise impacts on vegetation and habitat

Approach	How addressed	Justification
locating the project in areas where there are no biodiversity values	Where possible the development has utilised areas where there are no biodiversity values.	Where possible, the development has been located in areas where there are no biodiversity values such as cleared and exotic areas. Parts of the of the development are located in areas that contain biodiversity values, however, the development has been located to avoid the majority of the riparian corridor and 0.17 ha of Cumberland Plain Woodland. Impacts to Cumberland Plain Woodland could not be further reduced while still achieving the required targets for housing and employment to be provided by the precinct. Impacts of the development within areas containing biodiversity values will be appropriately offset with additional opportunities for Cumberland Plain Woodland to be retained in open space areas and streetscape to be considered during detailed design phase where possible.
locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition	Where possible, the project has utilised areas where native vegetation is in poorest condition.	Where possible, the development has been located in areas where vegetation and threatened species habitat is in the poorest condition including cleared areas or exotic vegetation. The development has been located to avoid the riparian corridor which contains moderate condition River Flat Eucalypt Forest. 0.17 ha of moderate condition Cumberland Plain Woodland will be retained and managed within the riparian corridor. 2.05 ha of Cumberland Plain Woodland will be cleared however this will be appropriately offset with additional opportunities for Cumberland Plain Woodland to be retained in open

Approach	How addressed	Justification
		space areas and streetscape to be considered during detailed design phase where possible. Further reduction of impacts to native vegetation could not be further achieved while still meeting the required targets for housing and employment to be provided by the precinct.
locating the project in areas that avoid habitat for species and vegetation in high threat categories (e.g. an EEC or CEEC), indicated by the biodiversity risk weighting for a species	Where possible, the development has utilised areas that do not contain habitat for species and vegetation in high threat categories.	Where possible, the project has utilised areas that do not contain vegetation and habitat for species in high threat categories, for example cleared land and exotic vegetation. The development has been located to avoid the majority of the riparian corridor which the EEC River Flat Eucalypt Forest and provides habitat for threatened fauna species. Impacts to Cumberland Plain Woodland could not be further reduced while still achieving the required targets for housing and employment to be provided by the precinct. Impacts to threatened species and vegetation in high threat categories will be appropriately offset.
locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained	The project is located such that connectivity enabling movement of species and genetic material between areas of adjacent habitat will be maintained.	The project is located outside of the riparian corridor, which forms a vegetated corridor providing habitat connectivity across the local landscape. The location of the project will allow continued movement of species and genetic material north from the development site to larger areas of habitat.

2.1.2 Designing a project to avoid and minimise impacts on vegetation and habitat

The development has been designed in a way which avoids and minimises impacts as outlined in Table 18.

Table 18: Designing a project to avoid and minimise impacts on vegetation and habitat

Approach	How addressed	Justification
reducing the clearing footprint of the project	Impacts have been avoided where possible within the scope the development resulting in the retention of the majority of vegetation within the riparian corridor. Further reduction in vegetation removal could not be achieved while still meeting required housing and employment targets for the precinct.	The project will avoid impacts to the majority of the riparian corridor and 0.17 ha of Cumberland Plain Woodland. Opportunities for retention and rehabilitation of native vegetation within open space areas will be considered during the detailed design phase. Further reduction of the clearing footprint could not be achieved while still meeting the housing and employment targets of the precinct.
locating ancillary facilities in areas where there are no biodiversity values	Ancillary facilities will be located within the operational footprint, avoiding additional impacts on biodiversity values.	Ancillary features for the purposes of construction will be located within the operational footprint, avoiding

Approach	How addressed	Justification
		additional impacts to areas containing biodiversity values.
locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	Ancillary facilities will be located within the operational footprint and will not result in removal of additional vegetation or threatened species habitat.	Ancillary features for the purposes of construction will be located within the operational footprint, avoiding additional impacts to areas of native vegetation or threatened species habitat.
locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	Ancillary facilities will be located within the operational footprint and will not result in additional removal of threatened species habitat or vegetation in in high threat categories.	Ancillary features for the purposes of construction will be located within the operational footprint, avoiding additional impacts threatened species habitat or vegetation in high threat categories.
providing structures to enable species and genetic material to move across barriers or hostile gaps	The development will not include structures to enable species and genetic material to move across barriers or hostile gaps.	It is considered unnecessary to provide structures to allow movement of species and genetic material across gaps. The vegetated riparian corridor adjacent to the development footprint will be retained enabling continued connectivity and movement of genetic material in a north-south direction across the local landscape.
making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.	Recommendations pertaining to the demarcation and maintenance of retained native vegetation have been provided.	The boundaries of the development footprint are to be clearly demarcated prior to commencement of construction to protect retained native vegetation. It is recommended that a Vegetation Management Plan (VMP) be prepared and implemented within the riparian corridor directly to the east of the development site to protect enhance retained native vegetation. Additional tree retention will be considered and implemented where feasible during the detailed design phase.

2.1.3 Prescribed biodiversity impacts

The development site has the prescribed biodiversity impacts as outlined in Table 19.

Table 19: Prescribed biodiversity impacts

Prescribed biodiversity impact	Description in relation to the development site	Threatened species or ecological communities effected
impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.	The proposed development will result in the removal of non-native vegetation. A row of mature planted pine trees will require removal.	Microbats and avifauna
impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	The proposed development will impact a small section of wetland/water (0.05 ha). There is also potential for the proposed development to have indirect impacts on the adjacent Elizabeth Macarthur Creek.	This creek sustains River Flat Eucalypt Forest, Freshwater Wetlands and provides foraging habitat for Southern Myotis.

2.1.3.1 Locating a project to avoid and minimise prescribed biodiversity impacts

The location of the Kellyville Station Precinct is located in proximity to Kellyville Station, one of the eight new railway stations forming the NSW Government's Sydney Metro Northwest Project. The development has been located in a way which avoids and minimises prescribed biodiversity impacts as outlined in Table 20.

Table 20: Locating a project to avoid and minimise prescribed biodiversity impacts

Approach	How addressed	Justification
locating the envelope of surface works to avoid direct impacts on the habitat features	The proposal has not been relocated to avoid direct impacts on non-native vegetation.	The row of planted pine trees provides potential foraging habitat for threatened microbats and avifauna.
locating the project to avoid direct impacts on waterbodies	The project has been located to minimise direct impacts on waterbodies.	The project has primarily avoided direct impacts on waterbodies. A small section of the creek will be impacted for the construction of a road. In creek works and direct impacts on the wetland should be minimised through detailed design. Controls should be implemented to mitigate these impacts such as continued flow of water and prevention of sedimentation/runoff.

2.1.3.2 Designing a project to avoid and minimise prescribed biodiversity impacts

The development has been designed in a way which avoids and minimises prescribed biodiversity impacts as outlined in Table 21.

Table 21: Designing a project to avoid and minimise prescribed biodiversity impacts

Approach	How addressed	Justification
design of the project to maintain environmental	The project has not been designed to maintain	The project will result in the removal of a row of planted pine trees which provide potential foraging habitat for

Approach	How addressed	Justification
processes critical to the formation and persistence of habitat features not associated with native vegetation	habitat features associated with non-native vegetation.	threatened avifauna and microbat species, however this vegetation to be removed is considered to have low habitat value compared to native vegetation within and adjacent to the development site. Native vegetation is of higher priority for retention than planted exotic vegetation.
design of the project to avoid and minimise downstream impacts on rivers, wetlands and estuaries by control of the quality of water released from the site.	The project has been designed to avoid direct impacts on the adjacent stream and wetland in Elizabeth Macarthur Creek. Specific controls such as erosion and sediment control should be implemented to control the quality of water released in the adjacent stream.	The project has been designed to avoid impacts to the majority of the riparian corridor, with the exception of a small area to be impacted for the construction of a road. Detailed design should minimise the direct impacts on the wetland. Controls should be implemented during and post construction to control the quality of water released from the development site into the waterway. It is also recommended that a Vegetation Management Plan (VMP) be prepared and implemented to manage the riparian corridor.

2.2 Assessment of Impacts

2.2.1 Direct impacts

The direct impacts of the development on:

- native vegetation are outlined in Table 22
- threatened ecological communities are outlined in Table 23
- threatened species and threatened species habitat are outlined in Table 24
- prescribed biodiversity impacts are outlined in Section 2.2.2

Direct impacts including the final project footprint (construction and operation) are shown on Figure 9.

Table 22: Direct impacts to native vegetation

Zone	PCT ID	PCT Name	Condition	Vegetation Class	Vegetation Formation	Direct impact (ha)
1	849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate	Coastal Valley Grassy Woodlands	Grassy Woodlands	0.22
2	849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Degraded	Coastal Valley Grassy Woodlands	Grassy Woodlands	1.83
3	849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Landscape Plantings	Coastal Valley Grassy Woodlands	Grassy Woodlands	2.1

Zone	PCT ID	PCT Name	Condition	Vegetation Class	Vegetation Formation	Direct impact (ha)
4	835	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Moderate	Coastal Floodplain Wetlands	Forested Wetlands	0.75
5	835	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Revegetated	Coastal Floodplain Wetlands	Forested Wetlands	0.07
6	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands	Coastal Freshwater Wetlands	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	0.05
					Total	**5.02**

Table 23: Direct impacts on threatened ecological communities

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Direct impact (ha)	Listing status	Name	Direct impact (ha)
849	CEEC	Cumberland Plain Woodland in the Sydney Basin Bioregion	2.05	CEEC	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	1.85
835	EEC	River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	0.82	Not listed	N/A	N/A
1071	EEC	Freshwater Wetlands on Coastal Floodplains of the NSW North	0.05	Not Listed	N/A	N/A

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Direct impact (ha)	Listing status	Name	Direct impact (ha)
		Coast, Sydney Basin and South East Corner Bioregions				

Table 24: Direct impacts on threatened species and threatened species habitat

Species	Common Name	Direct impact habitat (ha)	NSW listing status	EPBC Listing status
Myotis macropus	Southern Myotis	5.02	V	Not Listed

2.2.2 Change in vegetation integrity

The change in vegetation integrity as a result of the development is outlined in Table 25.

Table 25: Change in vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity
1	849	Degraded	0.22	45.4	0	-45.4
2	849	Moderate	1.83	64.9	0	-64.9
3	835	Planted	2.1	14.6	0	-14.6
4	835	Moderate	0.75	63.2	0	-63.2
5	835	Revegetation	0.07	40.8	0	-40.8
6	1071	Moderate	0.05	44.3	0	-44.3

2.2.3 Indirect impacts

The indirect impacts of the development are outlined in Table 26. Indirect impact zones are shown on Figure 9.

Table 26: Indirect impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
sedimentation and contaminated and/or nutrient rich run-off	Construction and operation	Runoff during construction and operation	Potential sedimentation and contaminated runoff into adjacent Elizabeth Macarthur Creek	During rainfall events	During construction and operational phase of project	Potentially long-term impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
noise, dust or light spill	Construction and operation	Noise and dust from machinery. Light spill during operational phase	Adjacent vegetation	Daily, during construction works and operational phase	During construction and operational phase of project	Potentially long-term impacts
inadvertent impacts on adjacent habitat or vegetation	Construction and operation	Damage to adjacent habitat and vegetation including TECs	Adjacent vegetation	Daily, during construction works and operational phase	During construction and operational phase of project	Potentially long-term impacts
transport of weeds and pathogens from the site to adjacent vegetation	Construction	Spread of weed seed and pathogens from incoming machinery and equipment	Potential spread into nearby habitat	Daily, during construction and operational phases	During construction and operational phase of project	Potentially long-term impacts
vehicle strike	Construction / operation	Potential for native fauna to be struck by working machinery and moving vehicles	Within development site and adjacent	Daily, during construction and operational phases	During construction and operational phase of project	Potentially long-term impacts
trampling of threatened flora species	Construction / operation	N/A – no threatened flora present	N/A	N/A	N/A	N/A
rubbish dumping	Construction / operation	Illegal dumping by workers and public	Potential for rubbish to spread into adjacent vegetation and outside development site	Daily, during construction and operational phases	During construction and operational phase of project	Potentially long-term impacts
wood collection	Construction / operation	Removal of wood in vegetation adjacent to development site	Throughout adjacent vegetation	Potential to occur at any time during construction or operational phases	During construction and operational phase of project	Short-term impacts
increase in predatory species populations	Construction / operation	Potential for an increase in predatory species in the locality through disturbance to vegetation	Throughout adjacent vegetation	Potential to occur gradually after disturbance to habitat and vegetation takes place	During construction and operational phase of project	Potentially long-term impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
increase in pest animal populations	Construction / operation	Potential to increase if food scraps/rubbish is left on or adjacent to site. Potential to increase -/+ decrease due to disturbance to existing vegetation.	Throughout adjacent vegetation	Potential to occur gradually after disturbance to habitat and vegetation takes place	Potentially long-term impacts	Potentially long-term impacts
increased risk of fire	Construction / operation	Potential for fire to spark during construction and operation from any machinery or electrical works	Throughout adjacent vegetation	Potential to occur at any time throughout the operational or construction phases	During operating/ construction hours	Potentially long-term impacts

2.2.4 Prescribed biodiversity impacts

The development site has the prescribed biodiversity impacts as outlined in Table 27.

Table 27: Direct impacts on prescribed biodiversity impacts

Prescribed biodiversity impact	Nature	Extent	Frequency	Duration	Timing
impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation	Removal of 0.17 ha of planted pine trees, constituting non-native vegetation	0.17 ha	During construction	One off event	Long-term impacts
impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	Construction of bridge over 0.02 ha of creekline. Potential impacts on water quality in adjacent Elizabeth Macarthur Creek due to runoff/sediment	Direct impact on 0.02 ha of creek. Downstream impacts of development site in Elizabeth Macarthur Creek.	During construction. Potential to occur at any time during construction or operational phases during rainfall events	During construction and operational phase of project	Short-term and long-term impacts

2.2.5 Mitigating and managing impacts

Measures proposed to mitigate and manage impacts at the development site before, during and after construction are outlined in Table 28.

Table 28: Measures proposed to mitigate and manage impacts

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Displacement of resident fauna	Medium	Low	Efforts should be taken to avoid the removal of habitat trees, particularly in the open space areas. Several hollow-roosting microbats have been recorded in the development site and potential breeding/roosting hollows should be retained. Pre-clearance and clearance survey to be undertaken by suitably qualified ecologist to relocate potential fauna inhabitants.	Prevent injury or death to native fauna	Prior to and during felling	Contractor, Project Ecologist
timing works to avoid critical life cycle events such as breeding or nursing	Medium	Low	Tree felling of hollow bearing trees should be undertaken outside of spring and summer (main breeding season for native birds and microbats) if possible. If this is not possible, pre-clearing protocols to be observed when removing tree hollows.	Prevent disturbance to fauna during breeding.	During felling	Contractor, project ecologist
installing artificial habitats for fauna in adjacent retained vegetation and habitat or human made structures to replace the habitat resources lost and encourage animals to move from the impacted site, e.g. nest boxes	Medium	Low	- Nest boxes should be installed in the adjacent retained riparian corridor to replace hollows removed at a minimum ratio of 1:1 (i.e. 1 nest box for each hollow removed). Boxes should be chosen to match the likely target species of each hollow. Boxes should be installed prior to construction to allow fauna to move/be relocated to nest boxes prior to removal of hollow-bearing trees.	Provide fauna with compensatory roosting/nesting habitat to replace removed hollow-bearing trees	Prior to construction	Ecologist, Project Manager
clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for	High	Low	- Boundaries of the impact area to be clearly delineated with fencing, retained areas marked with “No Go” signage, in particular for the riparian corridor.	Protection of vegetation outside	During construction	Project Manager

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations where partial clearing is proposed				development footprint		
sediment barriers or sedimentation ponds to control the quality of water released from the site into the receiving environment	Moderate	Low	- Install sediment barriers and erosion control during and post construction to prevent runoff into adjacent creekline. Maintain controls throughout construction and undertake weekly inspections. Appropriate stormwater infrastructure should be installed to manage long term impacts on adjacent creek. Consider installation of retention basins.	Control of erosion, sedimentation and runoff of contaminated substances into adjacent waterways	Throughout life of project	Project Manager
noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	Low	Very Low	Daily timing of construction activities is recommended in accordance with Table 1 of Interim Noise Guidelines (2009): Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1.00pm No work on Sunday or public holidays Night-time works should be avoided within proximity to the riparian corridor to prevent indirect impacts to microbats.	Noise impacts associated with the development will be managed in accordance with guidelines.	Low	Very Low
light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill	Low	Very Low	Conduct works during daylight hours. Where possible avoid installation of lighting adjacent to the retained vegetation in the riparian corridor or consider use of warm spectrum lower brightness globes or lights with protective shields.	Avoid light disturbance to native fauna during construction	During construction	Contractor

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
adaptive dust monitoring programs to control air quality	Low	Very Low	Dust management controls to be implemented during construction.	Control dust and maintain air quality during construction.	During construction.	Project Manager, Contractor.
temporary fencing to protect significant environmental features such as riparian zones	High	Low	Temporary fencing and signage to be installed at the edge of the development site to prevent entry into the adjacent riparian corridor to be retained.	No unintended clearing or trampling of adjacent vegetation to be retained.	During construction.	Project Manager
hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	Moderate	Low	Vehicles should be washed down before entering and exiting the site to prevent the spread of weeds to or from the development site and adjacent vegetation.	Spread of weeds between unaffected areas prevented.	During construction.	Project Manager / Contractors
staff training and site briefing to communicate environmental features to be protected and measures to be implemented	Low	Very Low	All staff working on the development will undertake an environmental induction as part of their site familiarisation. Site briefings should be updated based on phase of the work. This induction will include items such as: Site environmental procedures (vegetation management, sediment and erosion control, exclusion fencing and weeds of national significance (WoNS) and priority weeds) What to do in case of environmental emergency (chemical spills, fire, injured fauna) Key contacts in case of environmental emergency	All staff entering the site are fully aware of all environmental aspects relating to the development and know what to do in case of any environmental emergencies	To occur for all staff entering / working at the site and when environmental issues become apparent	Project Manager, all staff

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
development control measures to regulate activity in vegetation and habitat adjacent to residential development including controls on pet ownership, rubbish disposal, wood collection, fire management and disturbance to nests and other niche habitats	Medium	Low	Development controls should be implemented for the adjacent riparian corridor to be documented in a VMP	Protection of flora and fauna in adjacent vegetation.	Approval stage	Client, approval authority.
making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site	Medium	Low	- Preparation and implementation of a VMP is recommended to protect and enhance retained vegetation	Protection of flora and fauna outside of the development footprint	Prior to the commencement of construction	Client

2.2.6 Serious and Irreversible Impacts (SAII)

The development has candidate Serious and Irreversible Impacts (SAII) values as outlined in Table 29. Detailed consideration of whether impacts on candidate TECs are serious and irreversible is included in Table 30.

Table 29: Candidate Serious and Irreversible Impacts

Species / Community	Common Name	Principle	Direct impact area (ha)	Threshold
Cumberland Plain Woodland in the Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	1 & 2	2.05	Not published

Table 30: Evaluation of an impact on Cumberland Plain Woodland

Impact Assessment Provisions	Assessment
1. The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	0.17 ha of Cumberland Plain Woodland will be retained within the SSDA area. A further reduction in impacts to Cumberland Plain Woodland was not considered feasible while still achieving the required housing and employment targets for the precinct. Opportunities for retention of CPW within open space areas and streetscape will be considered at detailed design phase. Measures taken to minimise impacts have been detailed in Section 2.2.5.
2. the area and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone	The proposed development will result in the removal of 2.05 ha of Cumberland Plain Woodland within two conditions: Degraded and Moderate. 0.17 ha of Moderate condition Cumberland Plain Woodland will be retained adjacent to the riparian corridor. No areas of Cumberland Plain Woodland will be retained adjacent to the development site that would be indirectly impacted by the proposal.
3. a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the *Guidance to assist a decision-maker to determine a serious and irreversible impact*	A SAII threshold has not yet been published for Cumberland Plain Woodland.
4. an estimate of the extent and overall condition of the potential TEC within an area of 1000ha, and then 10,000ha, surrounding the proposed development footprint	The area of Cumberland Plain Woodland within 1,000 ha and 10,000 ha surrounding the development site is estimated at 57.66 ha and 467.87 ha respectively. The condition is not known for these areas; however, it is expected to range from good to poor.
5. an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion	Within the Sydney Basin IBRA region there is an estimated 1291.53 ha of Cumberland Plain Woodland remaining in the reserve system. Within the Cumberland Plain IBRA subregion there is also an estimated 1291.53 ha of Cumberland Plain Woodland remaining within the reserve system. It is estimated that the Cumberland subregion contains a total of approximately 22,158.8 ha of Cumberland Plain Woodland.
4. the development proposal's impact on:	

Impact Assessment Provisions	Assessment
a. abiotic factors critical to the long-term survival of the TEC; for example, will the impact lead to a reduction of groundwater levels or substantial alteration of surface water patterns; will it alter natural disturbance regimes that the TEC depends upon, e.g. fire, flooding etc.?	The proposed development is unlikely to impact abiotic factors critical to the survival of Cumberland Plain Woodland outside of the area to be impacted.
b. characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of under-storey species or harvesting of plants	The development will not impact characteristic and functionally important species outside of the area of Cumberland Plain Woodland to be directly impacted.
c. the quality and integrity of an occurrence of the TEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the TEC	It is possible that the retained 0.17 ha of Cumberland Plain Woodland would suffer from edge effects such as invasive flora or runoff of chemicals from the adjacent development which would impact the long-term quality of the remaining area of Cumberland Plain Woodland. Mitigation measures for such impacts are detailed in Section 2.2.5 and a VMP is recommended to ensure the long-term quality of this retained Cumberland Plain Woodland.
5. direct or indirect fragmentation and isolation of an area of the TEC	2.05 ha of Cumberland Plain Woodland within the locality will be removed as part of this SSDA. There is an additional area directly to the south of the development site. However, this area is expected to be removed in the future and therefore has not been assessed as retained. 0.17 ha of Cumberland Plain Woodland within the SSDA Area will be retained. It is considered that the local occurrence is generally fragmented, however, following the development the 0.17 ha to be retained will exist as an isolated fragment with limited connectivity to nearby patches of Cumberland Plain Woodland.
6. the measures proposed to contribute to the recovery of the TEC in the IBRA subregion.	No measures have been proposed as part of this development to contribute to the recovery of Cumberland Plain Woodland in the IBRA subregion.

2.3 Risk assessment

A risk assessment has been undertaken for any residual impacts likely to remain after the mitigation measures have been applied. Likelihood criteria, consequence criteria and the risk matrix are provided in Table 31, Table 32 and Table 33 respectively.

Table 31: Likelihood criteria

Likelihood criteria	Description
Almost certain (Common)	Will occur, or is of a continuous nature, or the likelihood is unknown. There is likely to be an event at least once a year or greater (up to ten times per year). It often occurs in similar environments. The event is expected to occur in most circumstances.
Likely (Has occurred in recent history)	There is likely to be an event on average every 1-5 years. Likely to have been a similar incident occurring in similar environments. The event will probably occur in most circumstances.
Possible	The event could occur. There is likely to be an event on average every five to twenty years.

Likelihood criteria	Description
(Could happen, has occurred in the past, but not common)	
Unlikely **(Not likely or uncommon)**	The event could occur but is not expected. A rare occurrence (once per one hundred years).
Remote **(Rare or practically impossible)**	The event may occur only in exceptional circumstances. Very rare occurrence (once per one thousand years). Unlikely that it has occurred elsewhere; and, if it has occurred, it is regarded as unique.

Table 32: Consequence criteria

Consequence category	Description
Critical **(Severe, widespread long-term effect)**	Destruction of sensitive environmental features. Severe impact on ecosystem. Impacts are irreversible and/or widespread. Regulatory and high-level government intervention/action. Community outrage expected. Prosecution likely.
Major **(Wider spread, moderate to long term effect)**	Long-term impact of regional significance on sensitive environmental features (e.g. wetlands). Likely to result in regulatory intervention/action. Environmental harm either temporary or permanent, requiring immediate attention. Community outrage possible. Prosecution possible.
Moderate **(Localised, short-term to moderate effect)**	Short term impact on sensitive environmental features. Triggers regulatory investigation. Significant changes that may be rehabilitated with difficulty. Repeated public concern.
Minor **(Localised short-term effect)**	Impact on fauna, flora and/or habitat but no negative effects on ecosystem. Easily rehabilitated. Requires immediate regulator notification.
Negligible **(Minimal impact or no lasting effect)**	Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Impacts are local, temporary and reversible. Incident reporting according to routine protocols.

Table 33: Risk matrix

Consequence	Likelihood				
	Almost certain	Likely	Possible	Unlikely	Remote
Critical	Very High	Very High	High	High	Medium
Major	Very High	High	High	Medium	Medium
Moderate	High	Medium	Medium	Medium	Low
Minor	Medium	Medium	Low	Low	Very Low
Negligible	Medium	Low	Low	Very Low	Very Low

Table 34: Risk assessment

Potential impact	Project phase	Risk (pre-mitigation)	Risk (post mitigation)
Vegetation clearing	Construction	High	Low

Potential impact	Project phase	Risk (pre-mitigation)	Risk (post mitigation)
	/ operation		
sedimentation and contaminated and/or nutrient rich run-off	Construction	Medium	Low
noise, dust or light spill	Construction	Low	Very Low
inadvertent impacts on adjacent habitat or vegetation	Construction	High	Low
transport of weeds and pathogens from the site to adjacent vegetation	Construction	Medium	Low
rubbish dumping	Construction / operation	Medium	Low
wood collection	Construction / operation	Medium	Low
disturbance to specialist breeding and foraging habitat (hollow-bearing trees, waterbodies)	Construction / operation	Medium	Low

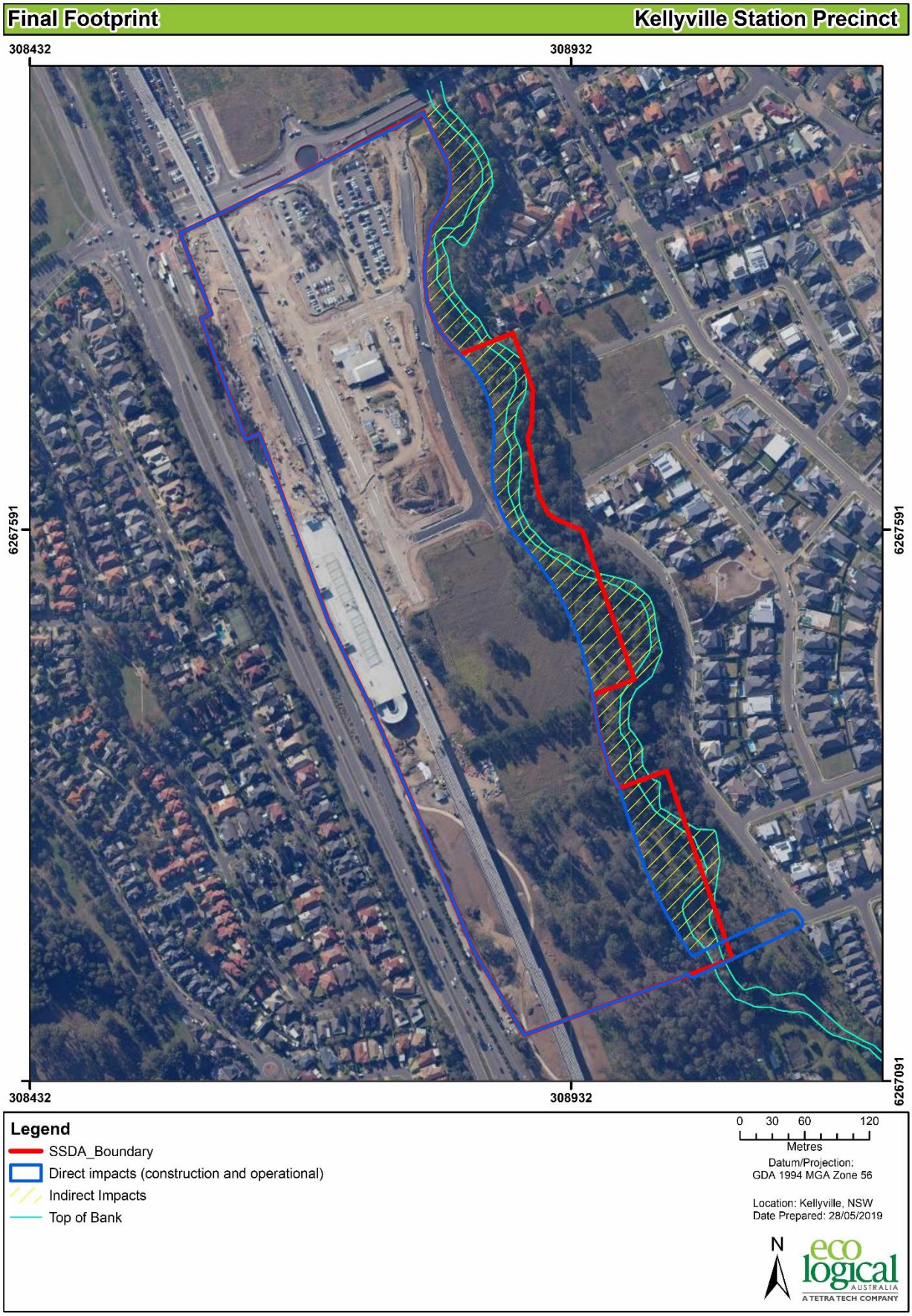

Figure 9: Final project footprint including construction and operation

2.4 Impact summary

Following implementation of the BAM and the BAMC, the following impacts have been determined.

2.4.1 Serious and Irreversible Impacts (SAII)

The development has candidate Serious and Irreversible Impacts (SAII) values as outlined in Table 29. Detailed consideration of whether impacts on candidate TECs is included in Table 30. A summary of impacts on candidate SAII entities is included in Table 35.

Table 35: Serious and Irreversible Impacts Summary

Community	Principle	Direct impact individuals / area (ha)
Cumberland Plain Woodland in the Sydney Basin Bioregion	1 & 2	2.05

2.4.2 Impacts requiring offsets

The impacts of the development requiring offset for native vegetation are outlined in Table 36 and shown on Figure 10. The impacts of the development requiring offset for threatened species and threatened species habitat are outlined in Table 37 and on Figure 7.

Table 36: Impacts to native vegetation that require offsets

Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
1	849	Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Valley Grassy Woodlands	Grassy Woodlands	0.22
2	849	Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Valley Grassy Woodlands	Grassy Woodlands	1.83
4	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Floodplain Wetlands	Forested Wetlands	0.75
5	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the	Coastal Floodplain Wetlands	Forested Wetlands	0.07

Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
		Cumberland Plain, Sydney Basin Bioregion			
6	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands	Coastal Freshwater Wetlands	0.05

Table 37: Impacts on threatened species and threatened species habitat that require offsets

Species	Common Name	Direct impact number of individuals / habitat (ha)	NSW listing status	EPBC Listing status
Myotis macropus	Southern Myotis	5.02	V	Not Listed

2.4.3 Impacts not requiring offsets

The impacts of the development not requiring offset for native vegetation are outlined in Table 38 and shown on Figure 11.

Table 38: Impacts of the development not requiring offsets

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)	Rationale
849	Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Valley Grassy Woodlands	Grassy Woodlands	2.1	This vegetation zone consists of landscape plantings and revegetation in a juvenile stage. Vegetation integrity score (14.6) lower than offsetting threshold (15) for TEC.

2.4.4 Areas not requiring assessment

Areas not requiring assessment are shown on Figure 12 These areas have been cleared of native vegetation and do not contain habitat for threatened species. These areas are dominated by exotic species such as *Eragrostis curvula* (African Love Grass) and *Cenchrus clandestinus* (Kikuyu) or consist of paved surfaces and buildings.

2.4.5 Credit summary

The number of ecosystem credits required for the development are outlined in Table 39. The number of species credits required for the development are outlined in Table 40. A biodiversity credit report is included in Appendix E.

Table 39: Ecosystem credits required

PCT ID	PCT Name	Vegetation Formation	Direct impact (ha)	Credits required
849	Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Grassy Woodlands	4.16	80
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Forested Wetlands	0.820	25
1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Coastal Freshwater Wetlands	0.05	1
			TOTAL	**106**

Table 40: Species credit summary

Species	Common Name	Direct impact number of individuals / habitat (ha)	Credits required
Myotis macropus	Southern Myotis	5.02	105

Figure 10: Impacts to vegetation/ecosystem credits requiring offset

Figure 11: Impacts not requiring offset

Figure 12: Impacts not requiring assessment

2.5 Consistency with legislation and policy

2.5.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act establishes a process for assessing the environmental impact of activities and developments where "Matters of National Environmental Significance" (MNES) may be affected. Under the Act, any action which "has, will have, or is likely to have a significant impact on a matter of MNES" is defined as a "controlled action", and requires approval from the Commonwealth Department of the Environment (DotE), which is responsible for administering the EPBC Act (DotE 2014).

The process includes conducting an Assessment of Significance for listed threatened species and ecological communities that represent a matter of MNES that will be impacted as a result of the proposed action. Significant impact guidelines (DotE 2014) that outline a number of criteria have been developed by the Commonwealth, to provide assistance in conducting the Assessment of Significance and help decide whether or not a referral to the Commonwealth is required.

A habitat assessment and Likelihood of Occurrence was completed and the following MNES were assessed in accordance with the Significant Impact Guidelines 1.1:

- Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest
- *Pteropus poliocephalus* (Grey-headed Flying-fox)

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest has certain condition thresholds which must be met to classify as the CEEC under the EPBC Act (Threatened Species Scientific Community 2009). The occurrence of Cumberland Plain Woodland which meets the condition thresholds is shown in Figure 13. It is noted that Zone 3 does not meet the condition criteria as the projected foliage cover is less than 10%. Two small patches of Zone 1 – Degraded Cumberland Plain Woodland also do not meet the criteria as the patch size is less than 0.5 ha.

It was determined that the proposed development has the potential to have a significant impact on Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest, and therefore, referral to the Commonwealth Minister for the Environment is required. The development is unlikely to have a significant impact on Grey-headed Flying-fox.

Table 41: Significant Impact Assessment on Cumberland Plain Woodland

Criterion	Question	Response
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:		
1)	reduce the extent of an ecological community	The proposed development will reduce the local extent of EPBC listed Cumberland Plain Woodland by 1.85 ha. The proposed development will not reduce the geographical extent of Cumberland Plain Woodland
2)	fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	The proposed development will remove 1.85 ha of Cumberland Plain Woodland within the development and retain 0.17 ha. The 0.17 ha to be retained will exist as an isolated fragment with limited connectivity to nearby patches of Cumberland Plain Woodland.

Criterion	Question	Response
3)	adversely affect habitat critical to the survival of an ecological community	Habitat critical to the survival of Cumberland Plain Woodland are those areas mapped as Priority Conservation Lands in the Cumberland Plain Recovery Plan (2011). The development site is not within the Priority Conservation Lands and therefore the development will not affect habitat critical to the survival of Cumberland Plain Woodland.
4)	modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The proposed development will result in the removal of 1.85 ha of Cumberland Plain Woodland which meets the EPBC condition threshold. 0.17 ha will be retained adjacent to the riparian corridor. The proposal will not impact any abiotic factors necessary for the survival Cumberland Plain Woodland outside of the development site.
5)	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	The proposed development will result in the removal of 1.85 ha of Cumberland Plain Woodland which meets the EPBC condition threshold. 0.17 ha will be retained adjacent to the riparian corridor. This retained area is unlikely to be impacted through decline or loss of functionally important species through activities such as burning or species harvesting.
6) i	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	The proposed development will result in the removal of 1.85 ha of Cumberland Plain Woodland which meets the EPBC condition threshold. 0.17 ha will be retained adjacent to the riparian corridor. This remaining area is likely to be impacted by edge effects and increased invasive species that would reduce the quality of the vegetation. The retained vegetation should be managed under a VMP to prevent such impacts.
6) ii	cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: 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, or	The proposed development will result in the removal of 1.85 ha of Cumberland Plain Woodland which meets the EPBC condition threshold. 0.17 ha will be retained adjacent to the riparian corridor. This remaining area could potentially be impacted by increased runoff from the adjacent development that would reduce the quality of the vegetation. Runoff controls should be implemented to prevent such impacts and the vegetation managed under a VMP.
7)	interfere with the recovery of an ecological community.	The removal of 1.85 ha of EPBC listed Cumberland Plain Woodland in moderate condition is considered to interfere with the recovery of the community.
Conclusion	Is there likely to be a significant impact?	It is considered that the proposed development has potential to have a significant impact on Cumberland Plain Woodland and Shale-Gravel Transition Forest for the following reasons: • A total of 1.85 ha of Cumberland Plain Woodland which meets the EPBC condition threshold will be removed • The area to be removed constitutes the majority of the local occurrence of this community. 0.17 ha will be retained within the SSDA area that is likely to be degraded by edge effects.

Figure 13: Cumberland Plain Woodland which meets the EPBC Condition Threshold

Table 42: Significant Impact Assessment on Grey-headed Flying-fox

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species	The closest known Grey-headed Flying fox camp as identified on the National Flying-fox monitoring viewer (DotEE 2016) is approximately 11 km south of the development site. The camp was last estimated to have 2,500- 9,999 individuals in November 2018, however, in February 2016 the camp was estimated to have 16,000-49,000 individuals. Foraging for this species occurs within a 50 km radius around camp sites. Available foraging resources include street trees, urban bushland and conservation reserves. Under the proposed works up to 5.06 ha of native vegetation is proposed to be removed representing potential foraging habitat for the GHFF. The amount of habitat to be affected is relatively small compared to the amount of vegetation available in the locality for this highly mobile species. No camps will be impacted by the proposed development. Given that foraging habitat exists in the surrounding landscape, and that this species is wide-ranging (traveling up to 50 km in one night), the proposed works are unlikely to affect any populations of this species that would lead to a long-term decrease in the size of an important population of this species.
2)	reduce the area of occupancy of an important population	Native vegetation in Sydney is important for the Grey-headed Flying-fox as individuals are known to move up to 50 km a night between camps to forage. This species is highly mobile and populations at each camp may change during seasonal fluctuations. Under the proposal approximately 5.06 ha of potential habitat would be removed, which may cause a temporary disturbance to the Grey-headed Flying-fox. However, these impacts are unlikely to reduce the area of occupancy this highly mobile species given that no camps will be impacted and only a relatively small area of foraging habitat is to be removed.
3)	fragment an existing important population into two or more populations	The Grey-headed Flying-fox population across camps in Sydney is highly dynamic and individuals move between permanent camps to utilise foraging resources. They will return to permanent camps to rear offspring. Individuals are highly mobile, and populations are not static. The known camp approximately 11 km to the south will not be fragmented as a result of the proposed development. The proposed action will result in approximately 5.06 ha of potential foraging habitat Large amounts of similar habitat will be retained within the study area and in the wider locality. Therefore, the proposed action is unlikely to fragment the existing important population into two or more populations.
4)	adversely affect habitat critical to the survival of a species	Foraging habitat within a 50-kilometre radius of a roost site with greater than 30,000 individuals is foraging habitat critical to the survival of this species. The camp at Parramatta Park had recorded numbers between 16,000 and 49,000 in 2015.

Criterion	Question	Response
		Therefore, foraging habitat at the study area is consistent with habitat that would be critical to the survival of this species. While the habitat would be critical to the survival of the species, the removal of 5.06 ha is unlikely to significantly impact the population. There is abundant habitat available surrounding the camp and in the wider locality, therefore the species is considered likely to use the study area on an occasional basis and would not be dependent on the foraging resources within the study area.
5)	disrupt the breeding cycle of an important population	As no breeding habitat would be removed or disturbed, it is unlikely the proposed work would disrupt the breeding cycle of the important population.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No campsites would be removed, or disturbed, and abundant foraging habitat will be retained within the foraging range of nearby camps, which may forage up to 50km from camps in a night. The proposed action would therefore be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposal would not result in invasive species, such as weeds, that would be harmful to Grey-headed Flying Fox. It is unlikely that the proposed action will result in a large increase in the number of weeds due to the current disturbed nature of the site.
8)	introduce disease that may cause the species to decline, or	Grey-headed Flying-foxes are reservoirs for the Australian bat lyssavirus (ABL) and can cause clinical disease and mortality in GHFF (DECCW 2009). The proposed action is unlikely to present a significant ecological stress on any camps or on individuals that may utilise the subject site and therefore the works are unlikely to introduce or exacerbate this virus or any other disease that may cause this species to decline.
9)	interfere substantially with the recovery of the species.	A Draft National Recovery Plan for the Grey-headed Flying-fox was developed in 2009. The maternity camp 11km south of the development site would not be removed and the proposed action will remove a relatively small amount of potential foraging habitat. Foraging habitat will be retained in the adjacent riparian corridor and larger amounts of habitat are available in the wider locality. It is therefore unlikely the proposed action would interfere with the recovery of this species.
Conclusion	**Is there likely to be a significant impact?**	The action will not affect known breeding habitat and will only impact on a relatively small amount of potential foraging for this highly mobile species. No important populations would be isolated or fragmented and the life cycle of this species is not likely to be affected. Therefore, the action is not likely to have a significant impact on this species and a Referral is not required.

3. Conclusion

This report has been prepared to meet the requirements of the Biodiversity Assessment Method (BAM) established under Section 6.7 of the NSW BC Act.

The following PCTs were mapped in the development site in various condition (totalling six vegetation zones):

- *PCT 849 – Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion,* consistent with the TEC Cumberland Plain Woodland in the Sydney Basin Bioregion, listed as critically endangered under both the BC Act and EPBC Act.
- *PCT 835 – Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion,* consistent with the TEC River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, listed as endangered under the BC Act.
- *PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion,* consistent with the TEC Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Two threatened microchiropteran bat species were positively identified (Mormopterus *norfolkensis* (East Coast Freetail Bat), *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)) and four were potentially identified during the bat call survey (*Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Myotis macropus* (Southern Myotis), *Saccolaimus flaviventris* (Yellow-bellied sheath-tailed Bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat)). Several species could only be potentially identified due to similar call frequencies between microchiropteran bats. Southern Myotis is a species credit species which was potentially identified. A conservative approach has been taken for this species which has been assumed present for the purposes of the assessment. No additional threatened flora or fauna species were recorded during the survey.

The residual unavoidable impacts of the project were calculated in accordance with BAM by utilising the Biodiversity Assessment Method Credit Calculator (BAMC).

A total of 106 ecosystem credits are required to offset the residual impacts of the proposed project (Table 43).

Table 43: Total number of ecosystem credits required

PCT ID	PCT Name	Condition	Vegetation Zone	Area (ha)	Vegetation Integrity Score	Credits
Ecosystem Credits						
849	*Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion*	Degraded	1	0.22	45.4	6
849	*Grey Box – Forest Red Gum grassy open woodland on flats of the*	Moderate	2	1.83	64.9	74

PCT ID	PCT Name	Condition	Vegetation Zone	Area (ha)	Vegetation Integrity Score	Credits
	Cumberland Plain, Sydney Basin Bioregion					
849	*Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*	Planted	3	2.09	14.6	0
835	*Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*	Moderate	4	0.83	63.2	24
835	*Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*	Revegetated	5	0.07	40.8	1
1071	*Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion*	Moderate	6	0.05	44.3	1
					Total Ecosystem Credits	**106**

Following BAM, no ecosystem credits are required to be offset for the removal of 2.09 ha of vegetation zone 3. With a vegetation integrity score of 14.6, this is lower than the offsetting threshold of 15 for a critically endangered ecological community.

A total of 105 species credit species are required to offset Southern Myotis, with a total impact of 5.06 ha on this species.

SAII values have been considered as part of this assessment. Cumberland Plain Woodland is a listed candidate entity. 2.05 ha of Cumberland Plain Woodland will be removed as a result of the development and 0.17 ha will be retained. It is noted that the threshold for what is considered a SAII is yet to be published by OEH and therefore whether the development will have a SAII cannot be determined. A SAII assessment has been undertaken in accordance with the BAM. The determination of SAII on biodiversity values is to be made by the approval authority. The approval authority may approve a major project which is likely to have SAII, however, the approval authority must take those impacts into consideration and determine whether there are any additional and appropriate measures that will minimise those impacts if approval is to be granted.

1.85 ha of Cumberland Plain Woodland within the development site met the condition criteria for listing under the EPBC Act. It is considered that the proposed development has the potential to have a significant impact on this CEEC in accordance with the EPBC Significant Impact Guidelines 1.1 – Matters of National Environmental Significance. Therefore, it is recommended that the development is referred to the Commonwealth Minister for the Environment to determine if the project is to be considered a Controlled Action. It is understood that Landcom will be referring the development to the commonwealth concurrently with the SSDA.

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Appendix A Definitions

Terminology	Definition
Biodiversity credit report	The report produced by the Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
BioNet Atlas	The BioNet Atlas (formerly known as the NSW Wildlife Atlas) is the OEH database of flora and fauna records. The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails) and some fish
Broad condition state:	Areas of the same PCT that are in relatively homogenous condition. Broad condition is used for stratifying areas of the same PCT into a vegetation zone for the purpose of determining the vegetation integrity score.
Connectivity	The measure of the degree to which an area(s) of native vegetation is linked with other areas of vegetation.
Credit Calculator	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site.
Development	Has the same meaning as development at section 4 of the EP&A Act, or an activity in Part 5 of the EP&A Act. It also includes development as defined in section 115T of the EP&A Act.
Development footprint	The area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials.
Development site	An area of land that is subject to a proposed development that is under the EP&A Act.
Ecosystem credits	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
High threat exotic plant cover	Plant cover composed of vascular plants not native to Australia that if not controlled will invade and outcompete native plant species.
Hollow bearing tree	A living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1 m above the ground. Trees must be examined from all angles.
Important wetland	A wetland that is listed in the Directory of Important Wetlands of Australia (DIWA) and SEPP 14 Coastal Wetlands
Linear shaped development	Development that is generally narrow in width and extends across the landscape for a distance greater than 3.5 kilometres in length
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately.
Local wetland	Any wetland that is not identified as an important wetland (refer to definition of Important wetland).
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000.

Terminology	Definition
Multiple fragmentation impact development	Developments such as wind farms and coal seam gas extraction that require multiple extraction points (wells) or turbines and a network of associated development including roads, tracks, gathering systems/flow lines, transmission lines
Operation period	The period in which the development will be operational i.e. the lifetime of the proposed residential and commercial development
Operational Manual	The Operational Manual published from time to time by OEH, which is a guide to assist assessors when using the BAM
Patch size	An area of intact native vegetation that: a) occurs on the development site or biodiversity stewardship site, and b) includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m for non-woody ecosystems). Patch size may extend onto adjoining land that is not part of the development site or stewardship site..
Proponent	A person who intends to apply for consent to carry out development or for approval for an activity.
Reference sites	The relatively unmodified sites that are assessed to obtain local benchmark information when benchmarks in the Vegetation Benchmarks Database are too broad or otherwise incorrect for the PCT and/or local situation. Benchmarks can also be obtained from published sources.
Regeneration	The proportion of over-storey species characteristic of the PCT that are naturally regenerating and have a diameter at breast height <5 cm within a vegetation zone.
Remaining impact	An impact on biodiversity values after all reasonable measures have been taken to avoid and minimise the impacts of development. Under the BAM, an offset requirement is calculated for the remaining impacts on biodiversity values.
Retirement of credits	The purchase and retirement of biodiversity credits from an already-established biobank site or a biodiversity stewardship site secured by a biodiversity stewardship agreement.
Riparian buffer	Riparian buffers applied to water bodies in accordance with the BAM
Sensitive biodiversity values land map	Development within an area identified on the map requires assessment using the BAM.
Site attributes	The matters assessed to determine vegetation integrity. They include: native plant species richness, native over-storey cover, native mid-storey cover, native ground cover (grasses), native ground cover (shrubs), native ground cover (other), exotic plant cover (as a percentage of total ground and mid-storey cover), number of trees with hollows, proportion of over-storey species occurring as regeneration, and total length of fallen logs.
Site-based development	a development other than a linear shaped development, or a multiple fragmentation impact development
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Subject land	Is land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land. It includes land that may be a development site, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement.
Threatened Biodiversity Data Collection	Part of the BioNet database, published by OEH and accessible from the BioNet website.

Terminology	Definition
Threatened species	Critically Endangered, Endangered or Vulnerable threatened species as defined by Schedule 1 of the BC Act, or any additional threatened species listed under Part 13 of the EPBC Act as Critically Endangered, Endangered or Vulnerable.
Vegetation Benchmarks Database	A database of benchmarks for vegetation classes and some PCTs. The Vegetation Benchmarks Database is published by OEH and is part of the BioNet Vegetation Classification.
Vegetation zone	A relatively homogenous area of native vegetation on a development site, land to be biodiversity certified or a biodiversity stewardship site that is the same PCT and broad condition state.
Wetland	An area of land that is wet by surface water or ground water, or both, for long enough periods that the plants and animals in it are adapted to, and depend on, moist conditions for at least part of their life cycle. Wetlands may exhibit wet and dry phases and may be wet permanently, cyclically or intermittently with fresh, brackish or saline water
Woody native vegetation	Native vegetation that contains an over-storey and/or mid-storey that predominantly consists of trees and/or shrubs

Appendix B Vegetation plot data

Table 44: Species matrix (species recorded by plot)

Species name	Exotic (*)	Form	High Threat Weed	Cover % Plot 1 (Z1P1)	Cover % Plot 2 (Z2P1)	Cover % Plot 3 (Z4P1)	Cover % Plot 4 (Z4P2)	Cover % Plot 5 (Z1P2)	Cover % Plot 6 (Z2P2)	Cover % Plot 7 (Z5P1)	Cover % Plot 8 (Z3P1)	Cover % Plot 9 (Z3P4)	Cover % Plot 10 (Z6P1)
Acacia decurrens		Tree (TG)	0				1			1	0.5	0.2	
Acacia falcata		Shrub (SG)	0								0.3	0.1	
Acacia spp.		Shrub (SG)	0								0.1		
Alternanthera denticulata		Forb (FG)	0					0.1					0.1
Anagallis arvensis	*		0	0.2	0.1	0.1					0.2		
Angophora floribunda		Tree (TG)	0		2	1	5			1			
Angophora subvelutina		Tree (TG)	0				5						
Araujia sericifera	*		1		0.1	0.1	2		0.1	0.1			
Aristida vagans		Grass & grasslike (GG)	0				0.5						
Asparagus asparagoides	*		1		0.5	0.2	2	1	0.1	0.1			0.1
Austrostipa spp.		Grass & grasslike (GG)	0								0.1		
Axonopus fissifolius	*	0	1									0.5	

Species name	Exotic (*)	Form	High Threat Weed	Cover % Plot 1 (Z1P1)	Cover % Plot 2 (Z2P1)	Cover % Plot 3 (Z4P1)	Cover % Plot 4 (Z4P2)	Cover % Plot 5 (Z1P2)	Cover % Plot 6 (Z2P2)	Cover % Plot 7 (Z5P1)	Cover % Plot 8 (Z3P1)	Cover % Plot 9 (Z3P4)	Cover % Plot 10 (Z6P1)
Bidens pilosa	*		1				0.1			15		0.1	0.1
Bidens subalternans	*		1							0.1			
Bothriochloa macra		Grass & grasslike (GG)	0								0.1	0.1	
Briza minor	*	0	0	10									
Brunoniella australis		Forb (FG)	0						0.1				
Bursaria spinosa		Shrub (SG)	0				10				0.1	0.1	
Callistemon spp.		Shrub (SG)	0								0.5		
Calochlaena dubia		Other (OG)											2
Carex appressa		Grass & grasslike (GG)	0				0.2						
Casuarina cunninghamiana		Tree (TG)	0				10			3			
Casuarina glauca		Tree (TG)	0							3			
Centella asiatica		Forb (FG)	0	0.5	1			0.5	0.1	0.2	0.1	0.1	
Cestrum parqui	*		1					0.1	0.1				0.1
Cheilanthes sieberi		Fern (EG)	0		0.1								

Species name	Exotic (*)	Form	High Threat Weed	Cover % Plot 1 (Z1P1)	Cover % Plot 2 (Z2P1)	Cover % Plot 3 (Z4P1)	Cover % Plot 4 (Z4P2)	Cover % Plot 5 (Z1P2)	Cover % Plot 6 (Z2P2)	Cover % Plot 7 (Z5P1)	Cover % Plot 8 (Z3P1)	Cover % Plot 9 (Z3P4)	Cover % Plot 10 (Z6P1)
Chloris gayana	*		1					10					
Chloris truncata		Grass & grasslike (GG)	0					0.1					
Cirsium vulgare	*		0				0.1	0.1	0.2			0.1	
Commelina cyanea		Forb (FG)	0		0.2			10	0.1				
Conyza bonariensis	*		0									0.3	0.1
Corymbia maculata		Tree (TG)	0							5			
Cynodon dactylon	*		0	5		5			0.1	0.5		1	
Cyperus eragrostis	*		1								2	0.2	
Cyperus gracilis		Grass & grasslike (GG)	0		0.2			2					
Cyperus rotundus	*	0	0									0.1	
Danthonia spp.		Grass & grasslike (GG)	0		0.1								
Desmodium varians		Other (OG)	0					0.1	0.3				
Dianella caerulea		Forb (FG)	0							2	3	3	
Dianella spp.		Forb (FG)	0					0.1					

Species name	Exotic (*)	Form	High Threat Weed	Cover % Plot 1 (Z1P1)	Cover % Plot 2 (Z2P1)	Cover % Plot 3 (Z4P1)	Cover % Plot 4 (Z4P2)	Cover % Plot 5 (Z1P2)	Cover % Plot 6 (Z2P2)	Cover % Plot 7 (Z5P1)	Cover % Plot 8 (Z3P1)	Cover % Plot 9 (Z3P4)	Cover % Plot 10 (Z6P1)
Dichelachne spp.		Grass & grasslike (GG)	0		0.1							0.1	
Dichondra repens		Forb (FG)	0	1	1		5	2	0.4	2			
Digitaria sanguinalis	*	0	0								1	0.1	
Digitaria spp.	*	Grass & grasslike (GG)	0					1	0.1				
Dodonaea viscosa		Shrub (SG)	0								0.2	0.1	
Echinochloa crus-galli	*	0	0								0.2	2	
Echinopogon ovatus		Grass & grasslike (GG)	0					0.1					
Ehrharta erecta	*	0	1				5	2		3			
Einadia hastata		Forb (FG)	0	2	0.5	0.2	0.5	5					
Einadia polygonoides		Forb (FG)	0				0.1			1	0.1	0.1	
Einadia spp.		Forb (FG)	0									0.1	
Einadia trigonos		Forb (FG)	0					5		30			
Entolasia marginata		Grass & grasslike (GG)	0						0.2				

Species name	Exotic (*)	Form	High Threat Weed	Cover % Plot 1 (Z1P1)	Cover % Plot 2 (Z2P1)	Cover % Plot 3 (Z4P1)	Cover % Plot 4 (Z4P2)	Cover % Plot 5 (Z1P2)	Cover % Plot 6 (Z2P2)	Cover % Plot 7 (Z5P1)	Cover % Plot 8 (Z3P1)	Cover % Plot 9 (Z3P4)	Cover % Plot 10 (Z6P1)
Eragrostis brownii		Grass & grasslike (GG)	0						0.1				
Eragrostis curvula	*	0	1						0.5	1			
Eragrostis leptostachya		Grass & grasslike (GG)	0						0.1				
Eremophila debilis		Shrub (SG)	0				0.5						
Eucalyptus amplifolia		Tree (TG)	0			30	10						
Eucalyptus crebra		Tree (TG)	0		40			30	10		0.3	2	
Eucalyptus eugenioides		Tree (TG)	0						10				
Eucalyptus moluccana		Tree (TG)	0	10						12			
Eucalyptus spp.		Tree (TG)	0								1	2	
Eucalyptus tereticornis		Tree (TG)	0					5		10			
Fimbristylis spp.		Grass & grasslike (GG)	0						0.1				
Foeniculum vulgare	*	0	0									0.1	
Forb spp.		Forb (FG)	0										0.1
Glycine clandestina		Other (OG)	0			0.1	0.1	0.1					

Species name	Exotic (*)	Form	High Threat Weed	Cover % Plot 1 (Z1P1)	Cover % Plot 2 (Z2P1)	Cover % Plot 3 (Z4P1)	Cover % Plot 4 (Z4P2)	Cover % Plot 5 (Z1P2)	Cover % Plot 6 (Z2P2)	Cover % Plot 7 (Z5P1)	Cover % Plot 8 (Z3P1)	Cover % Plot 9 (Z3P4)	Cover % Plot 10 (Z6P1)
Glycine tabacina		Other (OG)	0	0.5	0.5			0.2	0.3	1			
Goodenia ovata		Shrub (SG)	0								0.3	0.3	
Imperata cylindrica		Grass & grasslike (GG)	0			1							
Juncus acutus	*	0	1			0.2							0.2
Juncus usitatus		Grass & grasslike (GG)	0	0.1					0.1	0.1			
Kunzea spp.		Shrub (SG)	0							1	0.1	0.1	
Lemna spp.		Forb (FG)	0										0.5
Ligustrum sinense	*	0	1							0.1			
Lomandra filiformis		Grass & grasslike (GG)	0					0.1					
Lomandra longifolia		Grass & grasslike (GG)	0			0.2				1	3	3	
Lotus spp.	*	0	0	0.1									
Medicago spp.	*	0	0								1	0.2	

Species name	Exotic (*)	Form	High Threat Weed	Cover % Plot 1 (Z1P1)	Cover % Plot 2 (Z2P1)	Cover % Plot 3 (Z4P1)	Cover % Plot 4 (Z4P2)	Cover % Plot 5 (Z1P2)	Cover % Plot 6 (Z2P2)	Cover % Plot 7 (Z5P1)	Cover % Plot 8 (Z3P1)	Cover % Plot 9 (Z3P4)	Cover % Plot 10 (Z6P1)
Melaleuca sieberi		Shrub (SG)	0								0.1	0.2	
Melia azedarach		Tree (TG)	0				0.2			0.2			
Microlaena stipoides		Grass & grasslike (GG)	0	20	70	60	15	0.2	70	5			
Modiola caroliniana	*	0	0					0.5			0.1	15	0.1
Oplismenus aemulus		Grass & grasslike (GG)	0					0.1					
Opuntia stricta	*	0	1			0.1		0.2					
Oxalis perennans		Forb (FG)	0		0.1	0.1	0.1	0.3	0.3				
Ozothamnus diosmifolius		Shrub (SG)	0			0.5							
Panicum maximum var. maximum	*	0	0					20					
Paspalum dilatatum	*	0	1					5	0.2	5	5	5	
Paspalum urvillei	*	0	0										0.1
Passiflora caerulea	*	0	0			0.1		0.1		7			
Pennisetum clandestinum	*	0	1	20		0.5		5			2	10	
Persicaria decipiens		Forb (FG)	0								0.1	0.1	2
Phyllanthus gunnii		Shrub (SG)	0								0.1		

Species name	Exotic (*)	Form	High Threat Weed	Cover % Plot 1 (Z1P1)	Cover % Plot 2 (Z2P1)	Cover % Plot 3 (Z4P1)	Cover % Plot 4 (Z4P2)	Cover % Plot 5 (Z1P2)	Cover % Plot 6 (Z2P2)	Cover % Plot 7 (Z5P1)	Cover % Plot 8 (Z3P1)	Cover % Plot 9 (Z3P4)	Cover % Plot 10 (Z6P1)
Plantago lanceolata	*	0	0	5	0.1		0.1		0.1			0.1	
Plantago spp.		Forb (FG)	0					0.1					
Poa labillardierei var. labillardierei		Grass & grasslike (GG)	0		0.1						0.1		
Portulaca oleracea		Forb (FG)	0					0.1					
Potentilla indica	*	0	0				0.2						
Pratia purpurascens		Forb (FG)	0			0.1			5				
Pseuderanthemum variabile		Forb (FG)	0		0.2		0.1		1				
Ranunculus sp.		Forb (FG)	0										0.1
Rumex brownii		Forb (FG)	0					0.2					
Rumex crispus	*	0	0									0.1	0.2
Rytidosperma spp.		Grass & grasslike (GG)	0					0.3					
Senecio madagascariensis	*	0	1	0.2	0.5	0.2		0.1	0.1				
Senna pendula	*	0	1				5					0.2	
Setaria parviflora	*	0	0	15	0.1			0.2	0.2	5	1	1	
Sida rhombifolia	*	0	0	0.2	5	3	0.5	5	0.1	1	0.2	0.1	
Sisymbrium officinale	*	0	0					0.1			0.1		
Solanum linearifolium		Shrub (SG)	0	0.1	0.1	0.5	0.1	0.1					

Species name	Exotic (*)	Form	High Threat Weed	Cover % Plot 1 (Z1P1)	Cover % Plot 2 (Z2P1)	Cover % Plot 3 (Z4P1)	Cover % Plot 4 (Z4P2)	Cover % Plot 5 (Z1P2)	Cover % Plot 6 (Z2P2)	Cover % Plot 7 (Z5P1)	Cover % Plot 8 (Z3P1)	Cover % Plot 9 (Z3P4)	Cover % Plot 10 (Z6P1)
Solanum linnaeanum	*	0	0								0.1	0.1	
Solanum mauritianum	*	0	0				0.1	0.1					
Solanum nigrum	*	0	0			0.1	0.5	0.1					
Solanum prinophyllum		Forb (FG)	0		0.1	0.1	0.5	0.2	0.3				
Solanum spp.	*	Forb (FG)	0		0.1								
Sonchus oleraceus	*	0	0					0.1	0.1		0.1	0.1	
Sporobolus creber		Grass & grasslike (GG)	0					0.5			0.1		
Stellaria media	*	0	0					0.1					
Taraxacum officinale	*	0	0					0.1					
Themeda triandra		Grass & grasslike (GG)	0		10				10		1	2	
Tradescantia fluminensis	*	0	1			0.2	15						1
Trifolium fragiferum	*	0	0								20	15	
Trifolium repens	*	0	0								1	0.2	
Typha orientalis		Grass & grasslike (GG)	0										50
Verbena bonariensis	*	0	0	0.5		0.1		0.1			0.1		
Verbena spp.	*	Forb (FG)	0		1								

Table 45: Vegetation integrity data (Composition, Structure and function)

Plot location data						
Plot no.	PCT	Vegetation Zone	Condition	Eastings	Northings	Bearing
1	849	1	Degraded	308859	6267419	45
2	849	2	Moderate	308989	6267292	270
3	835	4	Moderate	308963	6267500	350
4	835	4	Moderate	308877	6267640	10
5	849	1	Degraded	308985	6267144	145
6	849	2	Moderate	308963	6267229	145
7	835	5	Revegetated	308826	6267936	153
8	849	3	Planted	308847	6267283	145
9	849	3	Planted	308882	6267156	333
10	1071	6	Moderate	309059	6267194	316

Composition (number of species)						
Plot no.	Tree	Shrub	Grass	Forb	Fern	Other
1	1	1	3	3	0	1
2	2	1	5	9	1	1
3	2	2	3	4	0	1
4	5	3	3	7	0	1
5	2	1	9	12	0	4
6	2	0	8	8	0	2
7	7	1	3	5	0	2
8	3	9	5	4	0	0

Composition (number of species)						
9	3	6	4	5	0	0
10	1	0	1	5	0	1

Structure (Total cover)						
Plot no.	Tree	Shrub	Grass	Forb	Fern	Other
1	10.0	0.1	25.1	3.5	0.0	0.5
2	42.0	0.1	80.4	4.2	0.1	0.5
3	31.0	1.0	61.2	0.5	0.0	0.1
4	21.2	10.6	15.7	8.3	0.0	0.1
5	35.0	0.1	4.4	23.6	0.0	0.5
6	20.0	0.0	80.7	7.3	0.0	0.6
7	32.2	1.0	6.1	35.2	0.0	8.0
8	1.8	1.8	4.3	3.3	0.0	0.0
9	4.2	0.9	5.2	3.4	0.0	0.0
10	2	0	50	2.8	0	2

Function											
Plot no.	Large Trees	Hollow trees	Litter Cover	Length Fallen Logs	Tree Stem 5- 9 cm	Tree Stem 10-19 cm	Tree Stem 20-29 cm	Tree Stem 30-49 cm	Tree Stem 50-79 cm	Tree Regen	High Threat Weed Cover
1	1	1	46	0	0	0	1	1	1	1	20
2	2	0	41	9	1	1	1	1	1	1	1
3	1	0	36	1	1	1	1	1	1	1	2
4	3	0	29	4	1	0	1	1	1	1	29

Function											
5	4	0	29	0	0	1	1	1	1	1	23
6	4	0	40	0	0	1	1	1	1	1	1
7	0	0	0	0	0	0	0	0	0	0	24
8	0	0	54	0	0	0	0	0	0	1	9
9	0	0	83	0	0	1	0	0	0	1	16
10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1

Figure 14: Plot 1 – Zone 1 PCT 849 (Degraded)

Figure 15: 2 – Zone 2 PCT 849 (Moderate)

Figure 16: Plot 3 – Zone 4 PCT 835 (Moderate)

Figure 17: Plot 4 – Zone 4 PCT 835 (Moderate)

Figure 18: Plot 5 – Zone 1 PCT 849 (Degraded)

Figure 19: Plot 6 – Zone 2 PCT 849 (Moderate)

Figure 20: Plot 7 – Zone 5 PCT 835 (Revegetation)

Figure 21: Plot 8 – Zone 3 PCT 849 (Planted)

Figure 22: Plot 9 – Zone 3 PCT 849 (Planted)

Appendix C Likelihood of Occurrence

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the site inspection and professional judgement. Some Migratory or Marine species identified from the Commonwealth database search have been excluded from the assessment, due to lack of habitat. The terms for likelihood of occurrence are defined below:

- "yes" - the species was or has been observed on the site
- "likely" = a medium to high probability that a species uses the site
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "unlikely" = a very low to low probability that a species uses the site
- "no" = habitat on site and in the vicinity is unsuitable for the species.

An assessment of significance was conducted for threatened species or ecological communities that were recorded within the site or had a higher likelihood of occurring and were not recorded during the site visit and that potential to be significantly impacted. It is noted that some threatened fauna species that are highly mobile, wide ranging and vagrant may use portions of the site intermittently for foraging. For these fauna species, the habitat present and likely to be impacted is not considered to be important to the threatened species, particularly in relation to the amount of similar habitat remaining in the surrounding landscape. As such, an assessment of significance in reference to State or Commonwealth legislation was not considered necessary.

Note, that assessments for the likelihood of occurrence were made both prior to site inspection and following site inspection. The pre-survey assessments were performed to determine which species were "affected species", and hence determine which sorts of habitat to look for during site inspection. The post-survey assessments to determine "final affected species" were made after observing the available habitat in the site and are depicted in the table below.

The records column refers to the number of records occurring within 5 km of the study area, as provided by the NSW Wildlife Atlas (BioNet) database search.

Information provided in the habitat associations' column has primarily been extracted (and modified) from the Commonwealth Species Profile and Threats Database (DotEE 2019b) and the NSW Threatened Species Profiles (OEH 2019a).

Table 46: Threatened ecological communities (TECs) likelihood table

Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Castlereagh Scribbly Gum and Agnes Banks Woodland	VEC	EEC	Occurs almost exclusively on soils derived from Tertiary alluvium, or on sites located on adjoining shale or Holocene alluvium. Often adjacent to and on slightly higher ground than Castlereagh Ironbark Forest or Shale Gravel Transition Forest in the Sydney Basin Bioregion. Dominated by *Eucalyptus parramattensis* subsp. *parramattensis*, *Angophora bakeri* and *E. sclerophylla*. A small tree stratum of *Melaleuca decora* is sometimes present, generally in areas with poorer drainage. It has a well-developed shrub stratum consisting of sclerophyllous species such as *Banksia spinulosa* var. *spinulosa, Melaleuca nodosa, Hakea sericea* and *H. dactyloides* (multi-stemmed form). The ground stratum consists of a diverse range of forbs including *Themeda australis, Entolasia stricta*, *Cyathochaeta diandra, Dianella revoluta* subsp. *revoluta, Stylidium graminifolium*, *Platysace ericoides*, *Laxmannia gracilis* and *Aristida warburgii.*	No. Not present.
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland	EEC	EEC	"The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. It has a dense to sparse tree layer in which Casuarina glauca (swamp oak) is the dominant species northwards from Bermagui. Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species and are found most frequently in stands of the community northwards from Gosford. *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui. The understorey is characterised by frequent occurrences of vines, *Parsonsia straminea, Geitonoplesium cymosum* and *Stephania japonica* var. *discolor,* a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter. The composition of the ground stratum varies depending on levels of salinity in the groundwater."	No. Not present.

Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Cooks River / Castlereagh Ironbark Forest	EEC	CEEC	Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. The structure of the community may vary from tall open forests (>40m) to woodlands. The most widespread and abundant dominant trees include *Eucalyptus tereticornis* (forest red gum), *E. amplifolia* (cabbage gum), *Angophora floribunda* (rough-barked apple) and *A. subvelutina* (broad-leaved apple). *Eucalyptus baueriana* (blue box), *E. botryoides* (bangalay) and *E. elata* (river peppermint) may be common south from Sydney. *E. ovata* (swamp gum) occurs on the far south coast, *E. saligna* (Sydney blue gum) and *E. grandis* (flooded gum) may occur north of Sydney, while *E. benthamii* is restricted to the Hawkesbury floodplain. A layer of small trees may be present, including *Melaleuca decora, M. styphelioides* (prickly-leaved teatree), *Backhousia myrtifolia* (grey myrtle), *Melia azadarach* (white cedar), *Casuarina cunninghamiana* (river oak) and *C. glauca* (swamp oak). Scattered shrubs include *Bursaria spinosa, Solanum prinophyllum, Rubus parvifolius, Breynia oblongifolia, Ozothamnus diosmifolius, Hymenanthera dentata, Acacia floribunda* and *Phyllanthus gunnii.* The groundcover is composed of abundant forbs, scramblers and grasses.	No. Not present.
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CEEC	CEEC	Has an open forest structure and occurs primarily where shallow deposits from ancient river systems overlay shale soils, but also associated with localised concentrations of iron-hardened gravel. A transition plant community which grades into Cumberland Plain Woodland where the influence of gravel soil declines, and grades into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thick. Community present in the east of the study area	Yes. Identified on the site during field survey
River-flat Eucalypt Forest	EEC	-	The structure of the community may vary from tall open forests (>40m) to woodlands. The most widespread and abundant dominant trees include *Eucalyptus tereticornis* (forest red gum), *E. amplifolia* (cabbage gum), *Angophora floribunda* (rough-barked apple) and *A. subvelutina* (broad-leaved apple). Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains.	Yes. Identified on the site during field survey
Shale/Sandstone Transition Forest	CEEC	CEEC	Occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrade with earthy and sandy soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. It typically occurs in moderately wet sites, with an annual rainfall of 800-1100mm per year, and on clay soils derived from Wianamatta shale. The tree canopy is dominated by Turpentine and a variety of eucalypt species. Its distribution is mainly on the Cumberland Plain of the Sydney region. Was not recorded during the site inspection s.	No. Not present.

Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	EEC	CEEC	Open forest, with dominant canopy trees including *Syncarpia glomulifera* (Turpentine), *Eucalyptus punctata* (Grey Gum), *Eucalyptus paniculata* (Grey Ironbark) and *E. eugenioides* (Thin-leaved Stringybark). In areas of high rainfall (over 1050 mm per annum) *E. saligna* (Sydney Blue Gum) is more dominant. The shrub stratum is usually sparse and may contain mesic species such as *Pittosporum undulatum* (Sweet Pittosporum) and *Polyscias sambucifolia* (Elderberry Panax). Occurs close to the Shale/Sandstone boundary on the more fertile shale influenced soils, in higher rainfall areas on the higher altitude margins of the Cumberland Plain, and on the shale ridge caps of sandstone plateaux. A transitional community, between Cumberland Plain Woodland in drier areas and Blue Gum High Forest on adjacent higher rainfall ridges.	No. Not present.
Western Sydney Dry Rainforest and Moist Woodland on Shale	EEC	CEEC	A dry vine scrub community of the Cumberland Plain, western Sydney. Canopy trees include Prickly Paperbark (*Melaleuca styphelioides*), Hickory Wattle (*Acacia implexa*) and Native Quince (*Alectryon subcinereus*). Many rainforest species occur in the shrub layer, such as Mock Olive (*Notelaea longifolia*), Hairy Clerodendrum (*Clerodendrum tomentosum*) and Yellow Pittosporum *(Pittosporum revolutum*). The shrub layer combines with vines, such as Gum Vine (*Aphanopetalum resinosum*), Wonga Vine (*Pandorea pandorana*) and Slender Grape (*Cayratia clematidea*) to form dense thickets in sheltered locations.	No. Not present.

Table 47: Threatened flora species likelihood table

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of Occurrence
Acacia bynoeana	Bynoe's Wattle	E	V	Acacia bynoeana is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains and has recently been found in the Colymea and Parma Creek areas west of Nowra. It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels.	2	Unlikely Suitable habitat not present within the site due to lack of associated soils and vegetation.
Acacia pubescens	Downy Wattle	V	V	*Acacia pubescens* occurs on the NSW Central Coast in Western Sydney, mainly in the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. It is associated with Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest growing on clay soils, often with ironstone gravel.	11	Potential. Suitable habitat present within site. Not recorded during targeted survey.
Allocasuarina glareicola		-	E	*Allocasuarina glareicola* is primarily restricted to the Richmond district on the north-west Cumberland Plain, with an outlier population found at Voyager Point. It grows in Castlereagh woodland on lateritic soil.	0	Unlikely Suitable habitat not present. No records within 5km of the development site.
Asterolasia elegans		E	E	Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground	0	Unlikely Suitable habitat not present for this species.
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	Grassy sclerophyll woodland on clay loam or sandy soils, or low woodland with stony soil. Currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast.	0	Unlikely. No known nearby populations. No records within 5k of the development site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of Occurrence
Callistemon linearifolius	Netted Bottle Brush	V		Grows in dry sclerophyll forest on the coast and adjacent ranges. Distribution between Georges River to the Hawkesbury in the Sydney area and north to the Nelson Bay area. Recent records in Sydney restricted to the Hornsby Plateau.	1	Potential Marginal habitat is available within the development site.
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest.	0	Unlikely. Suitable habitat not present. No records within 5km of the development site.
Cynanchum elegans	White-flowered Wax Plant	E	E	Dry rainforest; littoral rainforest; *Leptospermum laevigatum-Banksia integrifolia subsp. integrifolia* (Coastal Tea-tree– Coastal Banksia) coastal scrub; *Eucalyptus tereticornis* (Forest Red Gum) or *Corymbia maculata* (Spotted Gum) open forest and woodland; and *Melaleuca armillaris* (Bracelet Honeymyrtle) scrub.	0	Unlikely. Suitable habitat not present. No records within 5km of the development site.
Darwinia biflora		V	V	Recorded in Ku-ring-gai, Hornsby, Baulkham Hills and Ryde local government areas, in an area bounded by Maroota, North Ryde, Cowan and Kellyville. Woodland, open forest or scrub-heath on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone.	208	Unlikely. Suitable habitat not present due to lack of associated soils (sandstone and shale-capped sandstone ridges). Not recorded during threatened flora survey.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of Occurrence
Epacris purpurascens var. purpurascens		V		Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Sclerophyll forest, scrubs and swamps.	60	Unlikely. Suitable habitat not present for this species which is associated with shale-sandstone transitional soils.
Eucalyptus sp. Cattai			E	Between Colo Heights and Castle Hill, north-western Sydney. Scrub, heath and low woodland on sandy soils, generally on ridge tops on laterised clays overlying sandstone.	191	Unlikely. Suitable habitat not present due to lack of associated soils. Not recorded during threatened flora survey.
Eucalyptus nicholii				New England Tablelands from Nundle to north of Tenterfield. Dry grassy woodland, on shallow soils of slopes and ridges.	2	Unlikely. Development site outside natural distribution of species. Nearby records likely planted.
Genoplesium baueri	Yellow Gnat-orchid	V	E	Known from coastal areas from northern Sydney south to the Nowra district. Previous records from the Hunter Valley and Nelson Bay are now thought to be erroneous. Grows in shrubby woodland in open forest on shallow sandy soils and flowers from December to March.	0	Unlikely. Suitable habitat not present. No records within 5km of the development site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of Occurrence
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V		Endemic to Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town. Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest, on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium.	3	Potential. Habitat is available for this species within the development site. Not recorded during targeted survey.
Hibbertia superans		E		From Baulkham Hills to South Maroota in the northern outskirts of Sydney, and at one locality at Mount Boss, inland from Kempsey. Open woodland and heathland, and appears to prefer open disturbed areas.	29	Unlikely. This species is not associated with the vegetation type within the development site.
Leucopogon fletcheri subsp. fletcheri		E		Restricted to north-western Sydney between St Albans in the north and Annangrove in the south. Dry eucalypt woodland or in shrubland on clayey lateritic soils, generally along ridges and spurs.	8	Unlikely. Suitable habitat not present.
Melaleuca deanei	Deane's Melaleuca	V	V	Occurs in heath on sandstone. Distribution Ku-ring-gai/Berowra area, Holsworthy/Wedderburn area, Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas.	0	Unlikely. Suitable habitat not present. No records within 5km of the development site.
Persoonia hirsuta	Hairy Geebung	E	E	Sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. Scattered distribution around Sydney, from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west.	17	Unlikely. Suitable habitat not present due to lack of associated sandy soils. Not recorded during targeted flora survey.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of Occurrence
Persoonia nutans	Nodding Geebung	E	E	Northern populations: sclerophyll forest and woodland (Agnes Banks Woodland, Castlereagh Scribbly Gum Woodland and Cooks River / Castlereagh Ironbark Forest) on aeolian and alluvial sediments. Southern populations: tertiary alluvium, shale sandstone transition communities and Cooks River / Castlereagh Ironbark Forest.		Marginal habitat present in the development site. Not recorded during targeted flora survey. No records within 5km of the development site.
Pimelea curviflora* var. *curviflora		V	V	*Pimelea curviflora* var. *curviflora* is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. It grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Flowers October to May.	12	Unlikely. Marginal habitat available, however, associated with shale-sandstone transition soils. Not recorded during targeted flora survey.
Pimelea spicata	Spiked Rice-flower	E	E	In western Sydney, *Pimelea spicata* occurs on an undulating topography of well-structured clay soils, derived from Wianamatta shale. It is associated with Cumberland Plains Woodland, in open woodland and grassland often in moist depressions or near creek lines. Has been located in disturbed areas that would have previously supported	41	Potential. Suitable habitat present. Not recorded during targeted survey.
Pterostylis gibbosa	Illawarra Greenhood	-	E	Known from a small number of populations in the upper Hunter Valley (Milbrodale), the Illawarra region (Albion Park and Yallah) and near Nowra (DECC 2007). Plants grow in a variety of woodland and open forest communities with shallow rocky soils.	0	Unlikely. Suitable habitat not present. No records within 5km of the development site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of Occurrence
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Terrestrial orchid predominantly found in Hawkesbury Sandstone Gully Forest growing in small pockets of soil that have formed in depressions in sandstone rock shelves. Known from Georges River National Park, Ingleburn, Holsworthy, Peter Meadows Creek, and St Marys Tower.	0	Unlikely. Suitable habitat not present. No records within 5km of the development site.
Pultenaea parviflora		E	V	Dry sclerophyll forest, especially Castlereagh Ironbark Forest, Shale Gravel Transition Forest and transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	0	Potential Suitable habitat present. Not recorded during targeted survey.
Syzygium paniculatum	Magenta Lillypilly	V	V	This species occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW. On the Central Coast, it occurs on Quaternary gravels, sands, silts and clays, in riparian gallery rainforests and remnant littoral rainforest communities. In the Ourimbah Creek valley, *S. paniculatum* occurs within gallery rainforest with *Alphitonia excelsa*, *Acmena smithii*, *Cryptocarya glaucescens*, *Toona ciliata*, *Syzygium oleosum* with emergent *Eucalyptus saligna*. At Wyrrabalong NP, *S. paniculatum* occurs in littoral rainforest as a co-dominant with *Ficus fraseri*, *Syzygium oleosum*, *Acmena smithii*, *Cassine australe*, and *Endiandra sieberi*.	9	Unlikely. Suitable habitat not present for this species which occurs in rainforest communities.
Tetratheca glandulosa		V		Found from Sampons Pass (Yengo NP) in the north to West Pymble (Lane Cove NP) in the south. The eastern limit is at Ingleside (Pittwater LGA) and the western limit is at East Kurrajong (Wollemi NP). "Heath, scrub, woodlands and open forest on upper-slopes and mid-slope sandstone benches. Soils generally shallow, consisting of a yellow, clayey/sandy loam.	4	Unlikely. Suitable habitat not present. Species associated with sandstone or shale-sandstone soil landscapes.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of Occurrence
Thesium australe	Austral Toadflax	V	V	Widespread throughout the eastern third of NSW but most common on the North Western Slopes, Northern Tablelands and North Coast. Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (*Themeda australis*) (DECC 2007). The preferred soil type is a fertile loam derived from basalt although it occasionally occurs on metasediments and granite.	0	Unlikely. Suitable habitat not present. No records within 5km of development site.

Table 48: Threatened fauna species likelihood table

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
Fish						
Macquarie australasica	Macquarie Perch	E (FM Act)	E	Habitat for this species is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods.	0	No Suitable habitat no present.
Prototroctes maraena	Australian Grayling	PE (FM Act)	V	Historically, this species inhabited coastal streams from the Grose River southwards through NSW, VIC and TAS. On the mainland, this species has been recorded from rivers flowing east and south of the main dividing range. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops. Grayling migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous species (migratory between fresh and salt waters).	0	No
Amphibia						
Heleioporus australiacus	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams, where the soil is soft and sandy so that burrows can be constructed.	0	No. Suitable habitat not present due to absence of sand or rock based streams.
Litoria aurea	Green and Golden Bell Frog	E	V	It can utilise a variety of natural and man-made waterbodies such as coastal swamps, marshes, lakes, other estuary wetlands, riverine floodplain wetlands, stormwater detention basins, farm dams, bunded areas, drains, ditches and other structures capable of storing water. Permanent swamps and ponds with established fringing vegetation (e.g. *Typha* sp. and spikerushes–*Eleocharis* sp.) adjacent to open grassland areas for foraging and free from predatory fish such as Mosquito Fish (*Gambusia holbrooki*) are also utilized.	1	Potential Habitat available within riparian corridor adjacent to development site. Not

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
						recorded during targeted survey.
Litoria littlejohni	Littlejohn's Tree Frog			Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	0	Unlikely. Suitable habitat not present for this species. No records within 5km of the development site.
Mixophyes balbus	Stuttering Frog	E	V	Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	0	Unlikely. Suitable habitat not present for this species. No records within 5km of the development site.
Pseudophryne australis	Red-crowned Toadlet	V		Open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings.	8	Unlikely Suitable habitat not present for this species due to absence of sandstone-associated habitat.
Gastropoda						

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	Associated with open eucalypt forests, particularly Cumberland Plain Woodland (CPW) described in Benson (1992). Found under fallen logs, debris and in bark and leaf litter around the trunk of gum trees or burrowing in loose soil around clumps of grass. Urban waste may also form suitable habitat.	156	Potential Habitat available within development site. Not recorded during targeted survey.
Pommerhelix duralensis	Dural Land Snail	E	E	Shale-sandstone transitional landscapes. Found in Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest; Turpentine-Ironbark Forest; Shale/Sandstone Transition Forest; Turpentine Ironbark Margin Forest; Hinterland Sandstone Gully Forest; and Sydney Hinterland Transition Woodland.	15	Unlikely Suitable habitat not present for this species which is typically found on shale-sandstone transition soils.
Reptiles						
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Dry eucalypt forests and woodlands, cypress forest, rainforest and moist eucalypt forest. Roosts in tree hollows. Favours habitat close to riparian areas.	0	Unlikely Suitable habitat not present.
Aves						
Anthochaera phrygia	Regent Honeyeater	CE	E & M	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (*C. cunninghamiana*). It primarily feeds on nectar from box and ironbark eucalypts and occasionally from Banksia's and mistletoes. It is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar. Suitable habitat likely to be present within the Precinct.	2	Potential Marginal transitory foraging habitat available for this species.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	The Dusky Woodswallow is found in open forests and woodlands and may be seen along roadsides and on golf courses. The Dusky Woodswallow nests colonially in 'neighbourhoods'. The nest is a loose bowl of twigs, grass and roots, lined with fine grass, and is placed in a tree fork, behind bark, in a stump hollow or in a fence post, about 1 m - 10 m above the ground.	6	Potential. Foraging habitat available within development site.
Botaurus poiciloptilus	Australasian Bittern	E	E	Occurs in terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats, reedbeds, swamps, streams, and estuaries.	0	Unlikely Suitable habitat not present.
Burhinus grallarius	Bush-stone Curlew	E	-	In NSW, it occurs in lowland grassy woodland and open forest.	0	Unlikely. Suitable habitat not present.
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	During summer it is found in dense, tall, wet forests of mountains and gullies, alpine woodlands. In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages. They sometimes inhabit woodland, farms and suburbs in autumn/winter. Only one population of this remaining in Sydney bounded by Beecroft – Cheltenham, Epping-North Epping, Turramurra – South Turramurra and Thornleigh- Wahroonga.	1	Potential Marginal foraging habitat for vagrant individuals. Development site outside geographic limitation of Hornsby Ku-ring-gai population and unlikely to be breeding in development site.
Calidris ferruginea	Curlew Sandpiper	E	CE, M	Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	0	No.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
						Suitable habitat not present.
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.	9	Potential. Marginal foraging habitat available in riparian corridor and River Flat Eucalypt Forest due to presence of *Casuarina* species. Unlikely to nest within development site due to disturbance and urban surrounding.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V		Eucalypt woodlands and dry open forest.	1	Potential. Marginal foraging habitat available for this species.
Daphoenositta chrysoptera	Varied Sittella	V	-	Distribution includes most of mainland Australia except deserts and open grasslands. Prefers eucalypt forests and woodlands with rough-barked species, or mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods from bark, dead branches, or small branches and twigs.	13	Potential Marginal habitat available. .
Dasyornis brachypterus	Eastern Bristlebird	E1	E1	Habitat is characterised by dense, low vegetation and includes sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest, as well as open woodland with a	0	No. Suitable habitat not present. Site

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
				heathy understorey. In northern NSW occurs in open forest with tussocky grass understorey.		outside known distribution of this species.
Glossopsitta pusilla	Little Lorikeet	V	-	In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box *Eucalyptus albens* and Yellow Box *E. melliodora* are particularly important food sources for pollen and nectar respectively.	8	Potential. Foraging habitat present within site.
Grantiella picta	Painted Honeyeater		V	A nomadic species that typically inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests with abundant mistletoe (DECC 2007). It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias, preferring *Amyema* sp mistletoe (DECC 2007).	0	Unlikely Preferred vegetation not present. Typically occurs further inland.
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	Ma	Freshwater swamps, rivers, lakes, reservoirs, billabongs, saltmarsh and sewage ponds and coastal waters. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and urban areas.	2	Potential Marginal secondary foraging habitat available within development site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
Hieraaetus morphnoides	Little Eagle	V		Open eucalypt forest, woodland or open woodland, including sheoak or Acacia woodlands and riparian woodlands of interior NSW.	1	Potential. Foraging habitat available within study area.
Lathamus discolor	Swift Parrot	E	CE	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts. Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*).	5	Potential. Marginal foraging habitat available for this species.
Lophoictinia isura	Square-tailed Kite	V	-	In coastal areas associated tropical and temperate forests and woodlands on fertile soils with an abundance of passerine birds. May be recorded inland along timbered watercourses. In NSW it is commonly associated with ridge or gully forests dominated by *Eucalyptus longiflora* (Woollybutt), *C. maculata* (Spotted Gum), or *E. elata, E. smithii* (Peppermint Gum).	3	Potential. Foraging habitat available within study area.
Melithreptus gularis gularis	Black-chinned Honeyeater	V		Open forests or woodlands dominated by box and ironbark eucalypts, or by smooth-barked gums, stringybarks, river sheoaks and tea-trees.	2	Potential Foraging habitat available for this species.
Neophema pulchella	Turquoise Parrot	V	-	Eucalypt and cypress pine open forests and woodlands, ecotones between woodland and grassland, or coastal forest and heath.	2	Unlikely Preferred habitat not present.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
						Limited local records.
Pandion cristatus	Eastern Osprey	V	M	Rocky shorelines, islands, reefs, mouths of large rivers, lagoons and lakes.	0	Unlikely Suitable habitat not present.
Petroica boodang	Scarlet Robin	V	-	Dry eucalypt forests and woodlands, and occasionally in mallee, wet forest, wetlands and tea-tree swamps.	2	Potential Foraging habitat available for this species.
Petroica phoenicea	Flame Robin	V	-	Breeds in upland tall moist eucalypt forests and woodlands. In winter uses dry forests, open woodlands, heathlands, pastures and native grasslands. Occasionally occurs in temperate rainforest, herbfields, heathlands, shrublands and sedgelands at high altitudes.	1	Potential Foraging habitat available for this species.
Rostratula australis	Australian Painted Snipe		E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (ibid.). Breeding is often in response to local conditions; generally occurs from September to December. Roosts during the day in dense vegetation. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter (ibid.).	0	Unlikely Suitable habitat not present. No local records.
Nocturnal Aves						
Ninox connivens	Barking Owl	V	-	Woodland and open forest, including fragmented remnants and partly cleared farmland, wetland and riverine forest. Roosts in dense shaded foliage in large trees. Nests in large hollows in living or dead eucalypts. Typically hunts small arboreal mammals, also takes birds, invertebrates and terrestrial mammals.	2	Potential. Potential foraging habitat available within study area. No nesting habitat available

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
						due to lack of suitable hollows.
Ninox strenua	Powerful Owl	V	-	Woodland, open sclerophyll forest, tall open wet forest and rainforest. During the day roosts in dense vegetation. Preys on medium-sized arboreal marsupials. Nests in large tree hollows.	38	Potential. Suitable foraging habitat available within study area. No nesting habitat available due to lack of suitable hollows.
Tyto novaehollandiae	Masked Owl	V	-	Associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland and especially the ecotone between wet and dry forest, and non-forest habitat. Known to utilise forest margins and isolated stands of trees within agricultural land and heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained.	2	Potential. Potential foraging habitat available within study area. No nesting habitat available due to lack of suitable hollows.
Mammals						
Dasyurus maculatus	Spotted-tailed Quoll	V	E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECC 2007j), more frequently recorded near the ecotones of closed and open forest and in NSW within 200km of the coast. Preferred habitat is mature wet forest (Belcher 2000b; Green & Scarborough 1990; Watt 1993), especially in areas with rainfall 600 mm/year (Edgar & Belcher 2008; Mansergh 1984). Unlogged forest or forest that has been less disturbed by timber harvesting is also preferable (Catling et al. 1998, 2000). This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007).	1	Unlikely. Suitable habitat not present.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
				Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).		
Petaurus australis	Yellow-bellied Glider	V		Tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Den, often in family groups, in hollows of large trees. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.	2	Unlikely Suitable habitat not present due to lack of suitable tree hollows and high level of fragmentation.
Petauroides volans	Greater Glider		V	The greater glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The greater glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species.	0	Unlikely. Suitable habitat not present.
Petrogale penicillata	Brush-tailed Rock Wallaby	E	V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices.	0	Unlikely. Suitable habitat not present.
Phascolarctos cinereus	Koala	V	V	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70%, with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: *Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis.*	37	Unlikely. Suitable habitat not present.
Pseudomys novaehollandiae	New Holland Mouse	-	V	A small burrowing native rodent with a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. A social animal, living predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha and the species peaks in abundance during early to mid-stages of vegetation succession typically induced by fire.	0	No. Suitable habitat not present. Site outside known

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
						distribution of this species.
Mammals (Bats)						
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Wet and dry sclerophyll forests, Cyprus Pine dominated forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country. Roosts in caves, rock overhangs and disused mine shafts.	1	Potential. Marginal foraging habitat available within development site. No roosting / nesting habitat.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Prefers moist habitats with trees taller than 20m. Roosts in tree hollows but has also been found roosting in buildings or under loose bark.	9	Potential. Foraging and roosting habitat available.
Miniopterus australis	Little Bent-wing Bat	V		Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. "Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat. Maternity colonies form in spring. Males and juveniles disperse in summer.	15	Potential. Foraging habitat and secondary roosting habitat available. Breeding habitat not available.
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland. It forages above and below the tree canopy on small insects. Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter.	70	Potential. Foraging habitat and secondary roosting habitat available. Breeding habitat not available.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
Mormopterus norfolkensis	Eastern Freetail Bat	V	-	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range. Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges. Primarily roosts in hollows or behind loose bark in mature eucalypts but have been observed roosting in the roof of a hut.	43	Potential. Foraging and roosting habitat available.
Myotis macropus	Southern Myotis	V	-	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water. While roosting (in groups of 10-15) it is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains. It forages over streams, dams and pools catching insects and small fish by raking their feet across the water surface.	29	Potential. Foraging and roosting habitat available
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. Camps are often located in gullies, typically close to water, in vegetation with a dense canopy.	54	Potential Suitable foraging habitat present within site.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		It forages for insects above the canopy in eucalypt forests, and closer to the ground in more open country. It is dependent on suitable hollow-bearing trees to provide roost sites. The species has also been recorded using caves and abandoned sugar glider nests as roost sites. Breeding occurs between December and mid-march.	11	Potential. Foraging and roosting habitat available.
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range, tending to be more frequently located in more productive forests. Within denser vegetation types, use is made of natural and man-made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey.	26	Potential. Foraging and roosting habitat available.
Vespadelus troughtoni	Eastern Cave Bat	V		Dry open forest and woodland, near cliffs or rocky overhangs, cliff-lines in wet eucalypt forest and rainforest.	1	Potential. Marginal foraging habitat available.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
						No roosting habitat.
Migratory Fauna						
Actitis hypoleucos	Common Sandpiper	-	M	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	0	No. Suitable habitat not present.
Apus pacificus	Fork-tailed Swift	-	M	Sometimes travels with Needletails. Varied habitat with a possible tendency to more arid areas but also over coasts and urban areas.	2	Unlikely. This species may be found flying over the development site however is unlikely to inhabit the site.
Calidris ferruginea	Curlew Sandpiper	E	CE, M	Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	0	No. Suitable habitat not present.
Calidris melanotos	Pectoral Sandpiper	-	M	Shallow fresh to saline wetlands, including coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	0	No. Suitable habitat not present.
Calidris ruficollis	Red-necked Stint	-	M	Tidal mudflats, saltmarshes, sandy and shelly beaches, saline and freshwater wetlands, saltfields, sewage ponds.	1	Unlikely Suitable habitat not present for this species.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
Cuculus optatus	Oriental Cuckoo	-	M	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses.	0	Unlikely. Suitable habitat not present.
Gallinago hardwickii	Latham's Snipe	-	M	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover. Occupies a variety of vegetation around wetlands including wetland grasses and open wooded swamps. Can occur in habitats that have saline or brackish water, such as saltmarsh, mangrove creeks, around bays and beaches, and at tidal rivers. They are regularly recorded in or around modified or artificial habitats including pasture, ploughed paddocks, irrigation channels and drainage ditches and sewage and dairy farms. They can also occur in various sites close to humans or human activity (e.g. near roads, railways, airfields, commercial or industrial complexes).	1	Unlikely. Preferred habitat not present.
Hirundapus caudacutus	White-throated Needletail	-	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas. Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather.	2	Unlikely. This species may be found flying over the development site however is unlikely to inhabit the site.
Monarcha melanopsis	Black-faced Monarch	-	M	Habitat typically includes rainforest and eucalypt forests, with feeding occurring in tangled understorey.	0	Unlikely. Suitable habitat not present.
Motacilla flava	Yellow Wagtail	-	M	An insectivorous bird, inhabiting open country near water, such as wet meadows. It nests in tussocks.	0	Unlikely. Suitable habitat not present.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	Likelihood of occurrence
Myiagra cyanoleuca	Satin Flycatcher	-	M	Habitat typically includes wetter, denser forest, often at high elevations.	0	Unlikely. Suitable habitat not present.
Numenius madagascariensis	Eastern Curlew	-	CE, M	Estuaries, bays, harbours, inlets and coastal lagoons, intertidal mudflats or sandflats, ocean beaches, coral reefs, rock platforms, saltmarsh, mangroves, freshwater/brackish lakes, saltworks and sewage farms.	0	Unlikely. Suitable habitat not present.
Rhipidura rufifrons	Rufous Fantail		M	Wet sclerophyll forests, subtropical and temperate rainforests. Sometimes drier sclerophyll forests and woodlands.	0	Unlikely. Suitable habitat not present.
Tringa nebularia	Common Greenshank	-	M	Terrestrial wetlands (swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans, saltflats, sewage farms and saltworks dams, inundated rice crops and bores) and sheltered coastal habitats (mudflats, saltmarsh, mangroves, embayments, harbours, river estuaries, deltas, lagoons, tidal pools, rock-flats and rock platforms).	0	No. Suitable habitat not present. No local records.

Appendix D Ultrasonic analysis report

Report completed 12 April 2019.

Eco Logical Australia Pty Ltd (ELA) was engaged by Landcom to prepare a Biodiversity Development Assessment Report for the study area at Kellyville. This microbat report presents the results of the ultrasonic microchiropteran bat call survey conducted as part of the BDAR. The data presented in this report will contribute to the outcomes of a BDAR.

This report outlines the methodology used and results of the data analysis.

D1 Methods

Two Anabat Swifts (AS05 and AS06) and one SD2 Anabat (SN82076) recorders were set to record microbat calls at three survey sites located within the Kellyville study area.

Data was collected passively for a period of six consecutive nights between 18 and 23 February 2019. The total effort undertaken during this survey was equivalent to eighteen (18) detector nights.

A further and more detailed description of the vegetation community and structure at the subject site will be presented in the main report.

Data Analysis

Bat calls were analysed by Rodney Armistead from Eco Logical Australia (ELA) using the program AnalookW (Version 4.4a 17 September 2018, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al 2004); and south-east Queensland and north-east New South Wales (Reinhold et al 2001) and the accompanying reference library of over 200 calls from Sydney Basin, NSW (which is available at http://www.forest.nsw.gov.au/research/bats/default.asp). Rodney has over five years of experience in the identification of ultrasonic call recordings. This report and a sample of the calls was reviewed by Alicia Scanlon also from ELA, who has over twelve years of experience in the identification of ultrasonic call recordings.

Bat calls were analysed using species-specific call profile parameters including call shape, characteristic frequency, initial slope and time between pulses (Reinhold et al 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et al 2006) were followed:

- Search phase calls were used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al 2002). Cruise phase or feeding calls were labelled as being unidentifiable.
- Recorded calls containing less than three pulses were not analysed and these sequences were labelled as unidentifiable as they are too short to confidently determine the identity of the species making the call (Law et al 1999).
- For those calls that were useful to identify the species making the call, two categories of confidence were used (Mills et al 1996):

- Definitely present – the quality and structure of the call profile is such that the identity of the bat species making the calls is not in doubt
- Potentially present – the quality and structure of the call profile is such that there is some / low probability of confusion with species that produce similar calls profiles

- Calls made by bats which cannot be used for identification purposes such as social calls, short and low-quality calls, cruise and approach phase calls were labelled as unidentifiable.
- Sequences of inferior quality were labelled as unidentifiable as it is not possibly to be identified to microbat species making the call. These calls were however retained in the data as they can be used as an indicator of microbat activity at the site.
- *Nyctophilus* spp. (Long-eared bats) are difficult to identify or separate confidently to species level based upon their recorded calls. Therefore, we have made no attempt to identify any recorded *Nyctophilus* spp. calls to species level (Pennay et al 2004). There are two potential Nyctophilus species that could occur in the study area; *N. geoffroyi* (Lesser Long-eared Bat) and *N. gouldii* (Gould's Long-eared Bat). Both are relatively common and widely distributed across NSW and could occur within the study area.
- The Free-tailed Bats (previously referred to as the genus *Mormopterus*) have recently undergone taxonomic revision (Reardon et al 2014) and published reference calls for this group of species (Pennay et al 2004) are believed to contain errors (Greg Ford pers comm.). This report uses nomenclature for Free-tailed Bat species as referred to in Jackson and Groves (2015). The correlation between nomenclature used in this report and that used in NSW State legislation is presented in Table 49 below.
- Sequences not attributed to microbat echolocation calls (e.g. insect buzzes, wind, train and vehicle movement) were dismissed from the analysis.

Table 49: Correlations between current and previous nomenclature for the Free-tailed bats of NSW

Jackson and Groves 2015	Previously known as	Common Name	BC Act
Austronomus australis	*Tadarida australis*	White-striped Free-tailed Bat	
Micronomus norfolkensis	***Mormopterus norfolkensis***	**Eastern Coastal Free-tailed Bat**	**Vulnerable**
Ozimops petersi	*Mormopterus species 3 (small penis)*	Inland Free-tailed Bat	
Ozimops planiceps	*Mormopterus species 4 (long penis eastern form)*	Southern Free-tailed Bat	
Ozimops ridei	*Mormopterus species 2*	Ride's Free-tailed Bat	
Setirostris eleryi	***Mormopterus species 6***	**Bristle-faced Free-tailed Bat**	**Endangered**

D2 Results

There were 4,009 call sequences recorded during this survey. Of these, 2,940 (73.37%) were deemed to be useful because the call profiles were of sufficient quality or length to enable positive identification of a bat to genus or species. The remaining 1,067 (26.62%) call sequences were either too short (three or less pulses) or of low quality, thus preventing positive identification of bat species.

There were at least six and up to fourteen (14) species recorded during this survey (Table 50). Up to six species listed as vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act) were recorded among this data (Table 50, Figure 23 – Figure 31). The vulnerable species that were confidently identified as being present within the subject site include;

- ***Micronomus norfolkensis*** **(Eastern Coastal Free-tailed Bat)**
- ***Miniopterus orianae oceanensis*** **(Eastern Bentwing Bat)**

Four other threatened species were recorded as being potentially present. In the case of this survey, the four species that fit this description, include;

- ***Falsistrellus tasmaniensis*** **(Eastern False Pipistrelle)**
- ***Myotis macropus*** **(Southern Myotis)**
- ***Saccolaimus flaviventris*** **(Yellow-bellied sheath-tailed Bat)**
- ***Scoteanax rueppellii*** **(Greater Broad-nosed Bat)**

The quality, shape and characteristic frequency (defining features) of calls assigned to the threatened species listed above were such that we cannot be certain of their presence within the subject site. Consequently, these species were labelled as being potentially present only. This is because the defining features of the call profiles assigned to these threatened microbats overlap with other more common and non-threatened species. Whilst there were no defining call characteristics that would allow us to confidently attribute to these calls to these threatened species, all four microbats listed above are known to occur in the area and consequently, may be present within the survey sites. See the Survey Limitations section provided below for further information on call identification and separation of species with overlapping call profiles.

Large-eared Pied Bat is also listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Activity and foraging

The most commonly recorded call profile was attributed to the difficult to separate species grouping that includes the non-threatened Ride's Free Tail, threatened Eastern False Pipistrelle, Greater Broad-nosed Bat and non-threatened *Scotorepens orion* (Eastern Broad-nosed Bat). Collectively, 1,586 calls, most of which were recorded on Anabat Swift 05, were attributed to this species grouping, which accounted for 39.56% of the calls that were recorded during this survey. In contrast, very few call profiles were attributed to Eastern Bentwing Bat, *Nyctophilus spp* (Long-eared Bat species) and the species grouping containing *Vespadelus pumilus* (Eastern Forest Bat).

General microbat activity was regarded as being very low to moderate across the three survey sites. For example, very low activity levels (e.g. fewer than one call being recorded / ten minutes (on average) over the five nights of recording time) were recorded on SN82076 and Anabat Swift 06. Moderate

activity levels (e.g. two calls being recoded / ten minutes (on average) of recording time) were recorded on Anabat Swift 05.

Long sequences and feeding buzzes were observed throughout the data set. The majority of these calls were attributed to *Ozimops ridei* (Ride's Free-tailed Bat), Eastern Coastal Free-tailed Bat and the **Greater Broad-nosed Bat /** Eastern Broad-nosed Bat species grouping. The majority of the foraging buzzes were recorded on Swift 05. However, most of the recorded calls appeared to be cruise or search phase calls.

Feeding buzzes indicate that bats were actively foraging at the site in which Swift 05 was set. Few feeding buzzes were observed among the remaining data, thus suggesting that either

- little foraging activity was occurring at these sites,
- the weather conditions were not favourable for the recording of the lower intensity feeding calls, or
- bats were predominantly commuting through these areas.

Careful interpretation of these results is recommended because microbat activity at the subject site is a result of a multitude of factors. Activity can only be measured in a relative sense since it is impossible to determine whether each call is being made by a different bat or the same bat flying past the recorder multiple times. All of these factors can influence how the recorders record the data as well as the availability of insect prey and therefore the suitability of the surveys site at a given time as foraging habitat. The subject site was surveyed at the end of Summer, during a period of relatively warm and humid climatic conditions.

Interpretation of Survey Results

The Eastern False Pipistrelle primarily roosts in the hollows s of living trees, and occasionally in buildings Law et al. 2008). It has been recorded in wet high-altitude sclerophyll and coastal mallee forests and appears to prefer continuous patches of tall wet forests with trees that are greater in height than 20 m (Churchill, 2008; Law et al. 2008). This species is known to occur throughout the Sydney basin bioregion and is likely to forage over and within the Kellyville study area and may form maternity roosts within the hollow bearing trees that are present within the study area.

Eastern Coastal Free-tailed Bats are primarily a tree roosting species, but will at times roost in buildings (Churchill, 2008). This species prefers dry sclerophyll forest and woodland and forages over open spaces. It is known from this region, particularly from the rural residential and agricultural areas surrounding the Hawksbury River. This species will forage over the Kellyville site and may form maternity roosts within hollow bearing trees or buildings on the site.

Southern Myotis is known from this locality. Southern Myotis will roost and breed in hollow bearing trees (that are generally located within 200m radius of a permanent waterway (lakes, creeks and rivers with pools / stretches of water that ≥3m in width) as well as subterranean structures such as old railway tunnels, military bunkers, culverts, bridges, stormwater drains and mines (Churchill, 2008; Richards et al., 2008; Campbell, 2014). It has a unique feeding strategy amongst Australian bats in that it forages exclusively over water, trawling the surface for small insects and aquatic species such as fish and crustaceans (Anderson et al. 2006). Suitable waterbodies generally contain at least 3 m of open water

and include farm dams, creeks and rivers. Southern Myotis could forage across the creek present within and adjacent to the study area and may form maternity roosts within hollow bearing trees or culverts / bridges on site.

Further targeted survey would be required to positively identify the presence of Southern Myotis on site. Reliance upon ultrasonic call recordings to identify Myotis is not recommended because of the risk of confusion with calls from the *Nyctophilus* group of species. Trapping or trip lining over and adjacent to water bodies on site is the most reliable method of identifying the presence of Myotis. Inspection of tree hollows may also be required to locate roosting/breeding habitat.

Eastern Bentwing Bats and Little Bentwing Bats are known to occur in this region of the Sydney basin. These species are both subterranean roosting species that are only known to breed in a small number of shared caves in NSW (Churchill, 2008). Little Bentwing Bats have also been known to roost in tree hollows, though not in any great numbers (Churchill, 2008). Caves provide the perfect microclimatic conditions for rearing of young. Breeding occurs over the summer months and bats disperse to other non-breeding winter and hibernation roosts between March and August each year (Churchill, 2008; Hoye and Hall 2008a and 2008b). It is likely that Eastern Bentwing Bats and Little Bentwing Bats will forage over the Kellyville study area and possible that either species could roost in culverts or other man-made structures on site. It is also possible that Little Bent-winged Bats could roost in hollow bearing trees on site. Neither species will form breeding colonies within tree hollows or bridges / culverts on site.

Greater Broad-nosed Bats have been recorded roosting and breeding in a very similar rural landscape in this part of the Sydney Basin. Greater Broad-nosed Bats are known to forage, roost and breed around isolated paddock trees (ELA pers. comm) and along riparian corridors in open areas, particularly when they are connected to areas of more extensive forest. Further targeted survey may be required to positively identify the presence of this species on site but given the nearby records and habitat it is likely to be present. Reliance upon ultrasonic call recordings to identify Greater Broad-nosed Bats is not recommended because of the risk of confusion with calls of two other species; the Eastern False Pipistrelle and Eastern Broad-nosed Bat. Trapping around large old trees and along tree-lined creeks is the most reliable method of identifying the presence of Greater Broad-nosed Bats. Inspection of tree hollows and old buildings may also be required to locate roosting/breeding habitat.

D3 Survey Limitations

The species recorded in this survey with overlapping call profiles include *Chalinolobus gouldii* (Gould's Wattled Bat), Eastern Coastal Free-tailed Bat and Ride's Free-tailed Bat. The calls of these three species overlap in the range 30 kHz to 32 kHz. Eastern Coastal Free-tailed Bat calls were identified by alternation in call frequency between pulses, a flat shape (initial slope S1 of less than 100 octaves per second) and a characteristic frequency of between 31 – 36 kHz. Calls were identified as Ride's Freetail Bat if the call shape was flat (initial slope S1 of less than 100 octaves per second) and the frequency was between 28 – 32 kHz. Gould's Wattled Bat was distinguished by a frequency of 28.5 – 32.5 kHz and alternation in call frequency between pulses. Calls with intermediate characteristics were assigned mixed species labels.

The calls of Eastern False Pipistrelle, Greater Broad-nosed Bat and Eastern Broad-nosed Bat can be difficult to separate as their call frequencies and some other call characteristics overlap.

Eastern False Pipistrelle bat calls have a characteristic frequency between 35 and 39 kHz, display curved, often steep pulses without up-sweeping tails and sometimes with down-sweeping tails. The pre-characteristic section is often long (greater than 3 kHz). This species can only be separated from Eastern Broad-nosed Bat, as stated above when the characteristic frequency is above 38 kHz.

Greater Broad-nosed Bats can be distinguished by a frequency of 32 – 36 kHz, lack of a tail or short down-sweeping tail, frequency of the knee greater than 37 kHz, and drop of more than 3 kHz from the knee to the characteristic section.

Eastern Broad-nosed Bat calls fall between 34 and 37 kHz but can only be separated from Eastern False Pipistrelle when calls are between 34 and 35 kHz, and the frequency of the knee is above 38 kHz.

When calls showed characteristics intermediate between these three species they were assigned mixed species labels.

Eastern Bentwing Bats have call profiles that overlap with other species, including *Vespadelus darlingtoni* (Large Forest Bat) and *Vespadelus regulus* (Southern Forest Bat). Eastern Bentwing Bat calls can be identified by a characteristic frequency of 43.5 – 47.5 kHz, a down-sweeping tail, uneven time between call pulses and pulse shape within a sequence and a drop of more than 2 kHz between the knee and characteristic section of the call. Both Large and Southern Forest Bat calls have a characteristic frequency of 40 - 44 kHz, have no tail or up-sweeping tails. Large Forest Bats often have a long characteristic section which can aid in separating this species from the Southern Forest Bat. Some of the calls recorded during this survey displayed a drop of more than 2 kHz, downward sweeping tails and variability between the pulses leading to an identification of Eastern Bent-winged Bat.

In this region, calls of Eastern Forest Bat, Little Forest Bat and *Chalinolobus morio* (Chocolate Wattled Bat) can overlap in the range 47 – 53 kHz. Chocolate Wattled Bat calls have a down-sweeping tail whereas Eastern Forest Bat, Eastern Cave Bat and Little Forest Bat calls have an up-sweeping tail. At frequencies between 50 and 53 kHz it is impossible to separate Eastern Forest Bat from Little Forest Bat. Calls with up-sweeping tails and a characteristic frequency that ranges between 54.5 and 58 can be attributed Eastern Forest Bat. When no distinguishing characteristics were present calls were assigned to multi-species groups or characterized as unidentifiable.

The calls of Little Bentwing Bats are generally easily separated from those of Chocolate Wattled Bats by higher frequency falling between 54.5 and 64.5 kHz, however both have down-sweeping tails. Calls falling between 54 and 55.5 kHz can be difficult to separate from the higher frequency calls of Chocolate Wattled Bats. Little Bentwing Bat calls often display variable shape and time between pulses and rarely call below 58 kHz. When calls with down sweeping tails were recorded at 54 to 55.5 kHz they were assigned mixed species labels.

The calls of Southern Myotis and the *Nyctophilus* group of species are difficult to separate. Calls can sometimes be identified as *Nyctophilus spp*. when the time between calls (TBC) is higher than 95ms and the initial slope S1 is lower than 300 octaves per second (OPS). Calls can sometimes be identified as Southern Myotis when the time between calls (TBC) is lower than 75ms and the initial slope S1 is greater than 400 (OPS). Southern Myotis calls are often louder and more distinct, recorded in longer sequences and more variable in shape and TBC than Nyctophilus calls. In addition, there is often two kinks in the slope of *Nyctophilus* spp. calls. Where the TBC is between 75 and 95ms and the OPS is between 300

and 400 calls are assigned a mixed species label of Southern Myotis / Long-eared Bats (Pennay, Law and Reinhold 2004).

The calls of Yellow-bellied Sheath-tailed Bats and White-striped Free-tailed Bats are generally easily separated by frequency of the characteristics section. The primary harmonic of Yellow-bellied Sheath-tailed Bat calls falls between 17 – 23 kHz and occasionally as low as 15 kHz, whilst those of the White-striped Free-tailed Bat fall between 10 and 15 kHz. However, when White-striped Free-tailed Bats are feeding their calls increase in frequency and can appear like those of the Yellow-bellied Sheath-tailed Bat.

Table 50. Microbat species diversity recorded over sixteen (16) survey nights from eighteen survey sites at Kellyville between 18 and 22 February 2019.

Species Name	Common Name	Result
Austronomus australis	White-striped Free-tailed Bat	X
Chalinolobus gouldii	Gould's Wattled Bat	X
Chalinolobus morio	Chocolate Wattled Bat	X
Falsistrellus tasmaniensis*	**Eastern False Pipistrelle**	P
Micronomus norfolkensis*	**Eastern Coastal Free-tailed Bat**	X
Miniopterus orianae oceanensis*	**Eastern Bentwing Bat**	X
Myotis macropus*	**Southern Myotis**	P
Nyctophilus spp. In this region the non-threatened *N. geoffroyi and N. gouldii* are likely to be present.	In this region the non-threatened Lesser and Gould's and the Lesser Long-eared Bats are likely to be present.	P
Ozimops ridei	Ride's Free-tailed Bat	X
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat	P
Scoteanax rueppellii*	**Greater Broad-nosed Bat**	P
Scotorepens orion	Eastern Broad-nosed Bat	P
*Vespadelus pumilus**	Eastern Forest Bat	P
Vespadelus vulturnus	Little Forest Bat	P

X = Definitely recorded, P = Potentially recorded. ***listed as threatened under the BC Act**

D4 Results tables

Table 51. Microbat species recorded ultrasonically on SN82076, Kellyville, 18 to 23 February 2019.

Species Name	Common name	Definitely present	Potentially present	Total
Austronomus australis	White-striped Free-tailed Bat	0	1	1
Chalinolobus gouldii	Gould's Wattled Bat	0	1	1
Chalinolobus morio	Chocolate Wattled Bat	2	4	6
Miniopterus orianae oceanensis* / *Vespadelus darlingtoni* / *Vespadelus regulus*	**Eastern Bentwing Bat** / Large Forest Bat / Southern Forest Bat	0	0	1
Myotis macropus* / *Nyctophilus* spp.	**Southern Myotis** / Long-eared Bat	0	0	38
Unidentifiable calls				82
Identifiable calls				47
Total Calls				129
Percentage usable calls				36.43

*** listed as vulnerable under the BC Act**

Table 52. Microbat species recorded ultrasonically at Anabat Swift 05, Kellyville, 18 to 23 February 2019.

Species Name	Common name	Definitely present	Potentially present	Total
Austronomus australis	White-striped Free-tailed Bat	3	6	9
Chalinolobus gouldii	Gould's Wattled Bat	250	142	392
Chalinolobus gouldii / *Ozimops ridei*	Gould's Wattled Bat / Ride's Free-tailed Bat	0	0	299
Chalinolobus morio	Chocolate Wattled Bat	11	14	25
Falsistrellus tasmaniensis* / *Scotorepens orion*	**Eastern False Pipistrelle /** Eastern broad-nosed Bat	0	0	16
Ozimops ridei / ***Falsistrellus tasmaniensis**** / ***Scoteanax rueppellii**** / *Scotorepens orion*	**Eastern False Pipistrelle / Greater Broad-nosed Bat** / Eastern broad-nosed Bat	0	0	1554
Micronomus norfolkensis*	**Eastern Coastal Free-tailed Bat**	3	1	4
Micronomus norfolkensis* / *Ozimops ridei*	**Eastern Coastal Free-tailed Bat /** Ride's Free-tailed Bat			10
Miniopterus orianae oceanensis*	**Eastern Bentwing Bat**	9	5	14
Miniopterus orianae oceanensis* / *Vespadelus darlingtoni* / *Vespadelus regulus*	**Eastern Bentwing Bat /** Large Forest Bat / Eastern Forest Bat	0	0	7

Species Name	Common name	Definitely present	Potentially present	Total
Myotis macropus* / *Nyctophilus* spp.	**Southern Myotis** / Long-eared Bat	0	0	3
Saccolaimus flaviventris*	**Yellow-bellied Sheathtail Bat**	0	5	5
Ozimops ridei	Ride's Free-tailed Bat	123	41	164
Unidentifiable calls				488
Identifiable calls				2502
Total Calls				2990
Percentage usable calls				83.68

*** listed as vulnerable under the BC Act**

Table 53. Microbat species recorded ultrasonically at Anabat Swift 06, Kellyville, 18 to 23 February 2019.

Species Name	Common name	Definitely present	Potentially present	Total
Chalinolobus gouldii	Gould's Wattled Bat	77	86	163
Chalinolobus gouldii / *Ozimops ridei*	Gould's Wattled Bat / Ride's Free-tailed Bat	0	0	77
Chalinolobus morio	Chocolate Wattled Bat	9	18	27
Chalinolobus morio / *Vespadelus pumilus* / *Vespadelus vulturnus*	Chocolate Wattled Bat / Eastern Forest Bat / Little Forest Bat	0	0	5
Falsistrellus tasmaniensis* / ***Scoteanax rueppellii**** / *Scotorepens orion*	**Eastern False Pipistrelle / Greater Broad-nosed Bat** / Eastern broad-nosed Bat	0	0	42
Micronomus norfolkensis*	**Eastern Coastal Free-tailed Bat**	1	0	1
Miniopterus orianae oceanensis*	**Eastern Bentwing Bat**	4	2	6
Myotis macropus* / *Nyctophilus* spp.	**Southern Myotis** / Large-eared Bat	0	0	15
Ozimops ridei	Ride's Free-tailed Bat	37	17	54
Scoteanax rueppellii* / *Scotorepens orion*	**Greater Broad-nosed Bat** / Eastern broad-nosed Bat	0	0	1
Unidentifiable calls				497
Identifiable calls				391
Total Calls				888
Percentage usable calls				44.03

*** listed as vulnerable under the BC Act**

D5 Example Call Profiles

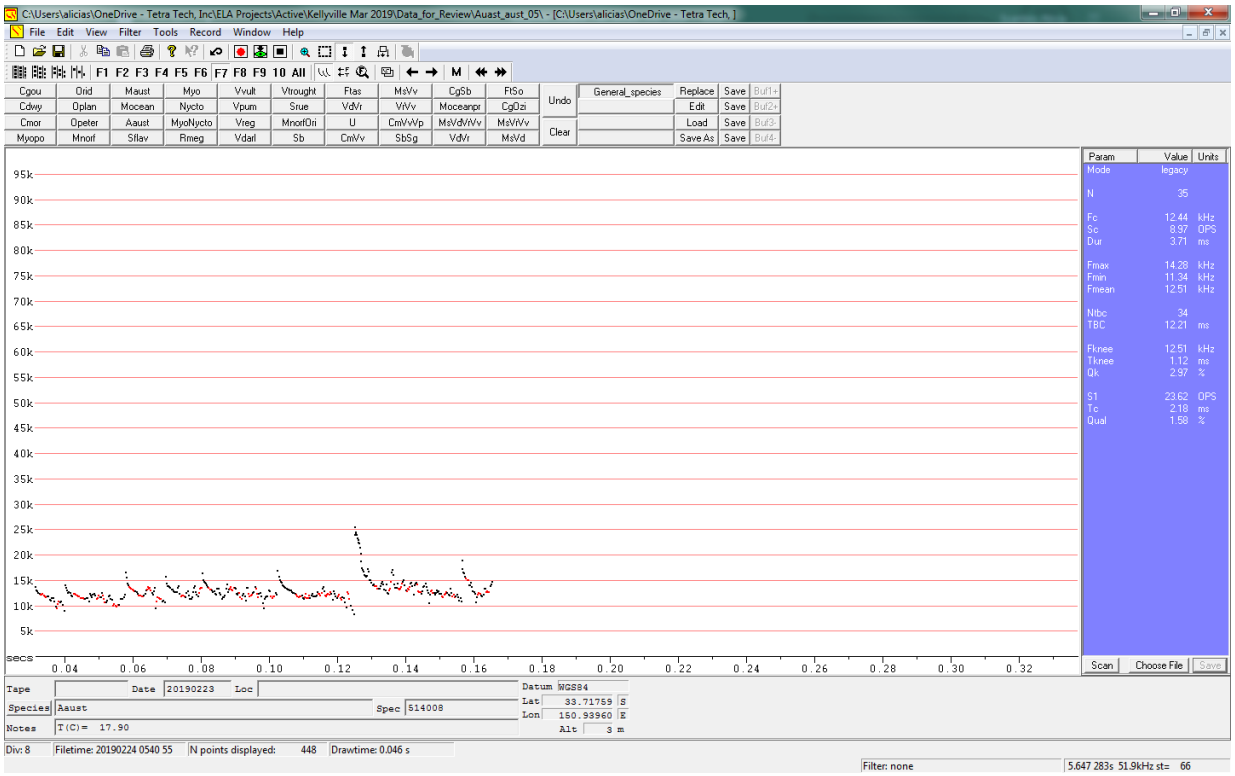

Figure 23. Call profile for Austronomus australis (White-striped Free-tailed Bat) recorded on Anabat Swift 05 at 0540 (5.40 am) on 24 February 2019.

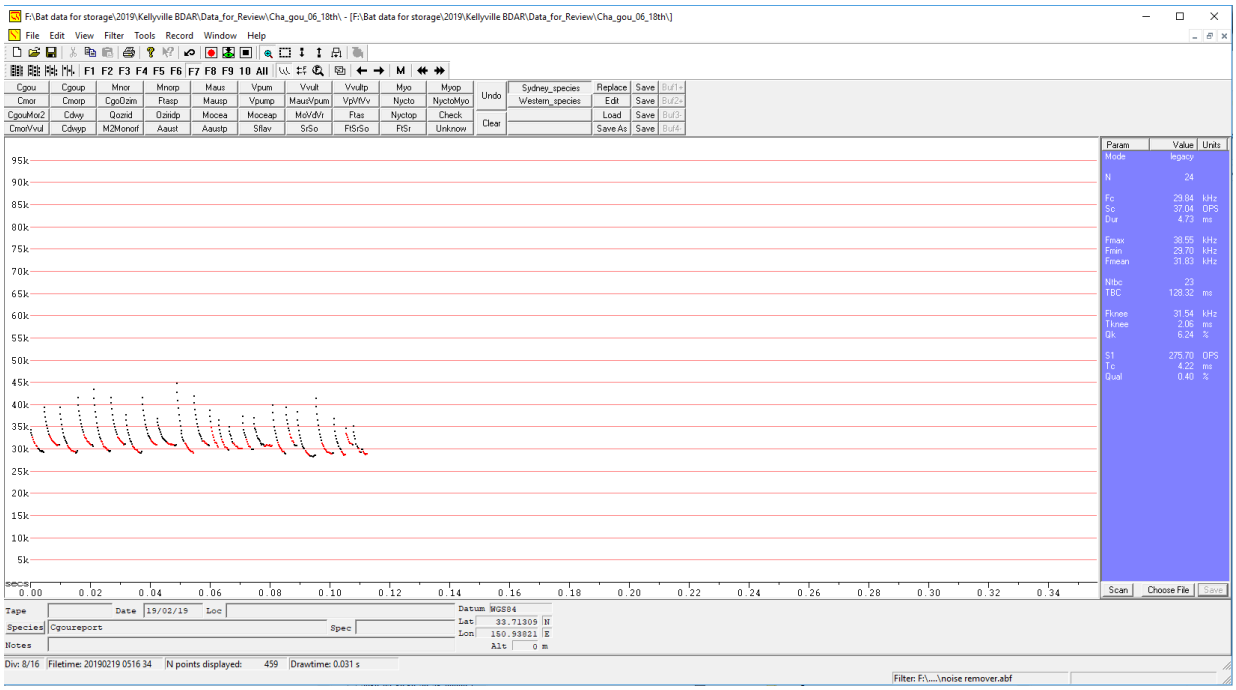

Figure 24: Call profile for Chalinolobus gouldii (Gould's Wattled Bat) recorded on Anabat Swift 06 at 0516 (5.16 am) on 19 February 2019.

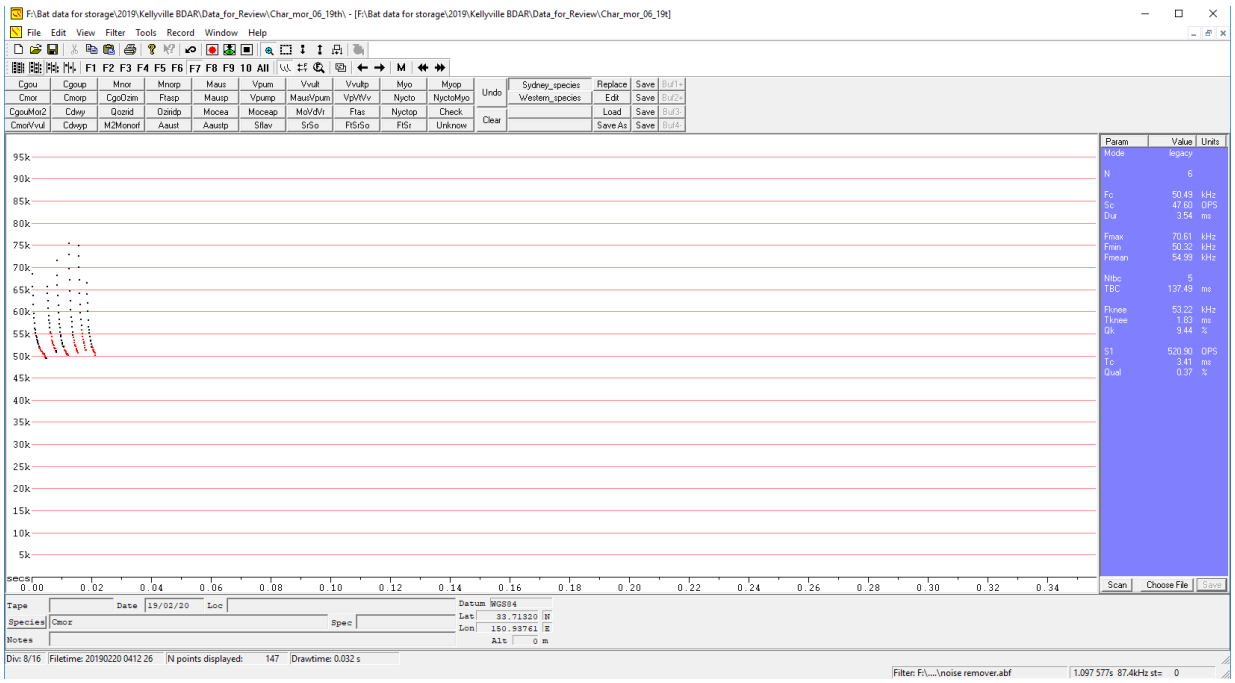

Figure 25: Call profile for Chalinolobus morio (Chocolate Wattled Bat) recorded on Anabat Swift 06 at 0412 (4.12 am) on 20 February 2019.

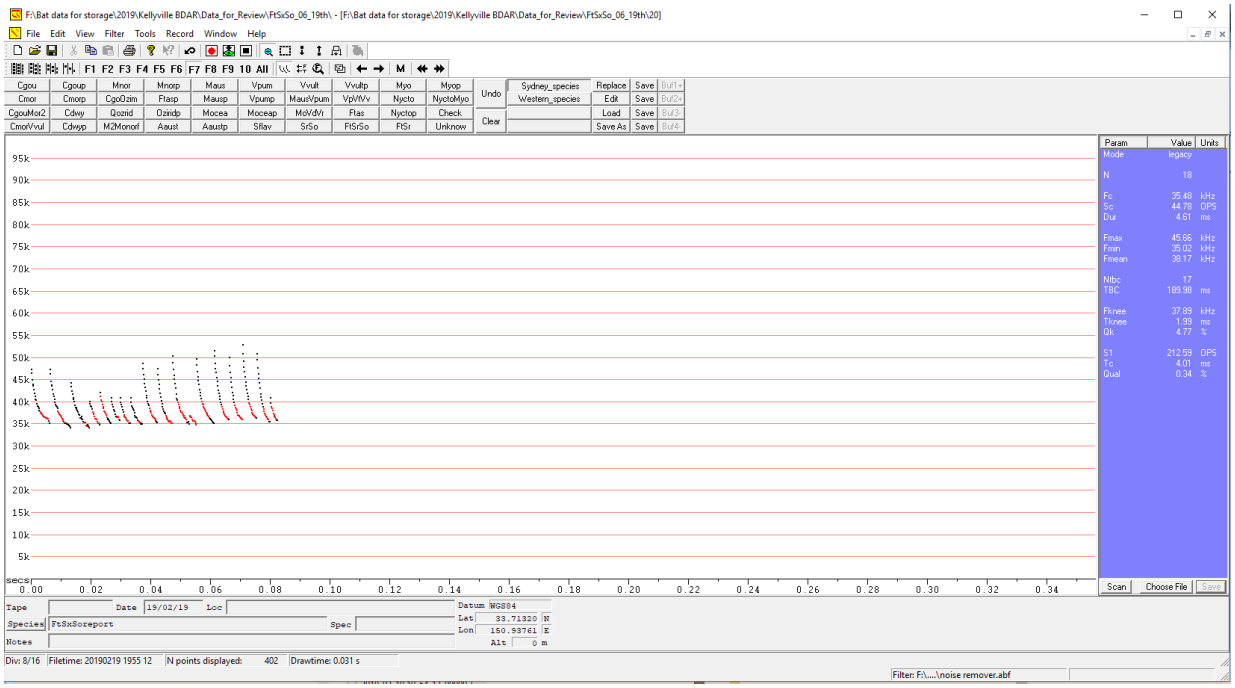

Figure 26: Potential call profile for Falsistrellus tasmaniensis (Eastern False Pipistrelle) / Scoteanax rueppellii (Greater Broad-nosed Bat) / Scotorepens orion (Eastern Broad-nosed Bat) recorded on Anabat Swift 06 at 1955 (7.55 pm) on 19 February 2019.

Figure 27: Call profile for Micronomus norfolkensis (Eastern Coastal Free-tailed Bat) recorded on Anabat Swift 06 at 0444 (4.44 am) on 21 February 2019.

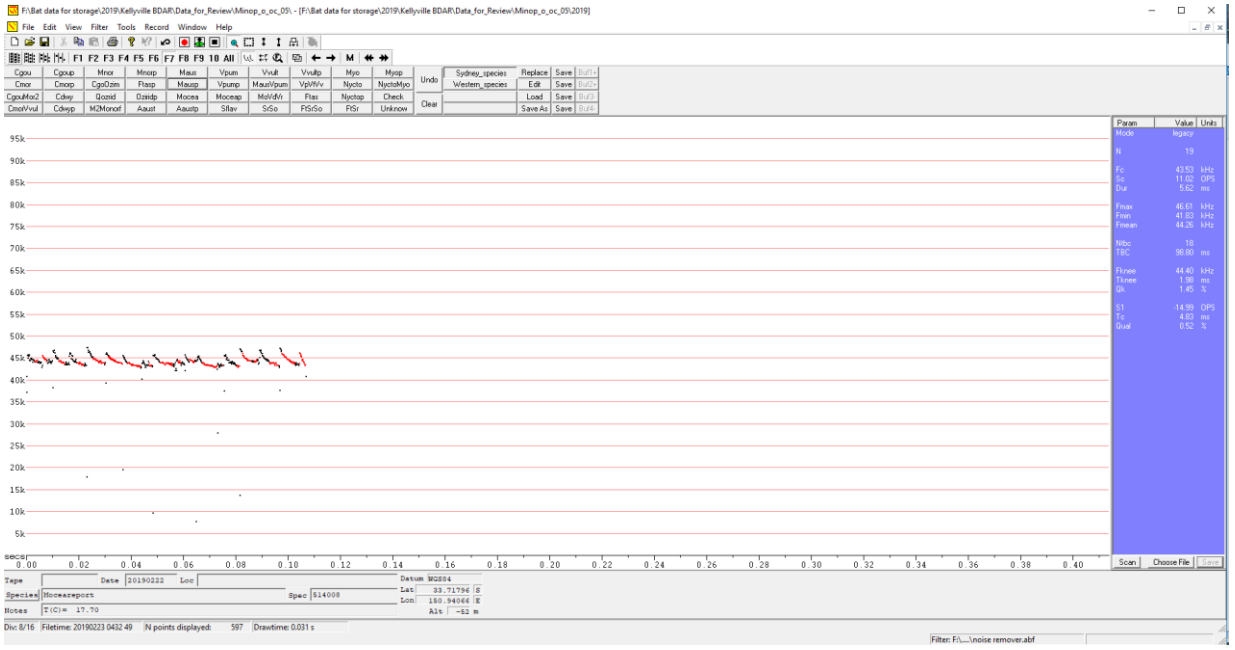

Figure 28. Call profile for *Miniopterus orianae oceanensis* (Eastern Bentwing Bat) recorded on Anabat Swift 06 at 0432 (4.32 am) on 23 February 2019.

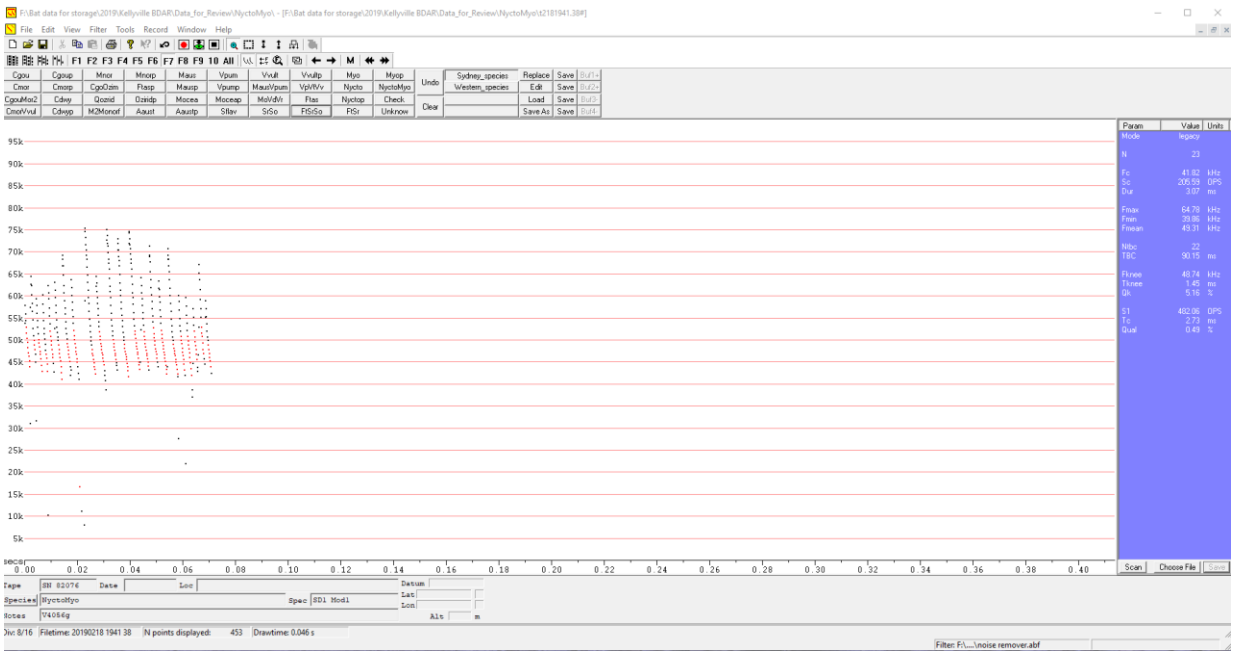

Figure 29: Call profile for *Myotis macropus* (Southern Myotis) / *Nyctophilus* spp. (possibly *Nyctophilus geoffroyi* (Lesser Long-eared Bat) or *Nyctophilus gouldii* (Gould's Long-eared Bat)) recorded on Anabat SD2 (SN82076) at 1941 (7.41 pm) on 18 February 2019.

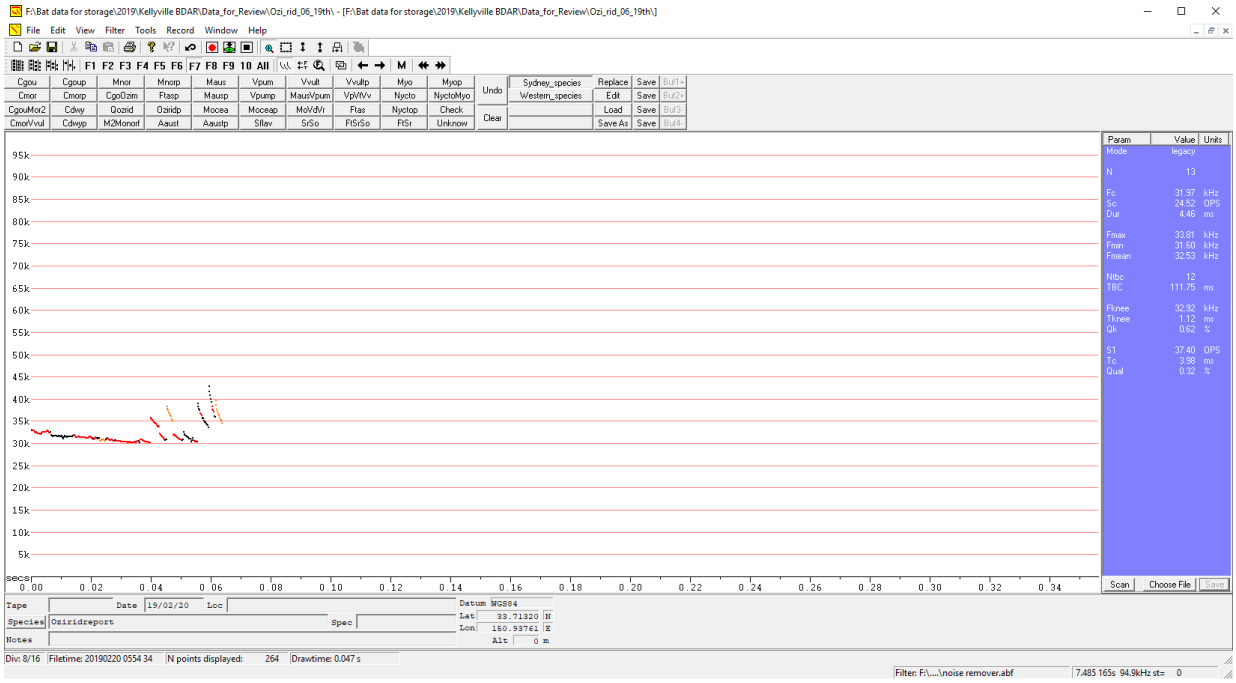

Figure 30: Call profile for *Ozimops ridei* (Ride's Free-tailed Bat) recorded on Anabat Swift 06 at 0554 (5.54 am) on 20 February 2019.

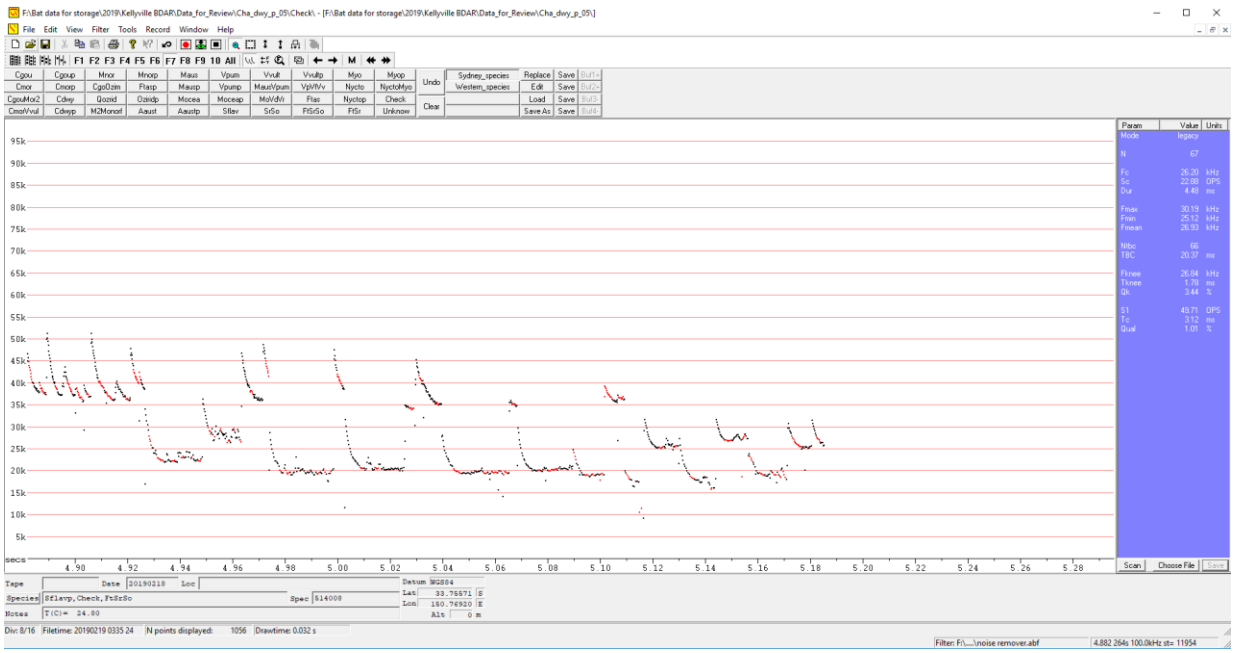

Figure 31: Potential call profile for *Ozimops ridei* (Ride's Free Tailed Bat) / (*Falsistrellus tasmaniensis* (Eastern False Pipistrelle) / *Scoteanax rueppellii* (Greater Broad-nosed Bat) / *Scotorepens orion* (Eastern Broad-nosed Bat) (in the centre of the call profile) and potential call profile for *Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat) (lower frequency call) recorded on Anabat Swift 05 at 0335 (3.35 am) on 19 February 2019.

D6 References

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Appendix E Biodiversity credit report

NSW GOVERNMENT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00009464/BAAS18162/19/00015248	Kellyville Station Precinct	26/11/2019
Assessor Name	Report Created	BAM Data version *
	06/03/2020	22
Assessor Number	BAM Case Status	Date Finalised
BAAS17006	Finalised	06/03/2020
Assessment Revision	Assessment Type	
0	Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion								
4	835_Moderate	63.2	0.8	0.25	High Sensitivity to Potential Gain	2.00		24
5	835_Revegetation	40.8	0.1	0.25	High Sensitivity to Potential Gain	2.00		1
							Subtotal	**25**

BAM Credit Summary Report

Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion								
1	849_Degraded	45.4	0.2	0.25	High Sensitivity to Potential Gain	2.50	TRUE	6
2	849_Moderate	64.9	1.8	0.25	High Sensitivity to Potential Gain	2.50	TRUE	74
3	849_Planted	14.6	2.1	0.25	High Sensitivity to Potential Gain	2.50	TRUE	0
							Subtotal	**80**
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion								
6	1071_Classname1	44.3	0.1	0.25	High Sensitivity to Potential Gain	2.00		1
							Subtotal	**1**
							Total	**106**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits
Myotis macropus / Southern Myotis (Fauna)						
849_Degraded	45.4	0.22	0.25	2	False	5
849_Moderate	64.9	1.83	0.25	2	False	59
849_Planted	14.6	2.1	0.25	2	False	15
835_Moderate	63.2	0.75	0.25	2	False	24
835_Revegetation	40.8	0.07	0.25	2	False	1
1071_Classname1	44.3	0.05	0.25	2	False	1
					Subtotal	**105**

Assessment Id: 00009464/BAAS18162/19/00015248

Proposal Name: Kellyville Station Precinct

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