Review of Environmental Factors

The Cooks to Cove GreenWay (In-Corridor Works)

Appendix F: Biodiversity Development Assessment Report (ELA, 2021)

June 2021

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The GreenWay In-Corridor Works
Biodiversity Development Assessment Report

Prepared for Inner West Council

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Template 2.8.1

Executive Summary

Eco Logical Australia Pty Ltd (ELA) was engaged by Inner West Council to prepare a Biodiversity Development Assessment Report (BDAR) for the proposed construction of a pedestrian pathway between Taverners Hills in the north and Dulwich Hill in the south, as part of the GreenWay In-Corridor works package. The development footprint includes the construction of the pedestrian pathway, access ramps, stairs, ecological restoration and play areas.

This BDAR has been prepared to meet the requirements of the Biodiversity Assessment Method (BAM) established under Section 6.7 of the NSW *Biodiversity Conservation Act 2016* (BC Act). Requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Local Environmental Plan (LEP), Development Control Plan (DCP) and applicable State Environmental Planning Policies have also been addressed in this report.

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).

The development site has been subject to extensive vegetation and threatened species surveys over the last decade. The literature reviewed identified that the vegetation within the development site is not remnant native vegetation. Vegetation has been established through revegetation works. Additional landscaping works as part of the GreenWay project have incorporated native species. The field surveys confirmed that the development site does not contain remnant ecological communities or threatened ecological communities. Where native vegetation has been established for roadside vegetation, these areas were assessed in accordance with the BAM 2020 Appendix D Planted native vegetation assessment tool and determined that they do not require additional considerations or offsets in accordance with the BAM 2020.

The remaining planted native vegetation which has been established from restoration works was assigned Plant Community Types (PCTs) based on the likely pre-European vegetation type and characteristic species used in revegetation works. The planted native vegetation has been mapped as a modified version of a PCT. Two PCTs were mapped within the development site. *PCT 1232 Coastal Freshwater Swamp Forest* was mapped in the northern portion of the Central Links. A second PCT, *PCT 1281 Sydney Turpentine-Ironbark Forest* was mapped as two different vegetation zones to reflect differences in the vegetation structure and composition of species. Vegetation zone 2 *PCT 1281 Sydney Turpentine-Ironbark Forest_planted* contains bushcare sites with high native species diversity. Vegetation zone 3 *PCT 1281 Sydney Turpentine-Ironbark Forest_shrubs* which includes native shrubs and ground cover species and lacks a canopy layer.

Ecosystem credits are required for the removal of vegetation zone 1 and 2 (refer to the table below). No ecosystem credits are required for the removal of vegetation zone 3 within the development footprint because the vegetation integrity score for this zone was below the minimum threshold (20) which an offset is required where the PCT is not representative of an endangered ecological community.

Ecosystem credits required

Veg zone	PCT ID	PCT name	Trading Group	Direct impacts (ha)	Credits required
1	1232	Coastal Freshwater Swamp Forest	Coastal Swamp Forests ≥ 90% cleared group (including Tier 1 or higher threat status)	0.04	1
2	1281	Sydney Turpentine-Ironbark Forest	Northern Hinterland Wet Sclerophyll Forests ≥ cleared group (including Tier 1 or higher threat status)	0.23	8

No threatened flora species were recorded within the development site or were considered likely to occur based on literature review, field habitat assessment and targeted surveys.

Three threatened fauna species were recorded during initial field surveys:

- *Miniopterus australis* (Little Bent-winged Bat) – listed as vulnerable under the BC Act
- *Miniopterus orianae oceanensis* (Large Bent-winged Bat) – listed as vulnerable under the BC Act
- *Pteropus poliocephalus* (Grey-headed Flying-fox) – listed as vulnerable under the BC Act and EPBC Act.

Additional targeted surveys were conducted for two species credit species, Little Bent-winged Bat and Large Bent-winged Bat, to determine if breeding habitat occurs within the development site. Both of these species are listed as species credit species for breeding habitat only. Breeding habitat is defined within the 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (OEH 2018) as sites where female bats give birth and form nursery colonies. The results from visual inspections and emergence surveys of the microbat roosting habitat present on site and ultrasonic recording of microbat calls indicate that neither species is using the microbat roosting habitat as maternity roosting habitat (breeding habitat) within the development site. Both species are utilising the site as foraging habitat and the Large Bent-winged Bat is using the site as winter roosting habitat. Therefore, no breeding habitat was recorded for these species and no species credit species were generated for the proposed works.

In accordance with Section 8.3 of the BAM 2020, the assessor must take into consideration Prescribed Impacts which includes human-made structures such as culverts and bridges. The threatened Large Bent-winged Bat is known to use a human-made structure within the development site as winter-roosting habitat. The threatened Little Bent-winged Bat was recorded foraging on site and there is potential for this species to use human made structures on site as winter roosting habitat. Human made structures within the development site which provide microbat roosting habitat have been assessed as part of Prescribed Impacts. To address prescribed impacts, an adaptive microbat design plan and microbat management plan which will follow a similar methodology to an Adaptive Management Plan as specified in Section 8.5 of the BAM 2020, will be implemented. These plans will include details the of baseline studies required, mitigation and monitoring measures to be applied prior to and during the construction / operational phases of the proposed development and any additional conservation measures to minimise impacts and benefit these species. The retirement of credits for Prescribed Impacts on artificial structures has not been proposed as part of this BDAR.

Serious and Irreversible Impacts (SAII) have been considered as part of this assessment. The two Bent-winged Bats are listed as SAII entities for breeding habitat. As no breeding habitat for these species were recorded the development site does not contain SAII entities.

One Matters of National Environmental Significance has potential to be affected by the proposal: *Pteropus poliocephalus* (Grey-headed Flying-Fox) An assessment of the Commonwealth Significant Impact Criteria under the EPBC Act was undertaken for this entity and concluded the works are unlikely to have a significant impact on Matters of National Environmental Significance.

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Abbreviations

Abbreviation	Description
BAAS	Biodiversity Accredited Assessor System
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Credit Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
DAWE	Commonwealth Department of Agriculture, Water and Environment
DCP	Development Control Plan
DPIE	Department of Planning, Industry and Environment
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
MNES	Matters of National Environmental Significance
NSW	New South Wales
OEH	NSW Office of Environment & Heritage (now Department of Planning, Industry and Environment)
PCT	Plant Community Type
SEPP	State Environmental Planning Policy
TEC	Threatened Ecological Community
WM Act	NSW *Water Management Act 2000*

1. Introduction

This Biodiversity Development Assessment Report (BDAR) has been prepared by Belinda Failes (BAAS18159), an accredited person under the NSW *Biodiversity Conservation Act 2016* (BC Act) and Carolina Mora. The report has been peer reviewed by Accredited Assessor Dr Meredith Henderson (BAAS17001).

Definitions of terminology used throughout this report and set out in by the Biodiversity Assessment Method (BAM) are presented in Appendix A.

1.1 General description of the development site

The development site consists of two discrete areas known as the 'Central Links' and the 'Southern Links'. The Central Links extends from north of Parramatta Road to south of Old Canterbury Road while the Southern Links extends from Weston Street to Hercules Street (Figure 1).

The proposed works considers the construction of a shared path, lighting and landscaping within the Inner West Light Rail Corridor and adjacent land. The corridor is intersected by several major arterial roads, including New Canterbury Road, Old Canterbury Road and Parramatta Road. The development site includes the following lots within the Inner West local government area:

- Lot 24/ DP4182
- Lot 3 / DP10418
- Lot 1 / DP117359
- Lot 2 / DP117359
- Lot 1 / DP185291
- Lot A / DP322679
- Lot A / DP323197
- Lot B / DP323197
- Lot A / DP341485
- Lot 5 / DP918708
- Lot C / DP944563
- Lot D / DP944563
- Lot 1 / DP962909
- Lot 2 / DP962909
- Lot 5 / DP341485
- Lot 20 / DP658151
- Lot 1 / DP1003675
- Lot 1 / DP1065311
- Lot 292 / DP1093021
- Lot 1 / DP1140417
- Lot 20 / DP1217284
- Lot 555 / DP1221573
- Lot 19 / DP1220375
- Lot 18 / DP1223949.

The development site consists of existing or proposed pedestrian tracks adjacent to Hawthorne Canal, road verge and within the light rail corridor. The vegetation includes revegetated areas / bushcare sites, street trees and landscaped gardens. The surrounding environment is predominately urbanised and contains limited native vegetation.

This report includes three base maps, the Location Map (Figure 1), the Site Map North (Figure 2), and the Site Map South (Figure 3).

1.2 Development site footprint

The development footprint is defined as a buffer around the proposed pathway which includes direct or indirect impacts. The development footprint is displayed in the Site Map North (Figure 2), and the Site Map South (Figure 3).

A summary of the proposed scope of works is provided below.

1.2.1 Central Links

The Central Links works will include the construction of the following:

- An elevated path cantilevered over the Hawthorne Canal, north of Parramatta Road (owned by Sydney Water) on the eastern side, with footings integral with the Canal wall
- A suspended path under Parramatta Road (a state road managed by Transport for NSW) over the Hawthorne Canal, suspended from beams supported from the road bridge abutments
- An elevated path, south of Parramatta Road, cantilevered over the Hawthorne Canal on the eastern side, with footings integral with the Canal wall
- Realignment of a length of a 500 mm water main and modification to another existing water main, plus sewer and disused gas main near and under Parramatta Road
- Stairs linking from the GreenWay path to the southern side of Parramatta Road and Light Rail lift east of the Canal
- An on-grade path on the eastern side of the Hawthorne Canal (on land owned by Rail Corp NSW currently under control of Council), within Cadigal Reserve (also sometimes referred to as Gadigal Reserve)
- Channel access ramp and bridge construction in Cadigal Reserve to facilitate construction and maintenance
- Ecological restoration, a rest/nature play area on the eastern side and a separate observation area on the western side of Cadigal Reserve
- An elevated path under the main western rail line and whipple truss described in more detail in Section 1.2.3 below (on land owned by Rail Corp NSW)
- A jacked box culvert tunnel under Longport Street (a regional road managed by Council)
- A path through the light rail corridor (owned by Rail Corp NSW and operated by Transdev) west of the light rail tracks from Longport Street to Old Canterbury Road, connecting to the Summer Hill Flour Mills near Lewisham West light rail, and inclusive of rest areas
- Dog off leash area on the eastern side of the light rail tracks and north of Lewisham West Light Rail Stop
- A wetland on the eastern side of the light rail tracks and south of Lewisham West Light Rail Stop
- A path linking from the light rail corridor to Old Canterbury Road in the road reserve on the northern side of Old Canterbury Road
- Lighting and electrical work for all sections, including ecological sensitive lighting in Cadigal Reserve
- Associated fencing, landscaping, ecological restoration, signage and ancillary works.

1.2.2 Southern Links

The Southern Links works will include the construction of the following:

- A cut and cover tunnel (or jacked culvert) under Davis Street
- A low-level boardwalk from Davis Street to Jack Shanahan Reserve, inclusive of stormwater drainage works near Terry Road
- Upgrade of the path through Jack Shanahan Reserve including modification to the existing playground and surrounds

- A cut and cover tunnel (or jacked culvert) under Constitution Road, including retaining walls on the northern approach and a secant pile wall on southern approach, in close proximity to private property
- Protection and/or diversion of existing water and gas mains in Constitution Road during tunnel construction
- An elevated path from south of Constitution Road to south of New Canterbury Road, including through the back span under the New Canterbury Road bridge and connecting to the existing path south of New Canterbury Road
- A new on-grade path from Hercules Street near Consett Street to Jack Shanahan Reserve and Hercules Street near Terrace Road
- Creation of new parklands and ecological restoration area Hercules Street near Consett Street to Jack Shanahan Reserve and Hercules Street near Terrace Road, including earthworks and stormwater drainage improvements
- Lighting and electrical work for all sections, including ecological sensitive lighting in Cadigal Reserve
- Associated fencing, landscaping, ecological restoration, signage and ancillary works.

1.2.3 Elevated Pathway and Jacked Box Culvert Tunnel under Longport Street Detail Relevant to Microbat Roost

Construction of the elevated pathway and jacked box tunnel under Longport Street with associated lighting is relevant to evaluating the potential impacts to microbats and includes the following:

- The base of the elevated pathway will be supported on piles at a height of 8.9 m AHD RL which is just above the height of the top of the tunnel containing the bat colony (8.3 m AHD RL)
- The elevated pathway will adjoin the jacked box culvert with dimensions of 3 m wide by 2.4 m high
- The pathway will be located approximately 12-15 m away from the roost entrance and directly in the current flight path of the bats as they exit the roost
- There will be approximately 3 m of clearance above ground level beneath the elevated pathway.
- Supports for the elevated pathway will consist of piles driven into the ground at intervals of 5-10 m by an excavator
- The enclosed section of the elevated pathway will extend from where the pathway meets the brick wall on Longport Street northwards parallel to Hawthorne Canal for a distance of approximately 15 m (level with the whipple truss historical rail line)
- The enclosed section will begin to open out on the eastern side of the elevated pathway at approximately 10-12 m from the brick wall
- At 15 m from the brick wall the elevated pathway will begin sloping downwards to ground level at a 5% grade reaching ground level on the northern side of the main western rail line pylon, on the eastern side of Hawthorne Canal
- The existing fence line that prevents unauthorised human access to the Cadigal Reserve roost will be moved from its current location on the northern side of the main western rail line (more than 50 m from the roost) to the whipple truss, bringing the fence line to within 25 m from the roost entrance

- Tunnel boring for the jacked boxed culvert beneath Longport Street will use lowest impact machinery operating at slow speeds with low vibrations and move from the southern side of Longport Street to the northern side.

The construction and operational footprints are contained wholly within the development site and are presented in the Site maps(Figure 2 and Figure 3).

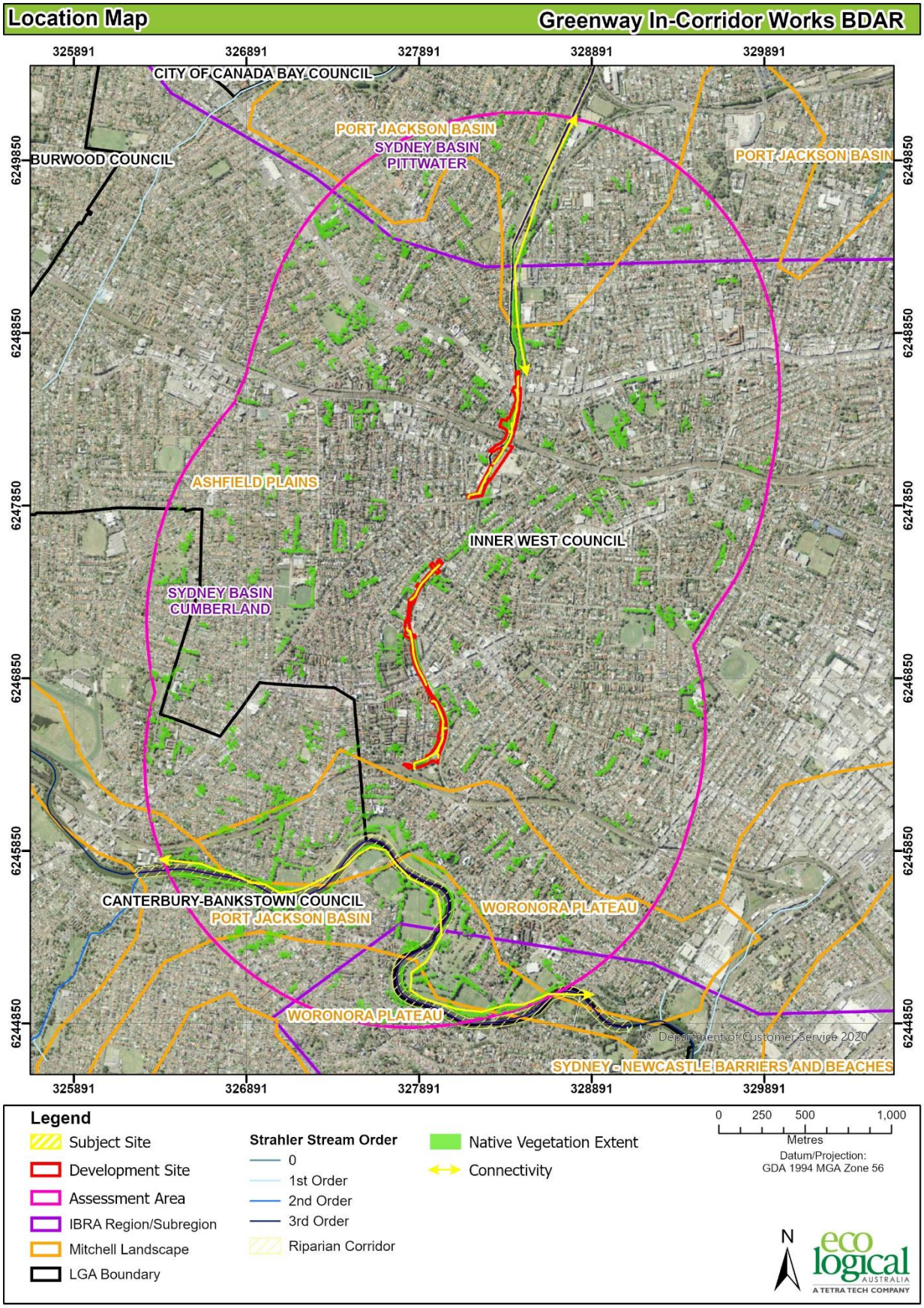

Figure 1: Location map

Figure 2: Site map North

Figure 3: Site Map South

2. Legislative context

Legislation relevant to the development site is outlined in Table 1.

Table 1: Legislative context

Name	Relevance to the project
Commonwealth	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act protects Matters of National Environmental Significance (MNES), such as threatened species and ecological communities, migratory species (protected under international agreements), and National Heritage places (among others). Any actions that will or are likely to have a significant impact on the MNES require referral and approval from the Australian Government Environment Minister. Significant impacts are defined by the Commonwealth (reference http://www.environment.gov.au/epbc/guidelines-policies.html) for MNES. MNES have been identified within and near the development site. A Significance Assessment was undertaken for *Pteropus poliocephalus* (Grey-headed Flying-fox). The assessment concluded that the proposed works are unlikely to significantly impact on this species.
State	
Environmental Planning and Assessment Act 1979 (EP&A Act)	The EP&A Act is the principal planning legislation for NSW. It provides a framework for the overall environmental planning and assessment of proposals. As Council is the proponent, the works are to be assessed as 'development permissible without consent' under Part 5 of the EP&A Act. Accordingly, Council must satisfy Sections 5.5 and 5.6 of that Act by examining, and taking into account to the fullest extent possible, all matters which are likely to affect the environment. This BDAR is intended to assist, and ensure compliance, with the EP&A Act including Sections 5.5 and 5.6.
Biodiversity Conservation Act 2016 (BC Act)	The BC Act seeks to conserve biological diversity at bioregional and State scales; to maintain the diversity and quality of ecosystems and enhance their capacity to adapt to change and provide for the needs of future generations; to assess the extinction risk of species and ecological communities and identify key threatening processes through an independent and rigorous scientific process; and to establish a framework to avoid, minimise and offset the impacts of proposed development and land use change on biodiversity. Section 7.3 of the Act requires proponents of activities subject to Part 5 of the EP&A Act to determine whether they will have a significant impact on threatened species, populations and threatened ecological communities. If a significant impact is likely to occur, the proponent of the activity must prepare a Species Impact Statement (SIS) in accordance with section 7.20 or a Biodiversity Development Assessment Report (BDAR). Tests of Significance were undertaken for the following threatened species and population: • *Miniopterus orianae oceanensis* (Large Bent-winged Bat) • *Miniopterus australis* (Little Bent-winged Bat) • Grey-headed Flying-fox • Endangered population of Long-nosed Bandicoot (*Perameles nasuta*) population in the inner West Sydney. The assessments concluded that the works are likely to result in a significant impact to threatened species (Large Bent-winged Bat) and therefore, in accordance with Section 7.8(3), the preparation of a BDAR is required.

Name	Relevance to the project
Fisheries Management Act 1994 (FM Act)	The FM Act provides for the protection, conservation and recovery of threatened species defined under the Act. It also makes provisions for the management of threats to threatened species, populations and ecological communities defined under the Act, as well as the protection of fish and fish habitat in general. The proposed works do not involve impacts to Key Fish Habitat, does not involve harm to marine vegetation, dredging, reclamation or obstruction of fish passage. A permit of consultation under the FM Act is not required.
Water Management Act 2000 (WM Act)	The WM Act aims to provide for the sustainable and integrated management of water resources for NSW. The Act requires developments on waterfront land to be ecologically sustainable and recognises the benefits of aquatic ecosystems to agriculture, fisheries, and recreation. The WM Act is administered by the Natural Resources Access Regulator (NRAR) and establishes an approval regime for activities within waterfront land, defined as the land 40 m from the highest bank of a river, lake or estuary. A Controlled Activity Approval (CAA) is typically required for work within waterfront land. Section 91E of the Act creates an offence for carrying out a controlled activity within waterfront land without approval. However, according to Section 41 of the *Water Management (General) Regulation 2018,* a public authority is exempt from Section 91E (1) of the Act. Council does not need to obtain a CAA from the NRAR as part of these works. However, where possible, works should be designed and constructed as per the NRAR's *'Controlled Activities on Waterfront Land: Guidelines for watercourse crossings on waterfront land'* (DPI Water, 2012).
Environmental Planning Instruments	
State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP)	The aim of this Policy is to facilitate the effective delivery of infrastructure across NSW by identifying whether certain types of infrastructure require consent, can be carried out without consent or are exempt development. Pursuant to clause 79 of the Infrastructure SEPP, development for the purpose of rail infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land. Under the definitions provided in clause 78 of the Infrastructure SEPP, rail infrastructure facilities include fences, tunnels, bridges, pedestrian and cycleway facilities. Part 2 of the Infrastructure SEPP contains provisions for public authorities to consult with other agencies prior to the commencement of development.
SEPP (Koala Habitat Protection) 2020	The Koala Habitat Protection SEPP aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. The Koala Habitat Protection SEPP does not relate to works under Part 5 of the EP&A Act. Therefore, this SEPP is not relevant to the proposed works.
Marrickville Local Environmental Plan 2011 (Marrickville LEP)	In accordance with the Marrickville LEP 2011, the development site is zoned as the following: • SP2 Infrastructure • R1 General Residential • RE1 Public Recreation. **6.4 Terrestrial Biodiversity** The objective of this clause is to maintain terrestrial biodiversity. The consent authority must not grant approval unless it is satisfied that the development will avoid significant environment impacts or cannot be reasonable avoided or the impacts cannot be minimised. The development site is mapped within the Terrestrial Biodiversity layer.

Name	Relevance to the project
	However, consideration of these factors is not required for works under Part 5 of the EP&A Act.
Leichhardt LEP 2013	The northern section of the development site is within the Leichhardt Local Government Area (LGA). The development site is zoned: • RE1 Public Recreation • SP2 Infrastructure (road). The Leichhardt LEP does not contain additional provisions relating to terrestrial biodiversity.
Ashfield LEP 2013	The middle section of the development site is located within the Ashfield LGA. The development site has been zone: • RE1 Public Recreation • SP2 Infrastructure (rail) • R2 Low Density Residential. The Ashfield LEP does not contain additional provisions relating to terrestrial biodiversity.

3. Methodology

3.1 Literature and data reviews

The following literature and data sources were reviewed prior to undertaking the field survey:

- Biodiversity Assessment Method Calculator Version 3.1
- NSW Government BioNet Vegetation Classification
- BioNet / Atlas of NSW Wildlife 5 km database search (Department of Planning, Industry and Environment DPIE 2020) (accessed September 2020)
- Commonwealth Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool 5 km database search (Department of Agriculture, Water and Environment) (DAWE 2020) (accessed October 2020)
- The Native Vegetation of the Sydney Metropolitan Area v.3 ((Office of Environment and Heritage (OEH) 2013 and 2016)
- Species credit threatened bats and their habitats (OEH 2018)
- aerial mapping (SIXMaps)
- additional GIS datasets including soil, topography, geology and drainage
- additional reports and threatened species information sources (for a summary see Table 2).

3.1.1 Use of local data

The use of local data is not proposed for this assessment.

3.1.2 Expert reports

Expert reports were not used as part of this assessment.

3.2 Results of Literature Review

The development site has been subject to a number of extensive ecological surveys over the last decade. An analysis of previous ecological surveys and key results are provided in the Table 2. In summary, the majority of the previous vegetation surveys have noted that the vegetation is highly disturbed and has been established from revegetation works.

3.2.1 Soils, Topography and Hydrology

The development site traverses several soil landscapes. The northern portion of the development site is located on Birrong (Alluvial) soil landscapes. The middle portion is located on Blacktown (Residual) soil landscapes. The southern portion of the development site is located on Gymea (Erosional) soil landscapes.

Birrong soil landscapes are associated with gentle undulating alluvial floodplains on Wianamatta Group shales (Chapman and Murphy 1989). Soils are characterised by waterlogging and low fertility. Vegetation has been extensively cleared but may have comprised *Eucalyptus paniculata* (Grey Ironbark), *Syncarpia glomulifera* (Turpentine) and *E. saligna* (Sydney Blue Gum).

Blacktown soil landscapes (residual) are similar to Birrong soil landscapes with low fertile soils on Wianamatta Group shales, however remnant vegetation consists of *Eucalyptus pilularis* (Blackbutt) in inner city regions (Chapman and Murphy 1989).

Gymea soil landscapes are located on Hawkesbury Sandstone with localised steep slopes and shallow soils (Chapman and Murphy 1989). Vegetation is typically dry sclerophyll woodland. Where a canopy is present, this is comprised of *Corymbia gummifera* (Red Bloodwood), *Eucalyptus haemastoma* (Scribbly Gum) and *E. piperita* (Sydney Peppermint). Tall shrubs of Epacridaceae, Myrtaceae, Fabaceae and Proteaceae families are also well represented.

One 1st Strahler Order stream, Hawthorne Canal, was mapped within the development site. Hawthorne Canal is located adjacent to the western boundary of the Central Link. The canal was installed in 1895 and between 1922 to 1939 the canal was converted into a stormwater channel (AWC 2018).

3.2.2 Previous Vegetation Mapping

No native Plant Community Types (PCTs) have previously been mapped in the development site. SMCMA (OEH 2016 and OEH 2013) have previously mapped Urban Exotic / Natives within the development site. This mapping is consistent with the results of the literature review.

Historic 1943 Aerial photography illustrates that the rail corridor was established, and the surrounding landscape consisted of dense residential housing similar to the landscape today. No vegetation was evident along the rail corridor from historic photos. The current extent of vegetation appears to have been established after 1943. This is consistent from the literature review which states that revegetation works along the GreenWay commenced in 1977 (AWC 2018).

3.2.3 Prior Studies of the Roost and its Significance in a Regional Setting

The most recent review of Large Bent-winged Bat roosts within the Sydney Basin was conducted in 2004 (Hoye and Spence 2004). This review documented changes in the structure of populations present in the Sydney Basin from historical records dating back to 1892. Hoye and Spence found that Large Bent-winged Bats were present at a few historically utilised roosts throughout the year up until the 1980s. Following that time, surveys of known roosts have recorded occupation patterns that show Large Bent-winged Bats present in roosts in the Sydney Basin between March and September but largely vacant over the summer months. The Cadigal Reserve roost was not known at the time the review was conducted and was discovered in 2014.

Of the 28 historical and known roosts of Large Bent-winged Bats in the Sydney Region at the time of the review, six have been destroyed, had bats excluded or been abandoned by bats (Hoye and Spence 2004). Two of these six were the largest known roosts for Large Bent-winged Bats in the Sydney Basin containing between 1,000 and 2,000 individuals (Hoye and Spence 2004). The fate of eight roosts is uncertain, with limited locational information or positive reports from landowners suggesting that at least four of these are no longer functional (Hoye and Spence 2004). Whether the four natural cave roosts on the outskirts of Sydney continue to be used is also uncertain. The remaining fourteen roosts generally support colonies of a few individuals and up to 1,000 (Hoye and Spence 2004).

The security of Large Bent-winged Bat roosts has also declined over time. Many of the larger and non-functional roosts were contained within buildings or tunnels, and over half of the remaining roosts are known to occur in stormwater drains (Hoye and Spence 2004). Roosts in stormwater drains or culverts expose the bats to greater risks of death and injury from flooding, human disturbance, pollution and predation by foxes, rats and domestic and feral cats and dogs (Hoye and Spence 2004). Rates of injury in urban populations of Large Bent-winged Bats were shown to be four times higher than those in non-

urban sites indicating that there is significant pressure on Large Bent-winged Bats residing in urban areas (Hoye and Spence 2004).

Whilst many of these pressures have been operating for years, the loss of large historical roosts and reduced security of existing roosts combined with an increasing human population and encroachment of built structures and lighting into the natural environment may result in urban populations acting as sinks with mortality levels greater than the wider Large Bent-winged Bat population can sustain (Hoye and Spence 2004). Preliminary modelling for the GreenWay indicates that there will be a five to seven-fold increase in the presence of people and bikes through Cadigal Reserve as a result of the creation of the GreenWay path (Cardno 2019). The increased presence of people, bikes, domestic animals and arguably, pest species within the development site has the potential to impact negatively upon the Large Bent-winged Bats roosting at Cadigal Reserve and in the broader community.

The effect that smaller and more fragmented winter roosts might have on the overall population biology of Large Bent-winged Bats is also uncertain given that mating occurs while the bats are at winter roost sites (Dwyer 1963). There is no information on the details of where and how mating and copulation occurs in Large Bent-winged Bat populations of the Sydney Basin. Studies by Lopez-Roig and Serra-Cobo (2014) on the effects of disturbance to roosting populations of *Pipistrellus pipistrellus* (Pipistrelle Bat) found a density dependent effect on the survival of female bats after disturbance indicating that female bats change roosts more regularly when there are fewer bats present – perhaps seeking safety in numbers at larger roosts; and that this behaviour affected survival rates. It is unknown whether a similar effect might occur for the Large Bent-winged Bats at the Cadigal Reserve roost. The risk of population level changes resulting from fewer, smaller and less secure roosts may result in poorer genetic fitness, fewer births and smaller population size.

The Cadigal Reserve roost contains up to 200 Large Bent-winged Bats that are generally present within the roost between the months of March and October each year, with individuals also present during some summer months. No harp trapping studies have been carried out at the roost to determine the sex ratio and ages of individual bats roosting at the site. It is possible that copulations (mating, fertilisation and implantation) occur at this roost site but there have been no studies to try and determine whether this occurs. It is unclear what levels of connection exist between over wintering colonies of Large Bent-winged Bats at different roost sites across the Sydney Basin and how that relates to mating activities. There is evidence to suggest that some movement of individual bats between roosts across the Sydney Basin and as far away as the Hunter Valley occurs throughout the year (Gonsalves and Law 2018, Hoye 2000, Hoye pers comm, White 2011).

Table 2: Summary of literature review

Report and Author	Development site	Methodology	Results
		ECOLOGICAL ASSESSMENT	
Ecological assessment: Sydney Light Rail Extension Stage 1 Parsons Brinckerhoff 2010	Inner West extension along Rozelle goods line corridor from Lilyfield to Dulwich Hill	Random meander technique used to determine vegetation type and condition and conducted over three days (18 and 24 August and 2 September 2010). Targeted survey for Long-nosed Bandicoot using remote cameras over two weeks (8-22 July 2010). Habitat surveys on 8 and 26 July 2010. Spotlighting at four locations no dates or survey effort is provided.	The literature review identified six bushcare sites which include some areas in Dulwich Hill have been revegetated to include representative species of Turpentine Ironbark Forest critically endangered ecological community. Due to the planted nature of the vegetation, it was not considered part of the conservation status under the BC Act and EPBC Act. No other native vegetation community was identified within the development site. No threatened flora species were recorded or were considered likely to occur based on poor habitat. Targeted surveys recorded one threatened fauna species, Grey-headed Flying-fox and one migratory species, *Apus pacificus* (Fork-tailed Swift) under the EPBC Act. The *Monarcha melanopsis* (Black-faced Monarch) (also listed under the EPBC Act as a migratory species) has previously been recorded by other surveys. No evidence of Long-nosed Bandicoots was recorded. The surveys noted the high occurrence of cats within the development site.
Cooks River to Iron Cove Revegetation and Bushcare Plan Eco Logical Australia 2011	Cooks River to Iron Cove GreenWay	ELA was engaged to prepare a revegetation plan for the GreenWay corridor.	The report identified Waratah Mills in Dulwich Hills, Pigott Street and Davis Street bushcare sites consisted of extensive weed removal followed by revegetated using 100 representative species of Sydney Turpentine-Ironbark Forest. Cadigal Reserve has been revegetated using over 40 native species but does not represent a particular native vegetation community. The report provides additional revegetation and weed control schedule.
GreenWay Biodiversity Strategy Australian Wetlands Consulting Pty Ltd 2012	Cooks River to Iron Cove GreenWay	The GreenWay Biodiversity Strategy provides a framework for the short to long term actions to support the vision to protect flora and fauna habitat and connectivity between landscapes (on public and private lands).	A literature review identified there are examples of regenerating native vegetation at: • New Canterbury Road and Constitution Road (western side of corridor) • Between Dulwich Hill and Hurlstone Park stations (in the rail corridor). Ten bushcare sites are located along the GreenWay which include revegetation works of representative species of Sydney Turpentine-Ironbark Forest, Sydney Sandstone Forest and Sandstone Heath communities. Revegetation works represents the majority of native vegetation found along the Greenway.

Report and Author	Development site	Methodology	Results
			The development site does not recognise the presence of threatened ecological communities (TEC), although it does recognise revegetation works including modified Swamp Oak Forest near the Cooks River (outside of the current development site) and Sydney Turpentine Ironbark Forest in bushcare sites along the GreenWay. These revegetated sites do not represent the TECs listed under the BC Act or EPBC Act. No threatened flora species has been previously recorded along the GreenWay. Two threatened species Grey-headed Flying-fox and *Miniopterus orianae oceanensis* (Eastern Bentwing Bat now called Large Bent-winged Bat) and the endangered population of *Perameles nasuta* (Long-nosed Bandicoot) are known to occur within the development site.
Cooks to Cove GreenWay – Missing Links Flora and Fauna Assessment Australian Wetlands Consulting Pty Ltd (AWC) 2018	Cooks River to Iron Cove GreenWay with focus on the southern sections including Gadigal Precinct, Mills Precinct, Parks Precinct, Dulwich Grove and Cooks River Precincts.	Flora, fauna and habitat data was collected at 11 locations along the GreenWay. Flora surveys involved transects recording dominant species, density, age class and patch size. Fauna assessments included: • Mammal – Call playback, motion detector cameras, hair tubes, ultrasonic detectors and habitat search over 4 nights • Diurnal birds – dawn and dusk transect over three days • Nocturnal birds – spotlighting, call playback over three nights • Reptiles – active searches • Amphibians – nocturnal searches using spotlighting and call playback • Macro invertebrate sampling in bushcare sites	A Literature review identified that bushcare works initiated in 1977 to include planting native grasses and Acacia species. Works for the Greenway were completed in 1991. This report identifies that the Dulwich Hill bushcare sites have been revegetated to resemble Turpentine-Ironbark Forest but did not previously contain remnant vegetation. Two patches of remnant vegetation were identified, between Dulwich Hill and Hurlstone Park station and in Marrickville Golf Course. Both of these sites are located outside of the development site for this current FFA. No threatened flora species were identified or were considered likely to persist in the development site. The targeted surveys recorded 43 birds, 7 mammals, 4 reptiles and no amphibians. Grey-headed Flying-fox and Large Bent-winged Bat were recorded. *Ninox strenua* (Powerful Owl), other microbat species and Long-nosed Bandicoot were considered likely to occur but not recorded during targeted surveys.
Biodiversity Development Assessment Report	Cooks River to Iron Cove	Field surveys involved surveys on 6, 18-22 December 2017 and 4 February 2019:	Two Plant Community Types (PCT)s were recorded:

Report and Author	Development site	Methodology	Results
Cardno 2019		• random meander techniques • three Biodiversity Assessment Method (BAM) plots • diurnal bird surveys 4 person hours • opportunistic amphibians, herptofauna and gastropod - 3 person hours • Nocturnal birds and mammals spotlighting and call playback – 2.5 person hours) • Microbat ultrasonic anabat one device over four nights (40 hrs).	• PCT 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion • PCT 1281 Turpentine-Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion. PCT 1281 did not satisfy the criteria for listing as part of the critically endangered ecological community Sydney Turpentine Ironbark Forest under the EPBC Act as it was in very poor condition. PCT 1232 was listed as part of a TEC under the BC Act. Two threatened fauna species were positively detected, and three additional threatened species were considered possible based on anabat calls during targeted surveys: • Large Bent-wing Bat • Grey-headed Flying-fox • *Falsistrellus tasmaniensis* (Eastern False Pipistrelle) • *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat) • *Scoteanax rueppellii* (Greater Broad-nosed Bat). The endangered population of Long-nosed Bandicoot (*Perameles nasuta*) population in the inner West Sydney and *Myotis macropus* (Southern Myotis) were not recorded but a species credits were calculated for offsets as a precautionary principle. The Little Bent-winged Bat was not recorded, however it was considered a candidate species and assumed present. Assumed present for two flora species as surveys did not coincide with survey periods: • *Caladenia tessellata* (Thick-lip Spider Orchid) • *Tetratheca glandulosa* Three Serious and Irreversible Impacts (SAII) were assessed, *Caladenia tessellata*, Large Bent-winged Bat and Little Bent-winged Bat. The BDAR concluded that the proposed works are unlikely to result in a significant impact.

BANDICOOT STUDIES

Report and Author	Development site	Methodology	Results
Australian Museum Business Services 2007 Fauna Study	Marrickville LGA which include a portion of the current development site.	The 2007 study follows on from 1996 fauna survey in Marrickville Council to provide an inventory of species within the Marrickville LGA. Ten sites over three days and three nights. • Small mammal surveys at two sites (Tempe Lands and Dulwich) using Elliott A traps, cage traps and hair funnels. • Spotlighting for three nights for 1.5 hrs • Ultrasonic anabat detectors • Diurnal bird surveys – call playback • Reptile active search • Dip-net surveys for tadpoles and fish • Nocturnal streamside searches	One dead Long-nosed Bandicoot was recorded during surveys at Dulwich Hill, no live individuals were recorded from targeted surveys. Three species were recorded: • *Chalinolobus gouldii* (Gould's Wattle Bat) – non threatened • Little Bent-winged Bat - listed as vulnerable under the BC Act • Grey-headed Flying-fox – listed as vulnerable under the BC Act and EPBC Act. The report includes additional discussions regarding the Long-nosed Bandicoot at Dulwich Hills. These included Parks and Wildlife ear tagging two males in an urban backyard at Dulwich Hill in 2003. Subsequent surveys by Parks and Wildlife did not recaptured tagged individuals. A habitat assessment identified that the freight rail line at long Dulwich Hill provides dense undergrowth habitat in the form of native vegetation and exotic (*Lantana camara*) for this species.
Yuppie Bandicoots of inner western Sydney. Tanya Leary et al 2010	Studies include the current development site around Dulwich Hill	Literature review and targeted surveys were conducted for Long-nosed Bandicoot in inner western Sydney. Seven live and seven dead bandicoots have been recorded in inner western Sydney between 2002 and 2007. Additional public reports have also been considered and investigated. Targeted surveys were conducted at Lewisham following reports of bandicoot activity.	The survey caught two females from Lewisham and fitted them with radio transmitters. The bandicoots were tracked between 9 nights to 1 month until the transmitters fell off. The transmitters provide information regarding the movement and habitat use of these urbanised bandicoots. The radio-tracking individuals did not utilise the rail corridor for shelter or dispersal, instead, individuals preferred to hide under old buildings and utilise backyards of parks to forage.
Inner West Light Rail Expansion Bandicoot Study – Price and Banks 2016	Surveys were conducted in Inner Western Sydney LGA	Public surveys and habitat modelling. Eight sites selected for monitoring adjacent to the Inner West Light Rail were selected	The literature review identified that there have been 17 observations from live or dead bandicoots in the inner west between 2002 and 2011.

Report and Author	Development site	Methodology	Results
		including 6 bushcare sites. Two motion sensitive cameras were set up at each site for four months.	No bandicoots were recorded during the targeted survey. Cats, foxes and dogs were recorded at all eight sites and are likely to impact negatively on the population of Long-nosed Bandicoot.
		BATS	
Balmain flora and fauna assessment. Biosis 2012	Studies were conducted within the inner-west light rail extension, Lilyfield.	Vegetation removal along rock-cutting within the inner-west light rail extension. • Flora surveys and habitat assessment • Two motion activated cameras deployed for seven consecutive nights in July 2012. • Two ultrasonic bat detectors deployed for two consecutive nights in July 2020. • Spotlighting on foot over two nights • Thermal imaging transects using	Large Bent-winged Bat was recorded on two nights shortly after dusk, although these were unlikely to be roosting along the rock cutting. Scats were taken for analysis these included fox, dog and cat. No Long-nosed Bandicoot hair or bone fragments were detected in the scats. The high number of foxes and cats recorded in the rail corridor and likely to discourage the use by Long-nosed Bandicoot within the rail corridor.
Microbat survey Balmain Tunnel Eco Logical Australia 2013	Balmain Tunnel. This area does not include the current development footprint; however, it does cover the topic of microbats use in tunnels.	Targeted surveys were conducted to determine presence of microbats in the Balmain Tunnel prior to Inner West Light Rail Extension • Four ultrasonic bat detectors (anabats) were deployed at entrances around the Balmain Tunnel for two consecutive nights in July 2013.	Two species were recorded, Large Bent-wing Bat and Gould's Wattled Bat (which is a non-threatened microbat species). Based on the analysis of the anabat calls, the tunnel was utilised infrequently by microbats. There was no evidence of microbat roosting in the tunnel.
Cadigal Reserve Eastern Bentwing Bat roost. Narawan Williams 2017	Cadigal Reserve in Ashfield	Monitoring of Eastern Bentwing-bat (now called Large Bent-winged Bat) over 12 months at known roost at Cadigal Reserve in Ashfield • Count of microbat flyouts by two observers for 1.5 hrs each night	Only one species utilised the tunnel (Large Bent-winged Bat). This species was recorded during June to early October and late February to June. No activity was recorded in November and January when individuals return to their breeding habitat. There is potential that some individuals remain during breeding season.

Report and Author	Development site	Methodology	Results
		• Ultrasonic bat detector recordings used by each observer.	
Lewisham Light Rail upgrade Eco Logical Australia 2018	Lewisham Light Rail within the current development site	Surveys were conducted to assess habitat for threatened species as part of the Lewisham Light Rail upgrade. • Habitat inspection and daytime roosting investigation of culvert • Stag watching 1.5 hrs at two locations • Anabats over two nights	Anabats were used to identify the possible presence of Eastern Bentwing-bat (now called Large Bent-winged Bat), however, no individuals were recorded flying out of the culvert. No evidence of threatened microbats or Long-nosed Bandicoots within the development site. The development site is unlikely to contain suitable habitat for these species given the presence of known predators (cats and foxes) for the Long-nosed Bandicoot and lack of habitat for the microbats.
Monitoring of Eastern Bentwing Bats in Cadigal Reserve. Hochuli et al 2019	The project involves a shared path through Cadigal Reserve.	Baseline surveys of the Eastern Bentwing-bat (now called Large Bent-winged Bat) for the Greenway project. • Thermal cameras on two occasions April and May 2019. • Acoustic surveys (anabat detectors) along the canal for two nights and the tunnel for two nights.	Counts estimate 130 -143 bats utilising the roost location at Cadigal Reserve. The Large Bent-winged Bat and occasional Gould's Wattle bat (non-threatened species) was recorded at Cadigal Reserve. There is potential that noise and vibrations during construction works of the path may significantly impact upon this species.

3.3 Survey effort: Native vegetation

3.3.1 Initial survey

An initial site inspection was undertaken by ecologist Belinda Failes and fauna specialists Alicia Scanlon and Rodney Armistead on 4 September 2020. Follow-up visits to Cadigal Reserve to conduct further emergence surveys for the Large Bent-winged Bat roost were conducted by Rodney Armistead and more details are provided below.

The vegetation survey consisted of the following:

- validation and mapping of the extent and quality of native vegetation to PCTs, and validation and mapping of threatened ecological communities listed under the BC Act and/or the EPBC Act if present
- identification of threatened species or populations or potential habitat within the development site.

The random meander method (Cropper 1993) was used to confirm the boundaries of vegetation communities and species assemblages within the development site. Where the boundaries of vegetation communities differed from existing vegetation mapping, these were modified on electronic maps and marked with a hand-held Global Positioning System (GPS).

The presence of threatened flora and fauna species identified as having the potential to occur in the development site was determined through a habitat assessment. Where threatened species or important habitat features were observed, such as hollow-bearing trees, their locations were marked using a hand-held GPS. Opportunistic sightings of all fauna present within the development site were also recorded.

3.3.2 BAM vegetation integrity plots

An additional day of field work was conducted on 27 November 2020 by Belinda Failes and Carolina Mora to collect BAM vegetation integrity plots for each vegetation zone mapped during initial surveys. A total of four vegetation integrity survey plots were undertaken on the development site to assess the composition, structure and function components of each vegetation zone, consistent with BAM (Table 3).

Due to the linear nature of the vegetation within the development site, the following BAM plots were undertaken using a modified version of the BAM design:

- Vegetation plot 1 (planted native vegetation)
- vegetation plot 2 (vegetation zone 1)
- vegetation plot 4 (vegetation zone 3).

The structure and function plots were modified to a 10 m x 100 m plot and the composition plot modified to a 40 m x 10m plot, rather than the standard 50 m x 20 m and 20 m x 20 m plot.

Vegetation plot 2 was located within the best location to accurately survey the vegetation within the plot. Therefore, a portion of the plot is located outside of the development site. However, this was conducted to ensure that the plot did not dissect the pedestrian access paths located within this vegetation zone.

Additionally, vegetation plot 3 was located on a steep embankment. Due to safety and access restrictions, the plot was not fully traversed. The vegetation was access at the top of the embankment and along the foot of the embankment. The vegetation was recorded from different angles to record the floristics assemblage and composition as accurately as possible.

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

Table 3: Full floristic and vegetation integrity plots

Veg Zone	PCT ID	PCT Scientific Name	Ancillary	Development site (ha)	Development footprint (ha)	Plots required	Plots surveyed
1	1232	Coastal Freshwater Swamp Forest	Planted	0.20	0.04	1	1
2	1281	Sydney Turpentine-Ironbark Forest	Planted	1.13	0.23	1	1
3	1281	Sydney Turpentine-Ironbark Forest	Shrubs	0.29	0.10	1	1
0		Planted Native vegetation		0.77	0.18	0	1
			TOTAL	**2.28**	**0.39**	**3**	**4**

3.4 Survey effort: Threatened species

3.4.1 Habitat assessments

Habitat assessments were undertaken during field survey on 4 September and 27 November 2020 to determine the likelihood of threatened species occurring within the development site on an intermittent or permanent basis.

Habitat assessments involved a search for important habitat features for threatened fauna species, such as hollow bearing trees, rocky outcrops or deep leaf litter. Assessments also included a search for evidence of fauna foraging or roosting such as chewed cones, sap trees, whitewash / pellets and inspections of bridges, culverts, stormwater channels, tunnels and abandoned buildings for suitable roosting or breeding habitat for threatened microchiropteran bats (microbats). Binoculars were used when required to inspect within high branches in the tree's canopy.

3.4.1.1 Diurnal Habitat Surveys – Long-nosed Bandicoot

Diurnal habitat surveys were conducted on 4 September to assess potential habitat for and search for evidence of occupancy by individuals of the endangered population of Long-nosed Bandicoot. Habitat surveys involved a traverse over the entire development site looking for potential habitat (i.e. dense groundcover species including weed thickets), direct (living Long-nosed Bandicoots) and indirect evidence of bandicoot activity and patch occupancy (i.e. characteristic conical diggings in the ground made by foraging bandicoots, scats, fur or dead animals).

Remote baited cameras were not utilised for the following reasons:

- There have been no records of this species from within the Inner West Light Rail Corridor since before 2010 (Leary et al. 2010).
- A more recently survey conducted by Price and Banks (2016) also failed to record this species during a 6-month survey period.
- Studies undertaken by ELA (2015/2016) failed to record this species during a remote camera survey conducted throughout the Rozelle marshalling yards.
- Pre-clearance surveys (ELA 2011 – 2014) undertaken for the construction of Inner West Light Rail did not identify this species.

3.4.1.2 Diurnal Habitat surveys - Microbats

Diurnal microbat habitat surveys were conducted on 4 September 2020 by Alicia Scanlon and Rodney Armistead to assess a range of artificial structures and vegetation as potential roosting and foraging habitat for threatened microbat species. Visual surveys of accessible bridges, culverts, stormwater channels and hollow-bearing trees both within the alignment and within close proximity to it which may provide roosting / breeding habitat for microbat species were undertaken using spotlights and binoculars. A diurnal inspection of the entrance to the known Large Bent-winged Bat roost in Cadigal Reserve was also undertaken. Due to the risk of disturbing roosting bats surveyors did not enter the roost to conduct counts of bats.

3.4.2 Targeted surveys

Targeted survey methodology was undertaken consistent with the following documents:

- Surveying Threatened Plant and their Habitats - NSW Survey Guide for the Biodiversity Assessment Method (DPIE 2020)
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft (DEC 2004)
- 'Species credit' threatened bats and their habitats (OEH 2018).

3.4.2.1 Threatened flora

Where suitable habitat was identified for candidate threatened flora species, targeted flora surveys were undertaken in accordance with NSW Guide to Surveying Threatened Plants (DPIE 2020) and within the seasonal requirements outlined in the BAM Calculator and Threatened Biodiversity Data Collection (Table 4). Targeted flora surveys involved parallel field traverses with a separation width of approximately 5 m in areas of dense vegetation. Survey effort is displayed in Figure 4 and Figure 5. The flora species included in the targeted survey are presented in Table 4.

Table 4: Flora species included in targeted survey

Target species	Common name	BAM survey period	Survey dates
Caladenia tessellata	Thick Lip Spider Orchid	September - October	4 September 2020
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	August – November	4 September 2020 27 November 2020
Hibbertia puberula	-	October – December	27 November 2020

Target species	Common name	BAM survey period	Survey dates
Hibbertia superans	-	July - December	4 September 2020 27 November 2020
Rhodamnia rubescens	Scrub Turpentine	All year	4 September 2020 27 November 2020
Syzygium paniculatum	Magenta Lilly Pilly	April – June	Out of season 4 September 2020 27 November 2020
Tetratheca glandulosa	-	August – November	4 September 2020 27 November 2020

3.4.2.2 Threatened fauna

Based on the results of the initial habitat assessment the following targeted surveys were conducted for the species credit species:

- Little Bent-winged Bat
- Large Bent-winged Bat
- Southern Myotis.

3.4.2.3 Nocturnal surveys

Targeted surveys were also conducted for potential roosting habitat for threatened microbat species within man-made structures. Some microbat species are dual credit species with only breeding habitat, considered for Species credits. Breeding habitat is defined in the BAM survey guide for threatened microbats (OEH 2018) as roost sites where birthing and rearing of young occurs and does not include roost sites where mating and copulation occur if these are separate from where birthing and rearing of young occurs. For a site to be classified as breeding habitat, breeding individuals must be present, or previously recorded present at the roost site. Breeding individuals include pregnant or lactating females or females carrying pups and / or juvenile bats. In accordance with Section 6.1.2 of the BAM 2020, the assessor must take into consideration Prescribed Biodiversity Impacts including any man-made structures which may be roosting habitat for threatened microbat species, this includes the Little Bent-winged Bat and Large Bent-winged Bat.

Nocturnal emergence surveys of the Large Bent-winged Bat roost in Cadigal Reserve were conducted on three separate occasions. On 4 September 2020 Rodney Armistead and Alicia Scanlon with assistance from Inner West Council conducted an emergence survey at the entrance to the roost from 30 minutes prior to sunset until 1 hour after sunset. The emergence survey was conducted in conjunction with ultrasonic call recordings at the roost entrance, at 18 m north of the roost on the western side of Hawthorne Canal and at 40 m north of the roost directly above Hawthorne Canal (Figure 4 and Figure 5). Two people were positioned on the western side of Hawthorne Canal approximately 4-5 m away from the roost entrance and the third person was positioned approximately 8 m further to the north on the western side of Hawthorne Canal. From these vantage points it was possible to observe and count bats as they emerged from the roost and to observe flight paths as they left the area to forage.

On 9 September 2020, Rod Armistead and two IWC staff carried out a second emergence survey commencing 30 minutes prior to sunset and concluding 1 hour after sunset. This survey was also undertaken in conjunction with ultrasonic call recording at the roost entrance, at 18 m north of the roost on the western side of Hawthorne Canal and at 40 m north of the roost directly above Hawthorne Canal. Two people were positioned on the western side of Hawthorne Canal approximately 4-5 m away from the roost entrance, and the third was positioned on the bridge to the dog walking area in Cadigal Reserve so comparisons could be made of the flyout paths of the bats.

On 29 September 2020 Rod Armistead and one IWC staff carried out the third emergence survey which was conducted from 30 minutes prior to sunset until 2 hours after sunset in conjunction with ultrasonic call recording at the roost entrance and at 40 m north of the roost directly above Hawthorne Canal.

3.4.2.4 Passive ultrasonic surveys

Ultrasonic recording was undertaken using Anabat Swifts during each site visit on 4, 9, 22 and 29 September 2020 (Table 5). As described above, ultrasonic recording was undertaken for the duration of emergence surveys on 4, 9 and 22 September at locations in front of the roost entrance, 18 m to the north of the roost on the western side of Hawthorne Canal and at 40 m north of the roost directly above Hawthorne Canal.

On 29 September 2020, two Anabat Swifts recorded calls at the roost entrance for the duration of the emergence survey and were then left in place for 8 nights and collected on 7 October 2020. In addition to this one Anabat Swift was positioned at Fred Street stormwater culvert, another potential roost location identified during the initial site inspection on 4 September and left in place until 7 October 2020.

Several other potential roost locations, including one in a stormwater culvert on Hercules Street and one beneath Parramatta Road Bridge were unable to be surveyed using ultrasonic detectors due to safety considerations surrounding the equipment and access issues related to proximity to the light rail corridor.

3.4.2.5 Breeding habitat surveys

On 4 November 2020 Rodney Armistead conducted an internal inspection of the tunnel in Cadigal Reserve over a period of 30 minutes. The aim of this inspection was to determine how many bats were roosting at the tunnel and to obtain information on the roosting location(s) within the tunnel. This inspection was carried out on foot just prior to dusk using a red-filtered light to minimise disturbance to any bats that may be roosting within the tunnel at the time. All surfaces of the tunnel were inspected, except for those directly behind the water pipe which were obscured from view by the water pipe.

A second internal inspection of the tunnel in Cadigal Reserve was undertaken on 1 December 2020 by Alicia Scanlon and Rodney Armistead over a period of 30 minutes. As before, the inspection was carried out on foot just prior to dusk using red-filtered lights. An ultrasonic detector was placed at the far internal end of the tunnel to record the calls of any bats that might enter the tunnel for roosting or nocturnal resting purposes and this detector remained in place until 4 December 2020 with results presented in Table 5.

Table 5. Microbat survey date, type of survey and climatic conditions at the time of the survey

Date	Survey type	Maximum daily temperatures (Celsius)	Minimum daily temperatures (Celsius)	Maximum wind speed (km/hr) and direction	Rainfall (mm)	Relative Humidity (%)
4 September 2020	1.5 hour emergence survey at the Cadigal Roost External inspection of accessible culverts and bridges within the development footprint to identify potential microbat habitat. 30 minute inspection of Fred St culverts, and Hercules Street culverts which contained potential microbat habitat.	20.7	18.4	28 WNW	0	53
9 September 2020	1.5 hour emergence survey at the Cadigal Roost	16.1	14.9	57 SSW	0	89
22 September	1.5 hour emergence survey at the Cadigal Roost	26.7	19.3	54 WNW	0	37
29 September 2020	2.5 hour emergence survey at the Cadigal Roost. Static detectors set passively at the Cadigal roost and at the Fred Street stormwater drain	21.1	13.2	28 E	0	52
30 September 2020	Static detectors set passively at the Cadigal roost and at the Fred Street stormwater drain	20.8	11.8	30 NNW	0	68
1 October 2020	Static detectors set passively at the Cadigal roost and at the Fred Street stormwater drain	25.5	14.4	39 km/hr E	2.6	57
2 October 2020	Static detectors set passively at the Cadigal roost and at the Fred Street stormwater drain	24.7	11.6	31 km/hr N	0.2	54
3 October 2020	Static detectors set passively at the Cadigal roost and at the Fred Street stormwater drain	25.2	12.9	48 km/hr NNE	0	56
4 October 2020	Static detectors set passively at the Cadigal roost and at the Fred Street stormwater drain	24.8	15.8	52 km/hr NNE	0	65
5 October 2020	Static detectors set passively at the Cadigal roost and at the Fred Street stormwater drain	33.7	17.2	70 km/hr S	0	37
6 October 2020	Static detectors set passively at the Cadigal roost and at the Fred Street stormwater drain	19.8	15.2	54 km/hr SSW	0	77

Date	Survey type	Maximum daily temperatures (Celsius)	Minimum daily temperatures (Celsius)	Maximum wind speed (km/hr) and direction	Rainfall (mm)	Relative Humidity (%)
7 October 2020	Static detectors set passively at the Cadigal roost and at the Fred Street stormwater drain	21.5	16.2	24 km/hr SW	0	91
4 November 2020	30 minute internal inspection of the tunnel at Cadigal Reserve.	24.7	13.7	39 km/hr NNE	0	62
1 December 2020	Static detectors set passively beneath Parramatta Road Bridge and Marion Street Bridge over Hawthorne Canal and inside the tunnel in Cadigal Reserve. 30 minute internal inspection of the tunnel at Cadigal Reserve. 30 minute internal / underbridge inspections of Parramatta Road Bridge and Marion Street Bridge over Hawthorne Canal.	28.4	19.3	56 km/hr WSW	0.0	64
2 December 2020	Static detectors set passively beneath Parramatta Road Bridge and Marion Street Bridge over Hawthorne Canal and inside the tunnel in Cadigal Reserve.	24.0	19.0	56 km/hr SSW	6.8	70
3 December 2020	Static detectors set passively beneath Parramatta Road Bridge and Marion Street Bridge over Hawthorne Canal and inside the tunnel in Cadigal Reserve.	23.0	17.2	37 km/hr NE	0.6	78

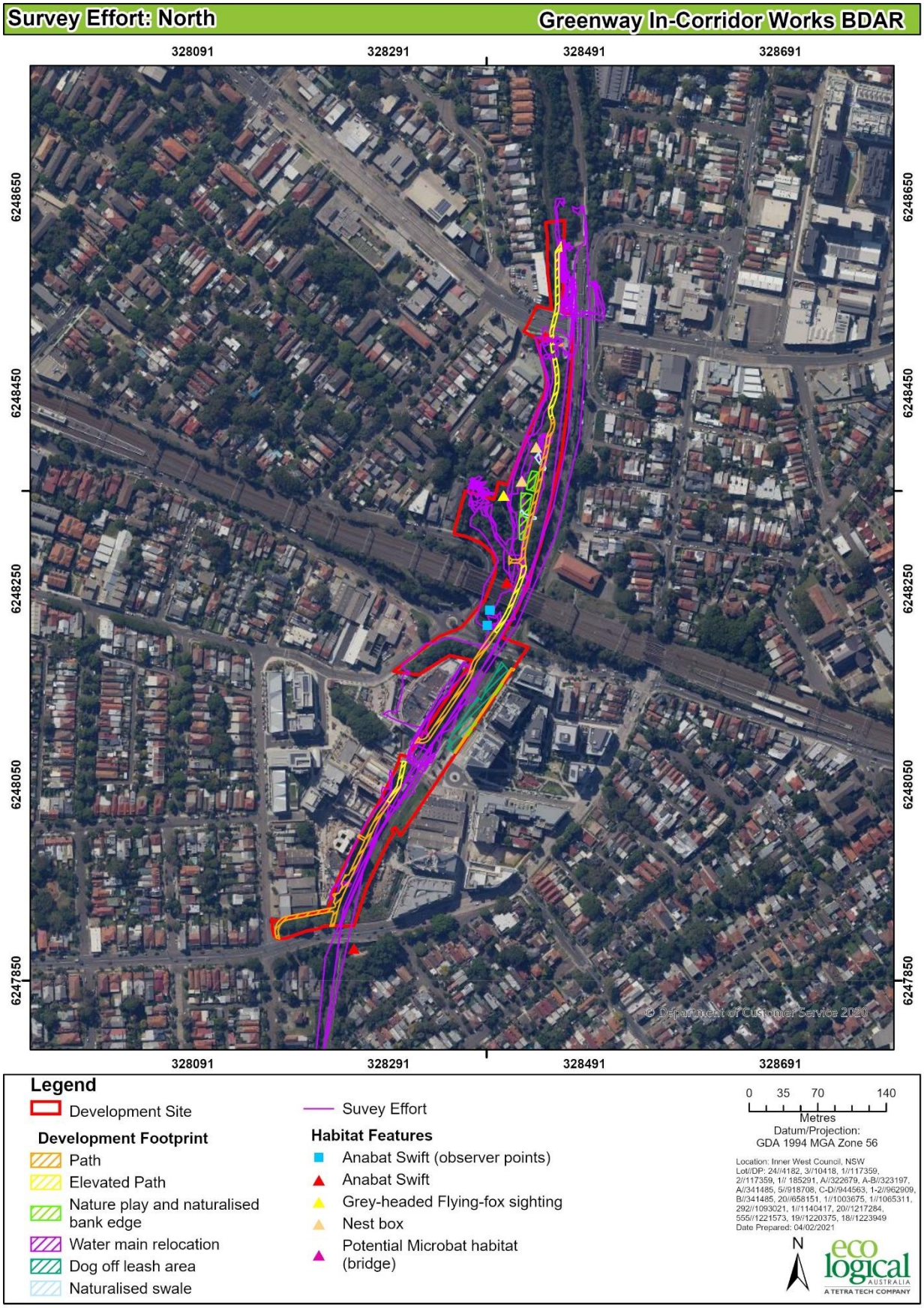

Figure 4: Targeted species survey effort North

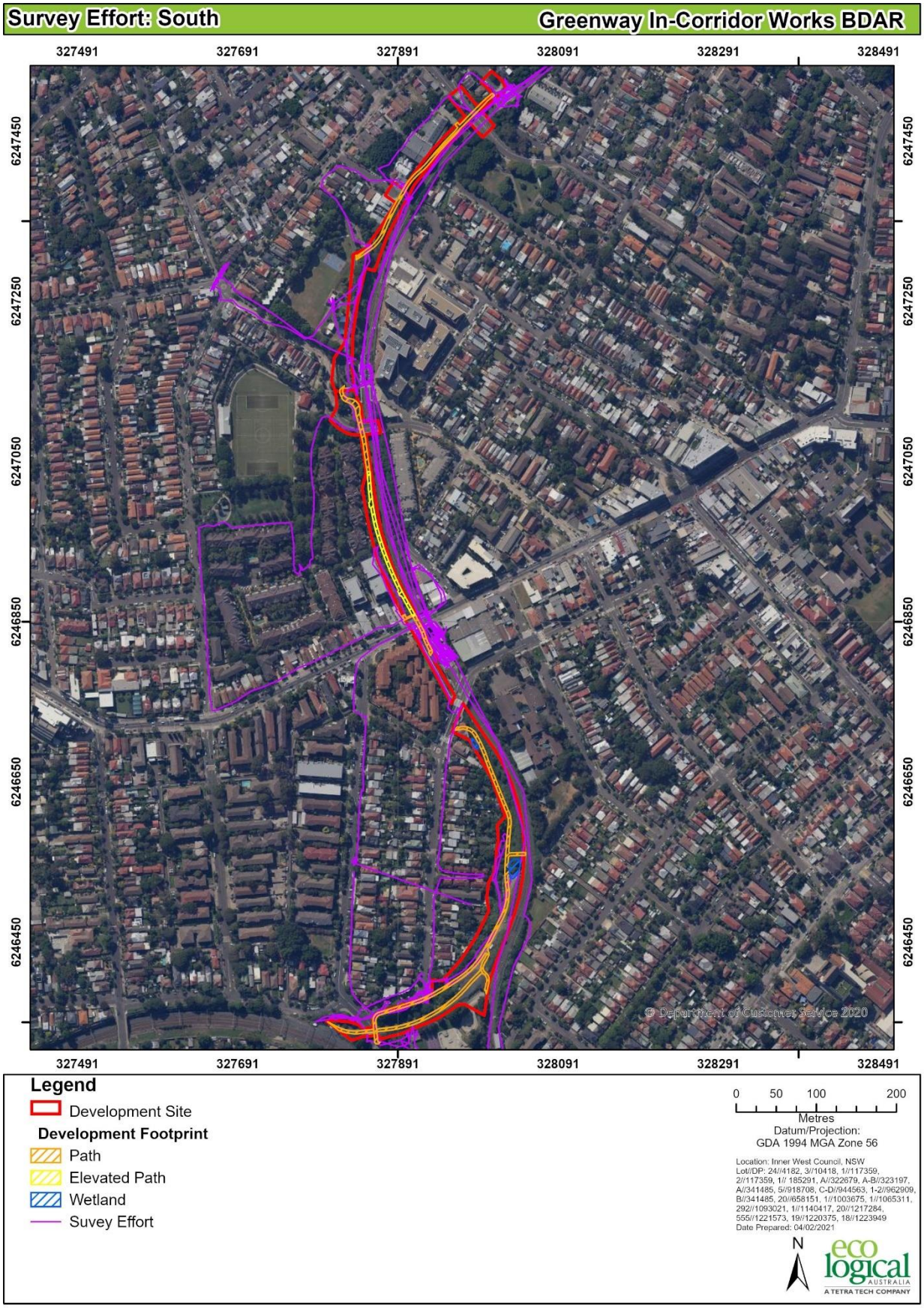

Figure 5: Targeted species survey effort South

4. Results

4.1 Landscape features

Landscape features within the development site are described below and are shown in Figure 1.

4.1.1 IBRA regions and subregions

The development site has an area of 6.25 ha and falls wholly within the Sydney Basin IBRA region and the Cumberland Plain subregion (Figure 1). The assessment area, defined as the area within a 1,500 m buffer of the development site, also falls within the Sydney Basin IBRA region and Cumberland IBRA subregion.

4.1.2 NSW Landscapes

The development site falls within the Ashfield Plains Plain NSW Landscapes (DECC 2002) as outlined in Table 6.

Table 6: NSW landscapes

NSW landscape	Description
Ashfield Plains	Undulating hills and valleys on horizontal Triassic shale and siltstone, occasional quartz sandstones especially near the margin of the Port Jackson landscape. General elevation 0 to 45m. Coastal extension of the Cumberland Plain landscape (DECC 2002). Vegetation is typically open forest of *Eucalyptus fibrosa* Broad-leaved Ironbark, *Eucalyptus moluccana* (Grey Box), with *Leptospermum* sp. (tea-tree) along creeks and forests of *Syncarpia glomulifera* (Turpentine), *Eucalyptus resinifera* (Red Mahogany), *Eucalyptus punctata* (Grey Gum), *Eucalyptus saligna* (Sydney Blue Gum) and *Eucalyptus pilularis* (Blackbutt) with a grassy understorey of *Themeda triandra* (Kangaroo Grass) on moister sites (DECC 2002).

4.1.3 9.Native vegetation extent

The extent of native vegetation within the development site and assessment area is outlined in Table 7. This area was calculated using the existing OEH (2016) vegetation datasets. Native vegetation for the purpose of this step has included native/exotic urban vegetation but did not include weeds. There are no differences between the mapped vegetation extent and the aerial imagery.

Table 7: Native vegetation extent

Location	Area (ha)	Extent of native vegetation (ha)
Development footprint	6.25	1.61
Assessment area	1488.426	94.6

4.1.4 Rivers and streams

The development site includes one mapped watercourse, Hawthorne Canal as outlined in Table 8. This watercourse is tidal; however, it does not contain instream or fringing vegetation. Hawthorne Canal contains a concrete side and bed. For the purpose of this assessment, the Hawthorne Canal was included in as a stream in the Biodiversity Assessment Method Credit calculator (BAMC).

Table 8: Rivers and streams

River/stream	Strahler order	Riparian buffer width (m)
Hawthorne Canal	1	10

4.1.5 Wetlands

The development site does not contain any natural wetlands, nor does it contain any previously mapped important wetlands.

4.1.6 Connectivity features

The development site provides a linear pathway which flows in a north-south direction through highly urbanised environment. It contains limited connectivity features as outlined in Table 8 and shown in Figure 1.

Vegetation within the development site consists of predominately revegetated areas or landscaped gardens within a highly urbanised environment. Major arterial roads intersect the corridor are regular intervals. In the broader landscape the vegetation within the development site is fragmented from large tracts of intact native vegetation.

Despite the poor condition of the vegetation, the vegetation within the development site provides an important connective pathway for the dispersal of highly mobile fauna species. It also provides a flyway or foraging and roosting habitat for migratory species and habitat for peri-urban species and threatened species including the Large Bent-winged Bat dispersing to and from the roost in Cadigal Reserve. Large Bent-winged Bats have been recorded ultrasonically in the area between the roost and the main western rail line regularly throughout the night even when not roosting on site indicating that the Greenway corridor is important habitat for this species year-round. Fragmented connections are present for highly mobile species as seen in Figure 1.

For the purpose of this assessment, the connectivity features were entered into the BAMC.

Table 9: Connectivity features

Connectivity feature name	Feature type
Greenway corridor	Connectivity links

4.1.7 Areas of geological significance and soil hazard features

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

4.1.8 Site context

4.1.8.1 Method applied

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

4.1.8.2 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 using increments of 5%. The percent native vegetation cover within the assessment area (1488.426 ha) is 6% (94.6 ha) (Table 7).

4.1.8.3 Patch Size

Patch size was calculated using available vegetation mapping for all patches of intact native vegetation on and adjoining the development site. The patch size is 9.97 ha, which falls into the size category 5-24 ha.

4.2 Native vegetation

4.2.1 Plant Community Types present

The vegetation within the development site has been substantially modified due to a long history of vegetation clearance and disturbance. The literature review identified that the development site lacks areas mapped as part of native vegetation communities. Additionally, the historic 1943 aerial photography demonstrates the vegetation has been substantially cleared and modified. Vegetation has since been established through revegetation works. The selection of species for revegetation works has resembled some characteristic species of pre-European locally indigenous ecological communities. Under the BAM, all vegetation native to NSW requires consideration as to the 'best fit' PCT. Therefore, both areas of revegetation native vegetation and landscaped native vegetation were assigned to PCTs listed in Table 10 and displayed in Figure 10 and Figure 11.

Table 10: Plant Community Types

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Area within development site (ha)	Percent cleared (%)
1232	*Coastal Freshwater Swamp Forest*	Coastal Swamp Forests	Forested Wetlands	0.20	95
1281	*Sydney Turpentine-Ironbark Forest*	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	1.42	90

4.2.2 Plant Community Type selection justification

Justification of the selection of PCTs recorded within the development site is based on quantitative analysis of full-floristic plot data and a summary is provided in Table 11. The soil landscape, elevation and vegetation mapping of the development site was used to determine the 'best-fit' PCT for native vegetation including regenerating native shrubs and canopy and patches of native grasslands. PCT 1232 was determined the most appropriate PCT for the vegetation adjacent to Hawthorne Canal in the north of the development site. PCT 1281 was selected for the remaining areas including bushcare sites.

Previous vegetation mapping (OEH 2016) indicated that the vegetation within the development site does not contain remnant vegetation. Some of the larger patches of vegetation has been previously mapped as Urban Exotics / Natives. This mapping is consistent with the results of the literature review (Table 2). The remaining vegetation within the development site has not previously been mapped.

Under the BAM, all vegetation native to NSW must be assigned to the 'best fit' PCT for assessment. The exception is for planted native vegetation consistent with Appendix D of BAM 2020. As a result, various attributes were considered in combination to assign vegetation to the best fit PCT. Attributes included dominant species, community composition, soils and landscape position. Reference was made to the PCT descriptions in the BioNet Vegetation Classification, the final determinations determined by the

Scientific Committee. ELA also referred to previous vegetation mapping (Cardno 2019) in the Central Links for PCT selection. Justifications for the classification of each PCT are provided below and summarised in Table 11.

Table 11: PCT selection justification

PCT ID	PCT Scientific Name	Selection criteria	Species relied upon for identification of vegetation type
1232	*Coastal Freshwater Swamp Forest*	Diagnostic species, position in the landscape, region, IBRA region and subregion.	Presence of *Casuarina cunninghamiana* (River Oak), *C. glauca* (Swamp Oak) and occasional *Melaleuca styphelioides* (Prickly-leaved Tea Tree) and *Glochidion ferdinandi* (Cheese Tree).
1281	*Sydney Turpentine-Ironbark Forest*	Diagnostic species, position in the landscape, region, IBRA region and subregion.	Presence of *Syncarpia glomulifera*, *Acacia parramattensis* (Parramatta Wattle), *Breynia oblongifolia* (Coffee Bush), *Bursaria spinosa* (Blackthorn) and *Lomandra longifolia* (Spikey Mat-rush).

4.2.3 Planted native vegetation

Consistent with Appendix D of BAM 2020 the assessor may apply the Streamlined assessment module to vegetation which is planted native vegetation. The BAM provides a framework for the assessment which is summarised in Table 12. The framework assists assessors to determine if the planted native vegetation requires further assessment. If the outcome of the framework determines that the vegetation does not require this, then the planted native vegetation needs only to consider if habitat for threatened species and apply relevant mitigation measures.

Native planted vegetation was mapped within the development site (Figure 12). The vegetation consists of planted vegetation which has been established for roadside vegetation. This includes planted native street trees (Figure 9). Planted street trees include *Lophostemon confertus* (Brush Box), *Ficus rubiginosa* (Port Jackson Fig) and *Melaleuca* species. These areas were located within parkland or were present as overhanging canopy from street verge plantings. Planted street trees lacked a native ground cover or midstorey layer.

Planted native vegetation also includes native shrubs *Pittosporum undulatum* (Sweet Pittosporum) and *Acacia parramattensis* and *A. decurrens* (Sydney Green Wattle). These native shrubs were often located in areas where the soil profile has been substantially modified such as rail batters. These areas contain dense weed blooms such as *Ligustrum lucidum* (Broad-leaf Privet) and *L. sinensis* (Small-leaved Privet) and lacks the presence of other native species.

One BAM vegetation integrity plot was undertaken to determine the vegetation assemblage. In accordance with the BAM 2020, if the framework outlined in Table 12 determines that the vegetation does not require additional consideration under the BAM, then Chapters 4 and 5 do not apply to the planted native vegetation provided the vegetation does not provide habitat for threatened species.

In summary, the planted native vegetation does not require further consideration. It was determined that the planted vegetation do not provide habitat for species credit species according to the methodology outlined in Appendix D2 of the BAM 2020.

Table 12: Decision making tool for Planted Native Vegetation in accordance with Appendix D of the BAM 2020

Decision making key	Response
1) Does the planted native vegetation occur within an area that contains a mosaic of planted and remnant native vegetation and which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal? i Yes – the planted native vegetation must be allocated to the best-fit PCT and the BAM must be applied. ii No – Go to 2.	No, the planted vegetation does not occur in a mosaic of planted and remnant vegetation.
2. Is the planted native vegetation: **a. Planted for the purpose of environmental rehabilitation or restoration under an existing conservation obligation listed in BAM Section 11.9(2.), and** **b. The primary objective was to replace or regenerate a plant community type of a threatened plan species or its habitat?** i Yes – the planted native vegetation must be assessed in accordance with Chapters 4 and 5 of the BAM ii No – Go to 3.	No, the vegetation has not been established for rehabilitation or restoration works. No, the primary objective was not conducted to replace or regenerate a PCT as the vegetation consists of non-indigenous species to the area.
3. Is the planted / translocated native vegetation individuals of a threatened species or other native species planted/ translocated for the purpose of providing threatened species habitat under one of the following: **a. A species recovery project** **b. *Saving our Species* project** **c. Other types of government funded restoration project** **d. Condition of consent for a development approval that required those species to be planted or translocated for the purpose of providing threatened species habitat** **e. Legal obligation as part of a condition of ruling of court. This includes regulatory directed or ordered remedial plantings (e.g. Remediation Order for clearing without consent issued under the BC Act or the Native Vegetation Act)** **f. Ecological rehabilitation to re-establish a PCT or TEC that was, or is carried out under a mine operations plan, or** **g. Approved vegetation management plan (e.g. as required as part of a Controlled Activity Approval for works on waterfront land under the NSW *Water Management Act 2000*)?** i Yes – the planted native vegetation must be assessed in accordance with Chapters 4 and 5 of the BAM • No – Go to 4.	No, the planted vegetation does not include translocated native vegetation of threatened species.
4. Was the planted native vegetation (including individuals of a threatened flora species) undertaken voluntarily for revegetation, environmental rehabilitation or restoration within a legal obligation to secure or provide for management of the native vegetation? i Yes – Go to D.2 Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied) • No – Go to 5.	No, the planted native vegetation was not undertaken as part of any conservation or rehabilitation projects or to satisfy a legal obligation.
5. Is the planted native vegetation (including individuals of a threatened flora species) planted for functional, aesthetic, horticultural or plantation forestry purposes? This includes examples such as; windbreaks in agricultural landscapes,	Yes, the planted native vegetation was conducted for roadside plantings. Therefore,

Decision making key	Response
roadside plantings (including street trees, median stripes, roadside batters), landscaping in parks, gardens and sport fields/complexes, macadamia plantations or teatree farms? i Yes – Go to D.2 Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied) ii No – Go to 6.	the native vegetation was assessed in accordance with Appendix D2 and it was determined that the vegetation did not provide habitat for threatened species credit species. Therefore, no additional consideration under the BAM is required.
6. Is the planted native vegetation a species listed as a widely cultivated native species on a list approved by the Secretary of the Department (or an officer authorised by the Secretary)? i Yes – Go to D.2 Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied) ii No – There may be other types of occurrences of planted native vegetation that do not easily fit into the decision-making key above.	N/A

4.2.4 Vegetation Zones

Four vegetation zones were identified within the development site (Figure 12 to Figure 16). These are described in Table 13.

A species list of flora identified throughout the development site during survey is provided in Appendix B. All field data collected during full-floristic and vegetation integrity plots is included in Appendix C.

Table 13: Vegetation Zones

Vegetation Zone	PCT	Condition	Area within development site (ha)	Impacted area (footprint) ha	Description
1	PCT 1232 Coastal Freshwater Swamp Forest	Planted	0.20	0.04	This vegetation zone was located to the east and west of the existing pedestrian pathway, between Hawthorne Canal and Taverners Hill station (Figure 6). This site has not been previously identified as a bushcare site, however, literature has indicated that this site was subject to revegetation works. The native vegetation resembles some characteristic species of PCT 1232, including a dominant canopy of *Casuarina cunninghamiana*, *C. glauca* and occasional *Melaleuca styphelioides* and *Glochidion ferdinandi*. Non—locally indigenous native species to PCT 1232 have been incorporated into the GreenWay landscaping such as *Angophora costata* (Sydney Red Gum), *Pittosporum undulatum*, *Ficus rubiginosa*, *F. fraseri* (Sandpaper Fig) and *Banksia integrifolia* (Coast Banksia). Clusters of *Lomandra longifolia* were interspersed with weeds, such as *Parietaria judaica* (Asthma Weed).
2	PCT 1281 Turpentine-Ironbark Forest	Planted	1.13	0.23	This vegetation zone corresponded to bushcare sites with established native plantings. The field survey identified that the vegetation within the bushcare site varied from areas with an intact canopy and mixed ground layer (Figure 7) or dense weeds (*Ligustrum lucidum*). The largest patch of vegetation zone 2 was represented within the northern section of the development site in Cadigal Reserve. The vegetation within vegetation zone 2 resembles some characteristic species of *PCT 1281 Sydney-Turpentine Ironbark Forest* such as *Syncarpia glomulifera*, *Acacia parramattensis, Breynia oblongifolia*, *Bursaria spinosa* and *Lomandra longifolia*. However, the remaining native species present in this vegetation zone did not conform to PCT 1281. These include *Eucalyptus tereticornis* (Forest Red Gum), *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *M. styphelioides*.
3	PCT 1281 Turpentine-Ironbark Forest	Shrubs	0.29	0.10	This vegetation zone contained additional bushcare sites; however, the vegetation lacked a canopy layer. The vegetation contained a diverse assemblage of shrub and ground layer species with minimal weeds. This vegetation zone was represented in areas such as on the rock face above Dulwich Grove station and within long narrow sections within the rail corridor. Species include *Themeda triandra* (Kangaroo Grass), *Kunzea ambigua* (Tick Bush), *Acacia myrtifolia* (Red-stemmed Wattle), *A.*

Vegetation Zone	PCT	Condition	Area within development site (ha)	Impacted area (footprint) ha	Description
					parramattensis, A. longifolia, *Lomandra longifolia, Hibbertia* sp. *Hardenbergia violacea* and *Tristaniopsis laurina* (Water Gum).
0	Native planted vegetation		0.77	0.28	This vegetation zone was present as native vegetation in highly modified environments. This includes planted native street trees (Figure 9) and shrubs in highly modified or weed infested habitats. Planted street trees include *Lophostemon confertus*, *Ficus rubiginosa* and *Melaleuca* species. These areas were located within parkland or were present as overhanging canopy from street verge plantings. Planted street trees lacked a native ground cover or midstorey layer. Native shrubs include *Pittosporum undulatum* and *Acacia parramattensis* and *A. decurrens*. These native shrubs were often located in areas where the soil profile has been substantially modified such as rail batters. These areas contain dense weed blooms such as *Ligustrum lucidum* and *L. sinensis* and lacks the presence of other native species.

4.2.5 Threatened Ecological Communities

The BioNet Vegetation Classification lists PCT 1232 Coastal Freshwater Swamp Forest and PCT 1281 Sydney Turpentine-Ironbark Forest as comprising of threatened ecological communities; however, the vegetation did not meet the TEC criteria for listing under the BC Act or EPBC Act (refer to Table 14). Justifications for each PCT are provided below.

Table 14: Threatened Ecological Communities

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Area (ha)	Listing status	Name	Area (ha)
1232	EEC	*Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	0*	EEC	*Coastal Swamp Oak (Casuarina glauca) Forest of the South-east Queensland and New South Wales*	0*
1281	CEEC	*Sydney Turpentine Ironbark Forest*	0*	CEEC	*Turpentine-Ironbark Forest*	0*

CEEC – Critically endangered ecological community
EEC – Endangered ecological community
* Note that PCTs did not satisfy the requirements for listing under the BC Act or EPBC Act.

4.2.5.1 PCT 1232: Coastal Freshwater Swamp Forest

Components of *PCT 1232 Coastal Freshwater Swamp Forest* may represent *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* which is listed as an endangered ecological community under the BC Act and listed as part of the *Coastal Swamp Oak (Casuarina glauca) Forest of the South-east Queensland and New South Wales* endangered ecological community under the EPBC Act.

The vegetation mapped as part of *PCT 1232 Coastal Freshwater Swamp Forest* in the development site is a landscaped environment in a narrow linear raised garden bed which is not natural habitat. The vegetation has been established for the purpose of providing native landscaping and was not conducted as part of revegetation works to re-establish this TEC into the landscape. However, the vegetation contains representative species of PCT 1231 and as such has been mapped as part of a PCT for this BDAR.

According to the Final determination for *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* under the BC Act this community is associated with saline environments subject to periodic flooding/ inundation. Hawthorne Canal is tidal, as such saline tolerant species such as *Casuarina glauca* has established successfully while other planted non-saline species have not. . It is noted that the soil profile has been substantially modified due to previous land use and excavations works of the canal. As such the soil profile is unlikely to contain remnant soil seed bank. According the literature review (AWC 2012) the pre-European vegetation along Hawthorne Canal was previously present as Mangrove species and was established using some characteristic species of PCT 1232 as part of the GreenWay corridor.

The vegetation mapped as part of *PCT 1232 Coastal Freshwater Swamp Forest* within the development site does not constitute as part of a TEC under the BC Act for the following:

- The vegetation been established through landscaping works
- It does not contain remnant or regenerating native vegetation
- It contains some indicative species of the TEC from unknown source of genetic material
- It does not contribute to the extent of *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*
- It does not provide a functioning ecological community with natural regeneration.

The criteria for listing this ecological community as part of the *Coastal Swamp Oak (Casuarina glauca) Forest of the South-east Queensland and New South Wales* endangered ecological community under the EPBC Act is more stringent than the BC Act criteria for listing. Under the EPBC Act, small or degraded patches are excluded from the national protection (Department of Environment and Energy (DoEE) 2018). The vegetation within the development site does not satisfy the listing under the EPBC Act as the patch size is less than 0.5 ha, it does not meet the key diagnostic and does not have a predominantly native understorey.

4.2.5.2 PCT 1281: Sydney Turpentine-Ironbark Forest

The BioNet Vegetation Classification system identifies that PCT 1281 may conform to *Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion* listed as critically endangered under the BC Act and listed as part of the *Turpentine-Ironbark Forest in the Sydney Basin Bioregion* under the EPBC Act if it meets the criteria for listing.

Planted vegetation which resembles TECs lack the diverse assemblage of characteristic species of the TEC, they also do not function as part of an ecological community (as opposed to landscaped environments) and often do not display evidence of regeneration. The vegetation within the development site resembles some characteristic species of *Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion* however, the landscape has been substantially modified and represents a high percentage of weeds and non-indigenous native species. As such the vegetation does not represent part of the state listing TEC. PCT 1281 was mapped as part of a PCT as the vegetation was established as part of rehabilitation works and does not meet the definition of planted native vegetation as per Appendix D of the BAM.

The criteria for listing as part of the Turpentine-Ironbark Forest under the EPBC Act states that only remnant, intact patches are considered for listing under the national protection, these include (Threatened Species Scientific Committee 2005):

- Vegetation contains characteristic species in all structural layers
- Tree canopy is > 10% and remnant size is > 1 ha
- If tree canopy is less than 10% then patch is > 5 ha patch.

Although the vegetation had a canopy > 10% the patch size was not greater than 1 ha. The vegetation does not satisfy listing under the BC Act or EPBC Act.

4.2.6 Vegetation integrity assessment

A vegetation integrity assessment using the BAMC was undertaken and the results are outlined in Table 15.

Table 15: Vegetation integrity

Veg Zone	PCT ID	Condition	Development site area (ha)	Composition Condition Score	Structure Condition Score	Function Condition Score	Current vegetation integrity score
1	1232	Planted	0.20	37.6	13	33	25.3
2	1281	Planted	1.13	78.5	31.1	53	54.3
3	1281	Shrubs	0.29	23.8	0.2	15	4.4

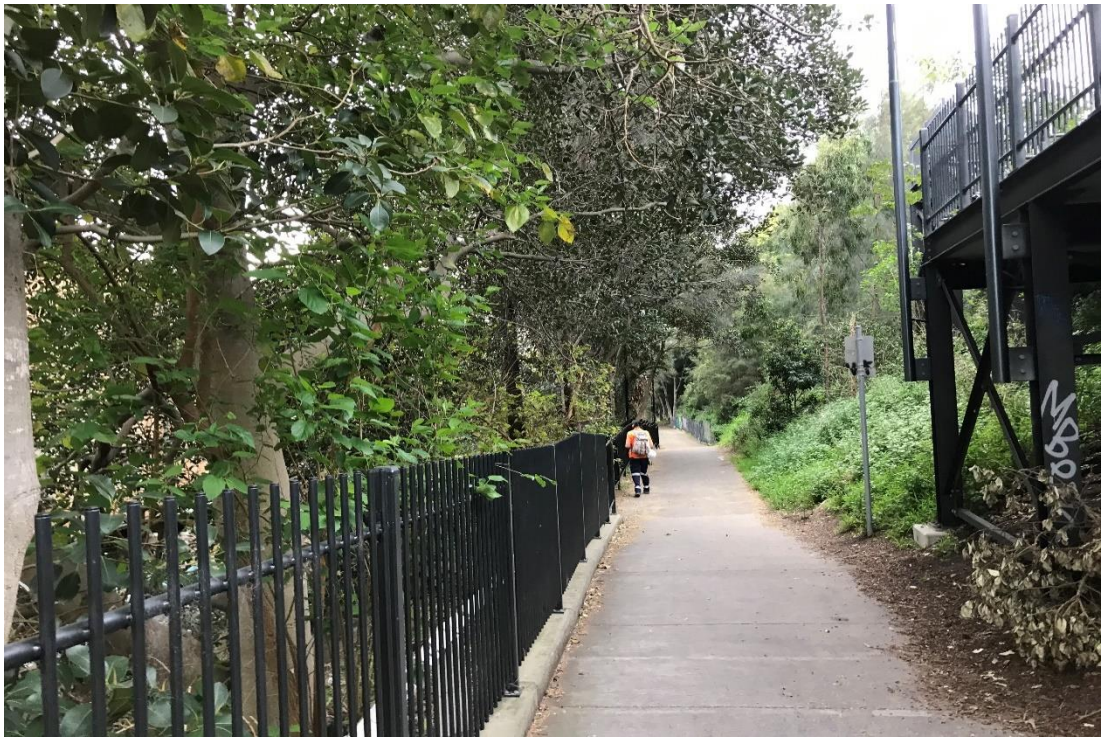

Figure 6: Vegetation Zone 1: PCT 1232 Planted

Figure 7: Vegetation Zone 2: PCT 1218 Planted

Figure 8: Vegetation zone 3: PCT 1281 shrubs

Figure 9: Planted native vegetation

Figure 10: Plant community types North

Figure 11: Plant community types South

Figure 12: Vegetation zones and plot locations North 1

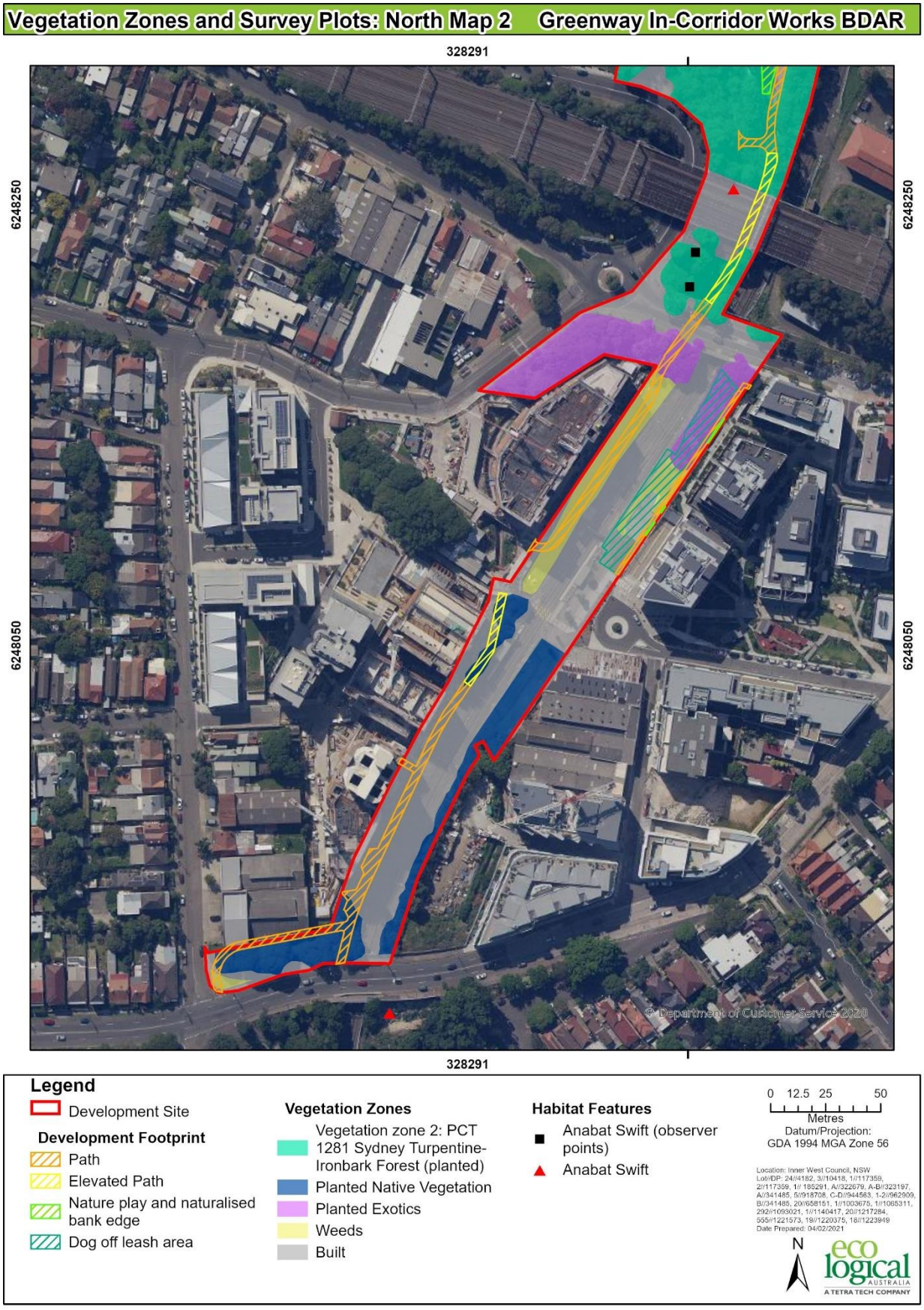

Figure 13: Vegetation zones and plot locations North 2

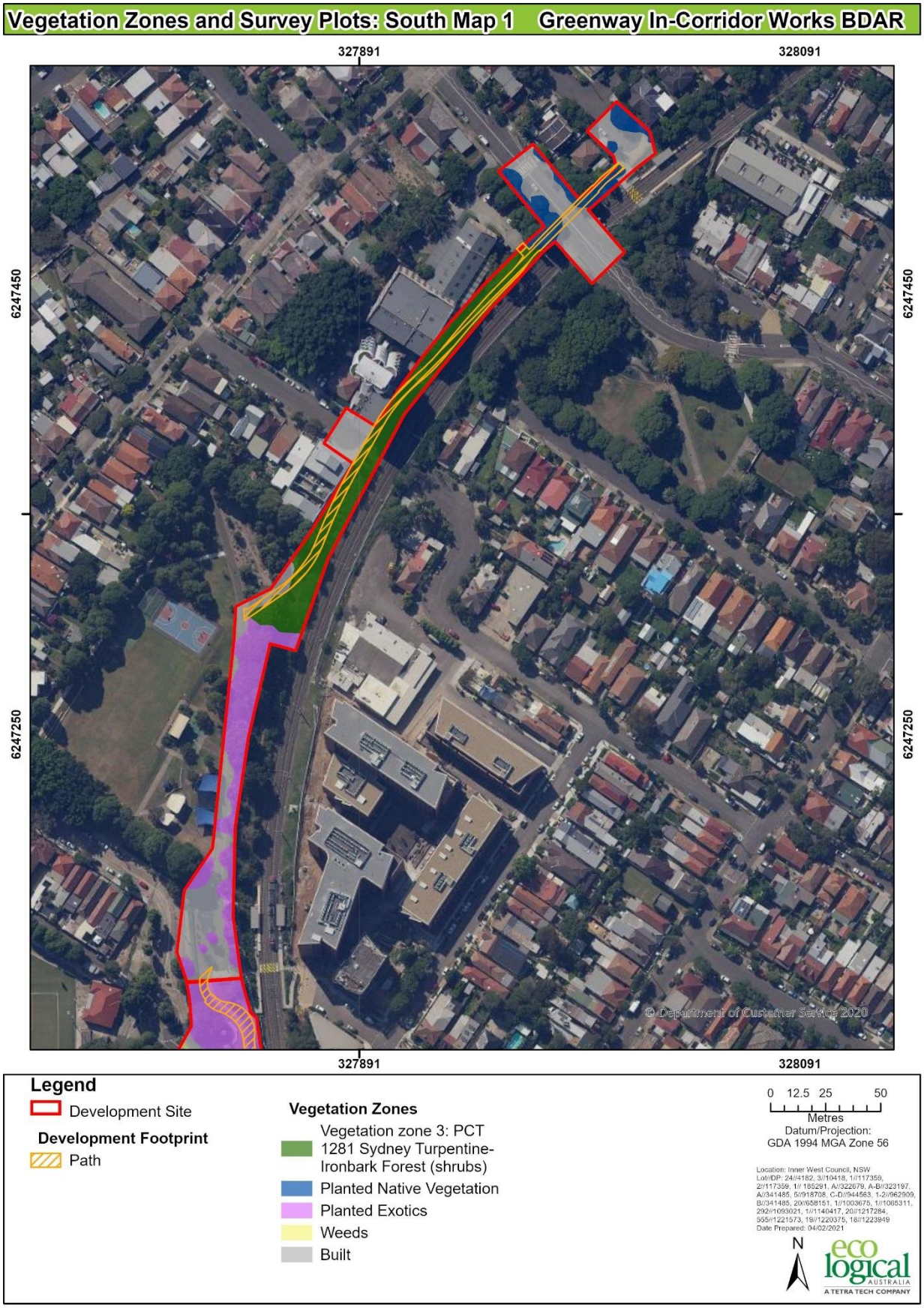

Figure 14: Vegetation zones and plot locations South 1

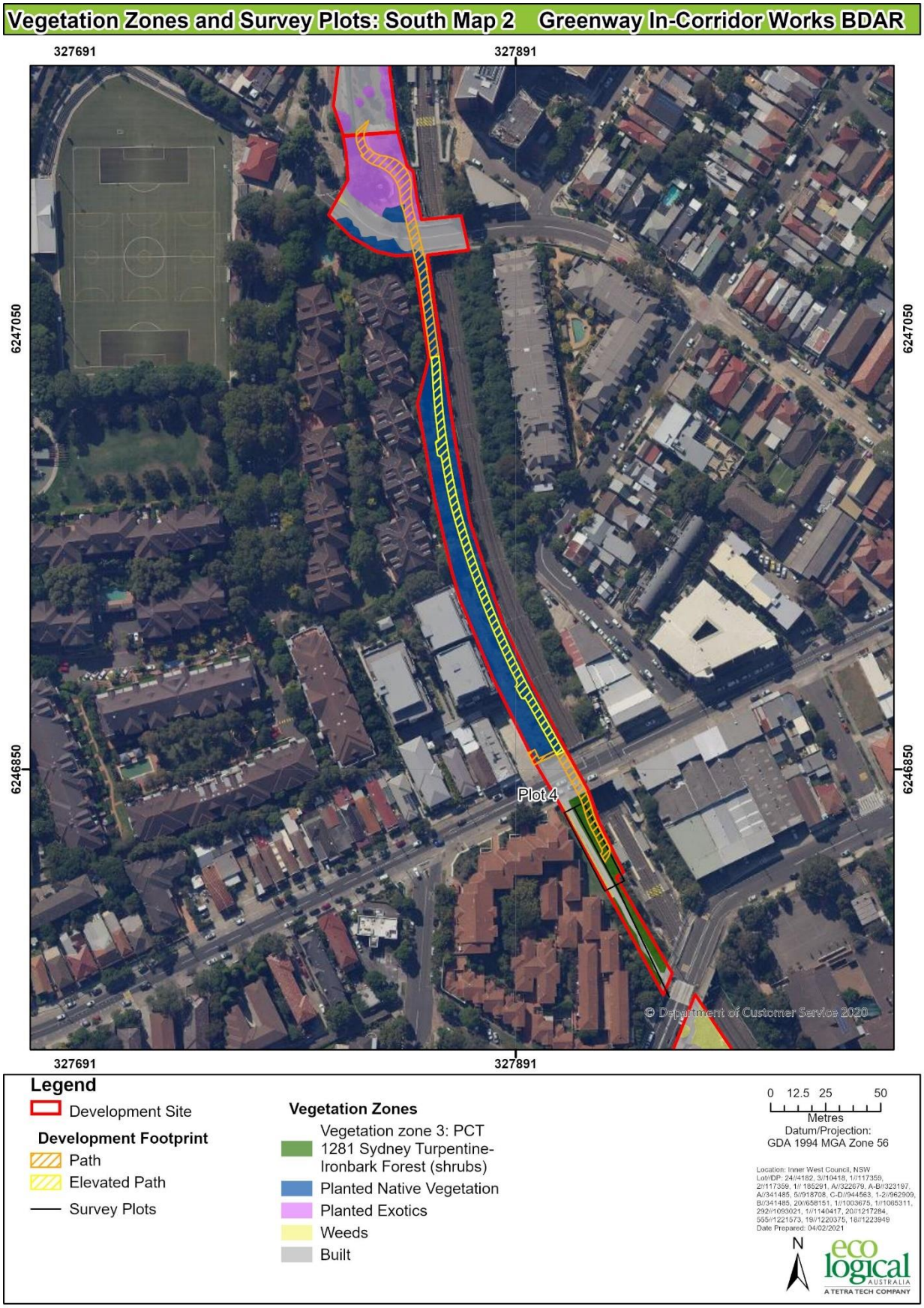

Figure 15: Vegetation zones and plot location South 2

Figure 16: Vegetation zones and plot locations South 3

4.3 Threatened species

4.3.1 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 16. Ecosystem credit species which have been excluded from the assessment and relevant justification are also included in Table 16. One candidate species, the Powerful Owl was added to the ecosystem credit species. This species has been recorded within a 2 km radius of the development site and may utilise the development site on occasion as supplementary foraging habitat.

Table 16: Predicted ecosystem credit species

Species	Common Name	Habitat constraints/ Geographic limitations	Sensitivity to gain class	BC Act listing status	EPBC Act listing status	Justification for inclusion or exclusion
Anthochaera phrygia	Regent Honeyeater	-	High	Critically Endangered	Critically Endangered	Included Marginal foraging habitat available.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	Moderate	Vulnerable	Not Listed	Included Potential habitat is available within the development site.
Botaurus poiciloptilus	Australian Bittern	Waterbodies Brackish or freshwater wetlands	Moderate	Endangered	Endangered	Excluded Although the development site contains mapped waterbody, this is actually a concrete canal with no fringing vegetation.
Calyptorhynchus lathami	Glossy Black-Cockatoo	Other Presence of Allocasuarina and Casuarina species	High	Vulnerable	Not listed	Included Casuarina and Allocasuarina species recorded in vegetation zones 1 and within the development site.
Chthonicola sagittata	Speckled Warbler	-	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	BC Act listing status	EPBC Act listing status	Justification for inclusion or exclusion
Dasyurus maculatus	Spotted-tailed Quoll	-	High	Vulnerable	Endangered	Excluded Habitat connectivity is fragmented within the urbanised locality such that this species is unlikely to be present.
Glossopsitta pusilla	Little Lorikeet	-	High	Vulnerable	Not Listed	Included Potential habitat is available within the development site.
Haliaeetus leucogaster	White-bellied Sea-Eagle	- Waterbodies - Within 1km of rivers, lakes, large dams or creeks, wetlands and coastlines.	High	Vulnerable	Not Listed	Included Marginal habitat available. However, the development site is located within 1 km of waterbodies.
Lathamus discolor	Swift Parrot	-	Moderate	Endangered	Critically Endangered	Included Marginal foraging habitat available.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	Moderate	Vulnerable	Not Listed	Included Potential foraging habitat is available within the development site.
Micronomus norfolkensis	Eastern Coastal Freetail-bat	-	High	Vulnerable	Not Listed	Included Potential foraging and roosting habitat available within the development site.
Miniopterus australis	Little Bentwing-bat (Foraging)	-	High	Vulnerable	Not Listed	Included Roosting habitat and potential foraging available within the development site.
Miniopterus orianae oceanensis	Large Bentwing-bat (Foraging)	-	High	Vulnerable	Not Listed	Included Roosting habitat and foraging habitat available within the development site.

Species	Common Name	Habitat constraints/ Geographic limitations	Sensitivity to gain class	BC Act listing status	EPBC Act listing status	Justification for inclusion or exclusion
Ninox strenua	Powerful Owl (foraging)	-	High	Vulnerable	Not listed	Included This species was added as a candidate species. Marginal foraging habitat available.
Pandion cristatus	Eastern Osprey (Foraging)	-	Moderate	Vulnerable	Not listed	Excluded Development site does not contain open waterbodies suitable for foraging habitat for this species.
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 Marginal foraging habitat is available within the development site.
Phascolarctos cinereus	Koala	-	High	Vulnerable	Vulnerable	Excluded 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 Although the development site contains mapped waterbody, this is limited to a concrete canal with no fringing vegetation.

Species	Common Name	Habitat constraints/ Geographic limitations	Sensitivity to gain class	BC Act listing status	EPBC Act listing status	Justification for inclusion or exclusion
Stictonetta naevosa	Freckled Duck	-	Moderate	Vulnerable	Not Listed	Excluded Although the development site contains mapped waterbody, this is limited to a concrete canal with no fringing vegetation.

4.3.2 Species credit species

Species credit species predicted to occur at the development site, their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 17. The *Long-nosed Bandicoot population in inner western Sydney* endangered population was entered as a candidate species credit species in the BAMC (Table 17) as this species has previously been recorded within the development site.

Species credit species which have been excluded from the assessment and relevant justification are also included in Table 17.

Table 17: Candidate species credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
Acacia bynoeana	Bynoe's Wattle	-	-	High	E	V	Excluded This species is associated with dry sclerophyll forests on sandy soils. Habitat for this species was not recorded within the development site. The development site is highly degraded.	N/A
Acacia prominens - endangered population	Gosford Wattle (Hurstville and Kogarah LGAs)	-	LGAs listed in the determination	Moderate	Endangered population	Not Listed	Excluded The development site is not located within the LGAs associated with this species.	N/A
Acacia pubescens	Downy Wattle	-	-	High	V	V	Excluded Suitable habitat not present due to high level of modified vegetation of the development site.	N/A
Anthochaera phrygia	Regent Honeyeater	Other - OEH mapped areas	-	High	CE	CE	Excluded The development site is not within OEH mapped important area in the BAMC (accessed 10 December 2020).	N/A
Caladenia tessellata	Thick Lip Spider Orchid	-	-	Moderate	E	V	Included Targeted surveys were conducted to determine the presence of this species within the development site	Absent This species was not recorded during recent surveys or during

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
								previous surveys as discussed in the literature review. The development site does not contain suitable habitat for this species.
Callocephalon fimbriatum	Glossy Black-Cockatoo (breeding)	Hollow bearing trees, Living or dead tree with hollows greater than 15 cm diameter and > 5 m above ground	-	High	V	Not listed	Excluded Suitable habitat in the form of large hollow bearing trees is not present for this species.	N/A
Camarophyllopsis kearneyi	-	Other; Creeks or drainage lines or within 500m, semi-permanent/ ephemeral wet areas; or within 500m/swamps, or within 500 m /waterbodies; or within 500m	-	High	E	Not Listed	Excluded The development site does not contain suitable habitats such as creeks, ephemeral areas, swamps. The development site is substantially degraded.	N/A
Epacris purpurascens var. *purpurascens*	-	-	-	Moderate	V	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is substantially degraded.	N/A

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
							There are no BioNet records for this species within a 5 km radius of the development site.	
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	-	-	High	V	Not Listed	Included Targeted surveys were conducted to determine the presence of this species within the development site	Absent. Not recorded during targeted survey.
Grevillea parviflora subsp. *supplicans*	-	-	North of the Great Western Highway	High	V	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A
Gyrostemon thesioides	-	Other; Sandy, alluvial or colluvial soil within 50m of a water course	-	High	E	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is substantially degraded. There are no BioNet records for this species within a 5 km radius of the development site.	N/A
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	-	High	V	Not Listed	Excluded No breeding habitat (large stick nests) present in the development site.	N/A

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
		nest in the canopy						
Hibbertia puberula	-	-	-	High	E	Not Listed	Included Targeted surveys were conducted to determine the presence of this species within the development site	Absent. Not recorded during targeted survey.
Hibbertia superans	-	-	-	High	E	Not Listed	Included Targeted surveys were conducted to determine the presence of this species within the development site	Absent. Not recorded during targeted survey.
Hygrocybe anomala var. *ianthinomarginata*	Other; creeks or drainage lines or within 500 m / semi-permanent/ ephemeral wet areas; or within 500m / swamps' or within 500 m/ waterbodies or within 500 m	-	-	High	V	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A
Hygrocybe aurantipes	Other; creeks or drainage lines or within 500 m / semi-permanent/ephemeral wet areas; or within 500m / swamps' or within 500 m/ waterbodies or within 500 m	-	-	High	V	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
Hygrocybe austropratensis	Other; creeks or drainage lines or within 500 m / semi-permanent/ephemeral wet areas; or within 500m / swamps' or within 500 m/ waterbodies or within 500 m	-		High	E	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A
Hygrocybe collucera	Other; creeks or drainage lines or within 500 m / semi-permanent/ephemeral wet areas; or within 500m / swamps' or within 500 m/ waterbodies or within 500 m	-		High	E	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A
Hygrocybe griseoramosa	Other; creeks or drainage lines or within 500 m / semi-permanent/ephemeral wet areas; or within 500m / swamps' or within 500 m/	-		High	E	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
	waterbodies or within 500 m							
Hygrocybe lanecovensis	Other; creeks or drainage lines or within 500 m / semi-permanent/ephemeral wet areas; or within 500m / swamps' or within 500 m/ waterbodies or within 500 m	-		High	E	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A
Hygrocybe reesiae	Other; creeks or drainage lines or within 500 m / semi-permanent/ephemeral wet areas; or within 500m / swamps' or within 500 m/ waterbodies or within 500 m	-		High	V	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A
Lathamus discolor	Swift Parrot (Breeding)	- As per OEH mapped areas	-	Moderate	E	CE	Excluded The development site is not within OEH mapped important area in the BAMC (accessed 10 December 2020).	N/A
Litoria aurea	Green and Golden Bell Frog	- Within 1km of wet areas	-	High	E	V	Excluded This species was not included as a candidate species. Previous targeted survey within the	N/A

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
		- Within 1km of swamp - Within 1km of waterbody					development site have not detected this species. The development site does not contain suitable habitat features for this species such as wetlands or drainage lines or fringing or semi-aquatic vegetation.	
Maundia triglochinoides	-	Other Riparian areas/drainage lines, water ponding, man-made dams and drainage channels up to 1 m deep/ semi-permanent/ephemeral wet areas/ swamps; shallow swamps up to 1 m deep/ waterbodies; shallow waterbodies up to 1 m deep	-	High	V	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A
Melaleuca biconvexa	Biconvex Paperbark	-	-	High	V	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species.	N/A

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
							There are no BioNet records for this species within a 5 km radius of the development site.	
Meridolum corneovirens	Cumberland Plain Land Snail	-	-	High	E	Not Listed	Excluded The development site does not contain suitable habitat for this species. The development site is outside of the geographic distribution for this species. There are no BioNet records for this species within a 5 km radius of the development site.	N/A
Miniopterus australis	Little Bent-winged Bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	-	Very High	V	Not Listed	Included Targeted surveys were conducted for this species to determine breeding activity.	Present. Recorded during echolocation surveys in the site boundary. However, no breeding habitat was recorded within the development site.
Miniopterus orianae oceanensis	Large Bent-winged Bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	-	Very High	V	Not Listed	Included Targeted surveys were conducted for this species to determine breeding activity.	Present. Recorded during echolocation surveys in the site boundary. However, no breeding habitat was recorded within the development site.
Myotis macropus	Southern Myotis	- Hollow-bearing trees	-	High	V	Not Listed	Included	Absent.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
		- Within 200m of a riparian zone - Bridges, caves or artificial structures within 200m of riparian zone					Targeted surveys were conducted for this species.	This species was not recorded during targeted surveys.
Pandion cristatus	Eastern Osprey (Breeding)	Other Presence of stick nests in living or dead trees (>15m) or artificial structures within 100m of a floodplain for nesting)	-	Moderate	V	Not Listed	Excluded The development site does not contain the presence of stick nests for this species. The development site is not located within 100 m of a floodplain.	N/A
Perameles nasuta – endangered population	Long-nosed Bandicoot population in inner western Sydney	-	-	High	E4	Not Listed	Excluded Habitat surveys were conducted for this species during the current assessment. Previous targeted surveys (see results of literature review Table 2) were conducted for this species and determined that this species does not occur within the development site.	Absent. This species is unlikely to occur within the development site.
Persoonia hirsuta	Hairy Geebung	-	-	High	E	E	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.	N/A

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
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.	N/A
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.	N/A
Pimelea curviflora var. *curviflora*	-	-	-	High	V	V	Excluded Habitat substantially degraded. Preferred habitat not present.	N/A
Pomaderris prunifolia	Endangered population in Parramatta, Auburn ,Strathfield and Bankstown LGAs	-	LGAs in the determination listing	High	E4	Not Listed	Excluded The development site is not within the LGAs associated with this species.	N/A
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	Excluded Habitat present is substantially degraded such that this species is unlikely to utilise the development site. This species is distributed in north-west Sydney between Rouse Hill, Cattai and Wiseman's Ferry. The development site is not located within the geographic distribution of this species distribution. There are no BioNet records for this species within 5 km radius of the development site.	N/A

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC Act	EPBC Act	Justification for inclusion or exclusion of species	Presence/absence
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	- Breeding camps	-	High	V	V	Excluded The development site does not contain any breeding sites that are suitable for the species to utilise	N/A
Rhodamnia rubescens	Scrub Turpentine	-	-	High	CE	Not Listed	Included Targeted surveys conducted for this species.	Absent. This species was not recorded during targeted surveys.
Syzygium paniculatum	Magenta Lilly Pilly	-	-	High	E	V	Included Targeted surveys conducted for this species.	Absent. This species was not recorded during targeted surveys.
Tetratheca glandulosa	-	-	-	High	V	Not Listed	Included Targeted surveys conducted for this species.	Absent This species was not recorded during targeted surveys.
Wahlenbergia multicaulis	Endangered population in the Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	-	Check for updated LGA names	High	E4	Not Listed	Excluded The development site is not within the LGAs associated with this species.	N/A

4.3.3 Habitat survey results

The development site contains limited habitat features such as hollow-bearing trees (HBTs), fallen logs, aquatic habitats or large patches of intact mature native vegetation. Two mature trees which contain nest-boxes were located in the Central Link of the development site (Figure 4).

One Grey-headed Flying-fox was observed roosting within a *Cinnamomum camphora* (Camphor Laurel) during the field surveys (Figure 4). The trees within the development site may be used as potential seasonal foraging habitat for the Grey-headed Flying-fox. The nearest nationally important camp is located at Wolli Creek within 3 km of the development site. The individual located within the development site does not represent a breeding camp. It is likely that suitable breeding habitat would be present outside the development site in this core area. Camps have never been recorded or observed within this development site. Additional habitat resources in the form of planted street trees was recorded in the locality of the development site and may provide supplementary foraging habitat for this species.

The habitat assessment did not record any direct or indirect evidence of the *Long-nosed Bandicoot population in inner western Sydney* endangered population. This species has previously been recorded within the development site prior to the installation of the Light Rail in 2015. There has been no credible recording of a Long-nosed Bandicoot in the inner western Sydney region despite recent targeted surveys. It has been noted during literature review of previous targeted surveys for the Long-nosed Bandicoot that the numbers of cats and foxes within the development site may have contributed to the reduction in bandicoots. Surveys conducted by ELA in association with the Inner West Light Rail project between 2011 and 2015 failed to provide direct (living Long-nosed Bandicoots) or indirect (diggings, nests, fur, scats or a carcass) evidence of Long-nosed Bandicoots. Despite the lack of records, the development site contains native and exotic vegetation which may be used by Long-nosed Bandicoots for connectivity between foraging and sheltering habitat. No targeted surveys were conducted for this species for this current project as literature review and habitat assessment did not identify potential habitat for this endangered population.

Numerous man-made structures such as stormwater drains, culverts and bridges were also identified within the study area (Figure 18). These man-made structures commonly provide potential habitat for several microbat species in an urban and peri-urban setting (Churchill 2008). The majority of structures inspected during the site visit contained some potential roosting habitat for microbats within expansion joins between culvert cells (Figure 19) and lifting holes, or within gaps and joins between bricks. Most of these structures were unlikely to support large aggregations of any microbat species for any length of time due to the risk of flooding through the culverts and stormwater drains or exposure to disturbance from humans and predators such as cats, dogs and foxes.

4.3.3.1 Targeted survey results

Details of targeted survey effort are discussed in Section 3.4.2. The results of targeted surveys are presented in Table 18 and discussed in more detail below.

Table 18: Results of targeted survey and credit requirements.

Target species	Common name	Species recorded during survey	Species credits required
FLORA			
Caladenia tessellata	Thick Lip Spider Orchid	No	This species was not recorded within the development site. Furthermore, due to an absence of records and lack of suitable habitat, it is unlikely to occur within the development site.
Hibbertia puberula	-	No	This species was not recorded within the development site. Furthermore, due to an absence of records and lack of suitable habitat, it is unlikely to occur within the development site.
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	No	This species was not recorded within the development site. Furthermore, due to an absence of records and lack of suitable habitat, it is unlikely to occur within the development site.
Hibbertia puberula	-	No	This species was not recorded within the development site. Furthermore, due to an absence of records and lack of suitable habitat, it is unlikely to occur within the development site.
Hibbertia superans	-	No	This species was not recorded within the development site. Furthermore, due to an absence of records and lack of suitable habitat, it is unlikely to occur within the development site.
Rhodamnia rubescens	Scrub Turpentine	No	This conspicuous species was not recorded within the development site during targeted surveys. It is unlikely to occur within the development site.
Syzygium paniculatum	Magenta Lilly Pilly	No	It is noted that the survey period for this species did not coincide with current surveys. However, targeted surveys conducted by Cardno (2019) within the survey period did not record this species. This conspicuous species is unlikely to occur within the development site.
Tetratheca glandulosa	-	No	This species was not recorded within the development site. Furthermore, due to an absence of records and lack of suitable habitat, it is unlikely to occur within the development site.
FAUNA			
Miniopterus australis	Little Bent-winged Bat	Yes, anabat results	No breeding habitat was recorded. The tunnel in Cadigal Reserve is the only potential breeding habitat for this species present within the

Target species	Common name	Species recorded during survey	Species credits required
			development site. It was inspected during the Little Bent-winged Bat breeding season (Dec – Feb) with no individuals present.
Miniopterus orianae oceanensis	Large Bent-winged Bat	Yes, anabat results	No breeding habitat was recorded. The tunnel in Cadigal Reserve is the only potential breeding habitat for this species present within the development site. The tunnel is a known winter roost for Large Bent-winged Bats. The tunnel was inspected during the Large Bent-winged Bat breeding season (Dec – Feb) with no individuals present.
Myotis macropus	Southern Myotis	No, this species was not recorded during targeted surveys.	No, this species is unlikely to utilise the development site as habitat

At least three and up to four microbat species were recorded during the ultrasonic surveys (Table 19). Of these, two species, the Large Bent-winged Bat and Little Bent-winged Bat are listed as being vulnerable under the BC Act. The other two species recorded in the study area were the Gould's Wattled Bat, and potentially *Ozimops ridei* (Ride's Free-tailed Bat) however, neither is listed under the BC or EPBC Acts.

Both Gould's Wattled Bats and Large Bent-winged Bats were recorded at Fred Street Reserve (Figure 5). Given the timing that calls were recorded and the low number of calls (12 definite or potential calls over 8 survey nights) neither species was likely to be roosting within this structure at the time of the survey.

The ultrasonic surveys conducted within Cadigal Reserve recorded both Bent-winged Bat species and Gould's Wattled Bat. The recordings taken during emergence surveys of the roost generally contained 50 -150 Large Bent-winged Bat calls per night, most of which were recorded as Large Bent-winged Bats exited the roost soon after dark. The results show that up to 6 October, this roost remained occupied by Large Bent-winged Bats. The results obtained by ELA between 1 and 4 December indicate that although there were no Large Bent-winged Bats (or any species of bat) roosting in the tunnel, there were calls recorded from Large Bent-winged Bats outside the tunnel on all nights form approx. 1 hour after sunset throughout the night. These results are supported by those gathered during repeated IWC ultrasonic surveys undertaken outside the roost during October and November 2020. This result is significant in that it shows that the roost and the area immediately surrounding it are important habitat for Large Bent-winged Bats throughout the summer months even when the roost is not being used. There were very few calls from Gould's Wattled Bat and the Little Bent-winged Bat recorded within Cadigal Reserve, and none which suggested either species was likely to be roosting in the tunnel.

The Little Bent-winged Bat was identified as being present within the study area from just six calls that were recorded within a short five-minute burst in Cadigal Reserve near the roost entrance. The timing of these calls indicated that Little Bent-winged Bat(s) were not emerging from the Large Bent-winged Bat roost in the tunnel. No other calls, or evidence of this species using the rail corridor, or the Cadigal Reserve roost has been previously recorded. However, this species is known to occur in the Sydney

basin, and it is possible that these recordings were made by a bat or bats foraging overhead or assessing whether the tunnel could form a suitable roost for individuals of this species. Little Bent-winged Bats and Large Bent-winged Bats are often found roosting together, particularly during the maternity season (Churchill 2008).

Detectors placed further away from the Cadigal Reserve roost (at 18 m and 40 m respectively) consistently recorded a reduced number of Large Bent-winged Bat calls than at the roost entrance (<30 calls per night) and only ever recorded Large Bent-winged Bat calls (Figure 4 and Figure 5).

Detectors placed at Paramatta Road Bridge recorded less than 5 calls from Large Bent-winged Bats and Gould's Wattled Bats. Detectors placed at Marion St Bridge (further north along Hawthorne Canal and out of the development footprint) recorded only two very poor-quality calls from Gould's Wattled Bats / Ride's Free-tailed Bat.

Observations of the flight paths of bats as they exited the roost indicated that the preferred direction of travel was in a north easterly direction, flying low over the main western rail line, or under it within the Inner West Light Rail corridor (Figure 4 and Figure 5). Some bats also flew north along Hawthorne canal beneath the main western rail line (Figure 4 and Figure 5). This result is consistent with the ultrasonic results and with what is known about preferred foraging patterns for Large Bent-winged Bats, generally flying just above or in the upper sections of the canopy and along the edges of forested areas (Churchill 2008). It is also notable that the route most often chosen by the bats as they exited and returned to the roost was through the darkest portion of the air space. Street lighting from Grosvenor Ave spilled over into the space beneath the main western rail line making the airspace in this area brighter than that on the eastern side of the main western rail line pylons and the Inner West Light Rail Corridor.

Two internal inspections of the tunnel in Cadigal Reserve were carried out; one on 4 November and one on 1 December 2020. There were no bats recorded roosting within the tunnel on either occasion. The tunnel floor was covered in layers of different aged guano from two thirds of the way along until the end wall at the back of the tunnel. There was no fresh guano deposited between the first internal tunnel inspection and the second. There were multiple areas above the guano that were stained from sustained bat roosting which also contained the remains of microbat parasite casings on the walls and roof of the tunnel. All of these signs suggest that the tunnel has a history of use by bats and is used by moderate aggregations of bats each year.

The absence of bats in December indicates that the tunnel is not used as a maternity roost by Little or Large Bent-winged Bats as females of these two species should already have formed maternity colonies and be preparing to give birth in December. However, as described above Large Bent-winged Bats continue to use the habitat immediately outside the roost (as evidenced by continued ultrasonic calls recorded nightly from 1 hour after sunset) even when no bats are roosting in the tunnel and this behaviour warrants further investigation.

Figure 17: Opening of the Cadigal Reserve Large Bent-winged Bat overwinter roost

Figure 18: General location of In-Corridor Works study area

Figure 19: Expansion crack between pipe cells in a reinforced concrete pipe culvert that could provide roosting habitat for Large Bent-winged Bats and other subterranean roosting microbat species

Figure 20: Reinforced concrete pipe culvert (top) and brick culvert (bottom) adjacent to Hercules Street containing potential microbat roosting habitat

Figure 21: Parramatta Road bridge over Hawthorne Canal containing potential microbat roosting habitat

Table 19: Results of the ultrasonic surveys

Location of survey	Date	Type of survey	Species name	Common name
Cadigal Reserve Roost	4 Sept 9 Sept	Evening emergence	*Miniopterus orianae oceanensis**	Large Bent-winged Bat
Cadigal Reserve Roost	29 Sept to 7 Oct 2020	Static passive survey	*Chalinolobus gouldii* *Miniopterus australis** *Miniopterus orianae oceanensis**	Gould's Wattled Bat Little Bent-winged Bat Large Bent-winged Bat
Fred Street Reserve	29 Sept to 7 Oct 2020	Static passive survey	*Chalinolobus gouldii* *Miniopterus orianae oceanensis**	Gould's Wattled Bat Large Bent-winged Bat
Parramatta Rd Bridge	1 Dec to 4 Dec	Static passive survey	*Chalinolobus gouldii* *Miniopterus orianae oceanensis**	Gould's Wattled Bat Large Bent-winged Bat
Marion St Bridge	1 Dec to 4 Dec	Static passive survey	*Chalinolobus gouldii / Ozimops ridei*	Gould's Wattled Bat / Ride's Free-tailed Bat
Cadigal Reserve Roost	4 Nov 1 De	Internal roost inspection and evening emergence survey	*Miniopterus orianae oceanensis**	Large Bent-winged Bat
Cadigal Reserve Roost	1 Dec to 4 Dec	Static passive survey	*Miniopterus orianae oceanensis**	Large Bent-winged Bat

* DENOTES THREATENED SPECIES

4.3.4 Species credits species included in this assessment

Following the completion of the habitat assessments and targeted surveys it was determined that the vegetation within the development site is highly disturbed and does not provide habitat for species credit species. Therefore, no additional assessment of species credit species is required.

5. Impact assessment (biodiversity values)

5.1 Avoiding impacts

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

The proposed development will result in the removal of native vegetation from within the development footprint. The project design has considered several design options. The current design has minimised impacts to native vegetation by utilising existing pathways and built areas. Some impacts to native vegetation and threatened species habitat will occur as part of the proposed development. These impacts and efforts to avoid or mitigate impacts to biodiversity values are discussed below (Table 20).

Table 20: Locating and designing a project to avoid and minimise impacts on vegetation and habitat

BAM project location and design principles	How addressed and justification
Locating the project in areas where there are no biodiversity values	The development footprint has utilised existing pedestrian pathways, highly disturbed areas such as within the light rail corridor and vegetation of low vegetation values (i.e. lacks significant habitat for threatened species) such as vegetation zone 3 (which have a low vegetation integrity score 4.4). The development footprint will also affect a small amount 0.04 ha of vegetation zone 1, 0.23 ha of vegetation zone 2 and 0.10 ha of vegetation zone 3. Vegetation zone 2 also includes potential winter-roosting habitat for the Little Bent-winged Bat and Large Bent-winged Bat. The impacts to native vegetation cannot be avoided due to small linear nature of the development site and the presence of exiting built structures such as Hawthorne Canal, roads and the Light Rail corridor surrounding the development site.
Locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition	The landscape within the development site has a long history of disturbance and native vegetation is present as a result of revegetation and landscaping works. The vegetation lacks significant key habitat features for a majority of threatened fauna species. One HBT recorded during the field surveys will be retained as part of the design. Winter-roosting habitat for Little Bent-winged Bat and Large Bent-winged Bat was recorded within the development site. The development design has located the pathway approximately 10 - 15 m from the roost site to reduce direct impacts upon this roost. The proposed development would impact 0.10 ha of PCT 1281_shrubs (vegetation zone 3) with a vegetation integrity score of 4.4. The development will also affect a small portion of planted vegetation with a higher vegetation integrity score including PCT 1232 (vegetation zone 1) with a vegetation integrity score of 25.3 and PCT 1281 planted (vegetation zone 2) with a vegetation integrity score of 54.3.
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	The proposed development design will affect planted native vegetation and does not represent high threatened categories such as EEC or CEEC vegetation. The development has considered the placement and design of the pedestrian pathway to reduce the risk to microbats at the roost location within the development site. Indirect impacts (or possible direct impacts) will be mitigated through a suite of management actions and careful scheduling of construction activities as well as via on-going monitoring of the roost and microbats during and post construction.

BAM project location and design principles	How addressed and justification
Locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained	The development site is located in a narrow linear corridor within a highly urbanised environment. Connectivity within the development site to intact native vegetation is currently severed by major arterial roads, the light rail and built structures. The proposed development design will result in a small loss to connectivity. However, much of the vegetation within the development site will be retained. The proposed design of the project may result in temporary disturbance to fauna species utilising the vegetation as a connective corridor during construction works. Mitigation measures (including low impact lighting) and a microbat management and monitoring plan will be implemented to reduce these impacts to microbats using the linear corridor to enter and exit the known Large Bent-winged Bat winter roost, and also using the linear corridor as foraging habitat.
Reducing the clearing footprint of the project	The project design has undergone several design options to reduce the clearing footprint. The current design utilises existing cleared areas and vegetation of low integrity value where possible.
Locating ancillary facilities in areas where there are no biodiversity values or threatened species habitat or habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	The project design includes the installation of ancillary facilities which may result in impacts to planted native vegetation. The development site does not contain vegetation in high threat status; however, the site does contain winter-roosting habitat for threatened microbat species. Ancillary facilities will be located away from this roost location.
Providing structures to enable species and genetic material to move across barriers or hostile gaps	The elevated pathway forms a potential barrier to microbats as it lies within the direct flight path of bats moving to and from the roost. The elevated pathway has been designed and located in such a way as to allow bats to fly above and potentially below it. There will be no light spill into the roost and minimal noise / vibration generated by the elevated pathway as it will be enclosed using noise buffering materials where it passes the roost entrance. Limited testing of a soft barrier (shadecloth) that mimics the elevated pathway is recommended to evaluate the response of bats to introduction of the barrier. Lighting will be located and designed to minimise light spill within 50 m of the roost entrance. Physical structures (poles, rope ladders) to enable species and genetic materials to move across barriers or hostile gaps are not considered appropriate to this development.
Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site	The vegetation within the development site which will not be affected will be protected through the implementation of demarcation structures to prevent accidental impacts. Landscaping will be conducted following the proposed works to reinstate the reduction of native vegetation within the development site. Landscaping works should consider the selection of species which represents locally indigenous vegetation communities such as PCT 1281 and PCT 1231.

5.2 Assessment of Impacts

5.2.1 Direct impacts

The direct impacts of the development on native vegetation and threatened ecological communities are presented in Table 21.

Table 21: Direct impacts to native vegetation

Veg Zone	PCT ID	PCT name	Vegetation Class	Vegetation Formation	TEC	Condition	Direct impact (ha)
1	1232	Coastal Freshwater Swamp Forest	Coastal Swamp Forests	Forested Wetlands	BC Act: No EPBC Act: No	Poor	0.04
2	1281	Sydney Turpentine-Ironbark Forest	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	BC Act: No EPBC Act: No	Poor	0.23
3	1281	Sydney Turpentine-Ironbark Forest	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	BC Act: No EPBC Act: No	Poor	0.10

5.2.2 Change in vegetation integrity

The change in vegetation integrity as a result of the development is outlined in Table 22.

Table 22: Change in vegetation integrity

Veg Zone	PCT ID	Condition	Direct impact (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity
1	1232	Planted	0.04	25.3	0	-25.3
2	1281	Planted	0.23	54.3	0	-54.3
3	1281	Shrubs	0.10	4.4	0	-4.4

5.2.3 Indirect impacts

The indirect impacts of the development are outlined in Table 23.

Table 23: Indirect impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Sedimentation and contaminated and/or nutrient rich run-off	Construction	Runoff during works	Confined to development site with the implementation of sediment fencing	During heavy rainfall or storm events	During rainfall events	Short term
Noise, dust or light spill	Construction	Noise and dust created from machinery (no night works proposed therefore no light spill)	Noise and dust likely to carry beyond development site boundary	Daily, during construction works	Sporadic throughout construction period	Short-term impacts
Inadvertent impacts on adjacent habitat or vegetation	Construction / operation	Damage to adjacent habitat or vegetation	Adjacent vegetation	Daily, during construction works and operation	Throughout construction and operation period	Short-term impacts
Transport of weeds and pathogens from the site to adjacent vegetation	Construction / operation	Spread of weed seed or pathogens	Potential for spread into adjacent habitat	Daily, during construction works and operation	Sporadic throughout construction and operation period	Potentially long-term impacts
Trampling of threatened flora species	N/A	No threatened flora present	N/A	N/A	N/A	N/A
Vehicle strike	Construction / operation	Potential for native fauna to be struck by working machinery and moving vehicles	Within access road and development site	Daily, during both construction and operational phases.	Throughout life of project	Potentially long-term impacts
Rubbish dumping	Construction / operation	Illegal dumping by construction crews / future landholder	Potential for rubbish to spread via wind into adjacent vegetation	Potential to occur at any time throughout construction or operational phases	Throughout life of project	Short-term impacts
Wood collection	Construction / operation	Minimal woody debris available for collection.	Within retained vegetation.	Daily, during both constructio	Throughout life of project	Short term impact.

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
				n and operational phases.		
Disturbance to specialist breeding and foraging habitat, e.g. beach nesting for shorebirds.	Construction / operation	Removal or modification of vegetation used for foraging by threatened species. Disturbance to roosting habitat for microbats	Within retained vegetation.	Daily, during both constructio n and operational phases.	Throughout life of project	Long and short term impacts
Increase in predatory species populations	Construction / operation	Negligible likelihood of impact occurring because only a small degraded are of native vegetation will be removed	N/A	N/A	N/A	N/A
Increase in pest animal populations	Construction / operation	Potential for pest animals to increase due to human activity	Within retained vegetation.	Daily, during both constructio n and operational phases.	Throughout life of project	Short term impact.

5.2.4 Prescribed biodiversity impacts

The development site contains prescribed biodiversity impacts as outlined in Table 24.

The list of potential prescribed impacts as per the BAM is provided below:

- Occurrence of karst, caves, crevices and cliffs – none occur within the development site
- Occurrence of rock – no rock outcrops or scattered rocks occur within the development site
- Occurrence of human made structures and non-native vegetation – **Yes, see section below**
- Hydrological processes that sustain and interact with the rivers, streams and wetlands – **Yes, see response below**.
- Proposed development for a wind farm and use by species as a flyway or mitigation route – the project does not involve any wind farm development.

The development site contains, artificial hydrological processes, human-made structures and non-native vegetation. Additional information regarding consideration prescribed impacts are provided below.

The development site contains one mapped watercourse, Hawthorne Canal. The canal is a tidal system which is connected to Parramatta River located 1.5 km north of the development site. Therefore, an assessment of hydrological processes is required for this development.

The development site contains human-made structures such as culverts, bridges and a known roost site for Large Bent-winged Bat within a brick tunnel (human-made structure).

Human-made structures located within the development site are known to, and have the potential to provide habitat for the following threatened microbat species:

- Little Bent-winged Bat
- Large Bent-winged Bat.

The non-native vegetation within the development site may also support foraging habitat for populations of threatened microbat species:

- Eastern False Pipistrelle
- Eastern Coastal Free-tailed Bat
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tail Bat)
- Greater Broad-nosed Bat.

Non-native vegetation was identified and assessed for any potential to provide habitat for threatened flora and fauna species, including presence of hollow bearing trees and foraging resources (such as flowers or fruit). Non-native vegetation also includes woody weeds such as and *Ligustrum lucidum*. No woody weeds were identified as containing suitable hollows (i.e. for birds or microbats) or suitable foraging for threatened species. However, possums have potential to occur within non-native vegetation and are considered a prey item for the Powerful Owl. No breeding habitat was recorded for the Powerful Owl.

The development site contains exotic flowering/fruiting trees which may provide supplementary foraging for the Grey-headed Flying Fox.

Table 24: 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: • karst, caves, crevices, cliffs and other geological features of significance, or • rocks, or • human made structures, or • non-native vegetation	The development site contains fruiting and nectar producing non-native vegetation and woody weeds which will be removed as part of the development proposal. This provides foraging habitat for common urban arboreal mammals (possums) which in turn provides foraging opportunities for threatened nocturnal bird species. The proposed works will result in a reduction in the extent of foraging habitat and reduction in availability of their prey items.	Potential foraging habitat for Grey-headed Flying Fox. Potential foraging habitat for Powerful Owl. Known important Large Bent-winged Bat winter-roosting habitat and potential Little Bent-winged Bat winter-roosting habitat. Potential foraging habitat for threatened microbat and raptor species above non-native vegetation canopy.

Prescribed biodiversity impact	Description in relation to the development site	Threatened species or ecological communities effected
	The development site contains winter-roosting habitat for microbats in human-made structures.	
Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	The proposed development will require the removal of non-native vegetation from within the development site. The development will result in a minor reduction in the extent of non-native vegetation within the development site. This vegetation may provide stepping stone habitat between urban fragmented patches of vegetation. The GreenWay corridor provides an important connective pathway for the dispersal of mobile species including the Large Bent-winged Bat.	Reduction in extent of potential foraging habitat or non-breeding occasional roosting habitat for Grey-headed Flying Fox. Reduction in extent of potential habitat foraging habitat for Powerful Owl. Potential for abandonment and loss of important Large Bent-winged Bat winter roost site. Potential reduction in security and suitability of an important Large Bent-winged Bat winter roost in the Sydney Basin. Potential reduction in connectivity between Sydney Basin Large Bent-winged Bat winter roost sites. Reduction in extent of potential foraging habitat for other threatened microbats.
Impacts of development on movement of threatened species that maintains their lifecycle	The proposed development will result in reduction of vegetation within the development site and marginal loss of potential connectivity for mobile threatened species. The proposed development will result in short-term disturbance during construction works and potential long-term impacts in response to increased human activity and disturbance near a known winter-roosting location of a threatened microbat species. No direct removal of this structure will occur as part of the development proposal. However, the proposed pathway lies directly within the flight path of bats as they enter and leave the roost. There will be an increase in noise, vibration and light levels both throughout construction and in some cases (noise / light) likely to be persisting into to the operational phase of the project. If the proposed development leads to partial or complete abandonment of the winter roost this may reduce mating opportunities and reproductive output for this species as mating occurs at winter roost sites. An Adaptive	Grey-headed Flying Fox, Powerful Owl and microbats (Large Bent-winged Bat and Little Bent-winged Bat)

Prescribed biodiversity impact	Description in relation to the development site	Threatened species or ecological communities effected
	Microbat Design Plan and Construction Microbat Management Plan will be prepared and implemented prior to construction. These plans will outline mitigation and monitoring measures aimed at reducing impacts from noise, light and vibration as well as maintaining the flyway to and from the roost and maintaining the roost in a functional state throughout construction and operation of the proposed works.	
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)	The development site includes the Hawthorne Canal which is considered part of a hydrological process. The Hawthorne Canal links to Parramatta River 1.5 km north of the development site. The Hawthorne Canal does not sustain any known threatened species habitat or threatened ecological communities.	The development does not contain threatened species or threatened ecological communities which are dependent upon hydrological flow or water bodies. The construction of a pedestrian pathway and associated infrastructure will not result in a loss hydrological process and will not result in impacts to threatened species or ecological communities which rely on hydrological processes.
Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	The development will result in an increase in the human traffic including pedestrians and bike-riders within the development site.	The increase in human traffic has potential to result in increased interactions with threatened species or result in threatened species avoiding areas where there are high traffic areas. Threatened species may include nocturnal species; Grey-headed Flying Fox, Powerful Owl and microbats (Large Bent-winged Bat and Little Bent-winged Bat).

5.2.4.1 Locating and designing a project to avoid and minimise prescribed biodiversity impacts

A full description of the project design to avoid and minimise impacts has been provided above in Table 20. Justification for how the project avoids and minimises prescribed biodiversity impacts as outlined in Table 25.

Table 25: Locating and designing a project to avoid and minimise prescribed biodiversity impacts

Approach	How addressed and justification
Locating the envelope of surface works to avoid direct impacts on habitat features	The project will not result in the direct impact to human-made structures which provides threatened species habitat. However, there is potential for indirect impacts to occur to a known roosting site for Large Bent-winged Bat and potential roosting habitat for Little Bent-winged Bat species within human-made structures.

Approach	How addressed and justification
	Non-native vegetation will be removed from the development site.
Locating the envelope of sub-surface works, both in the horizontal and vertical plane, to avoid and minimise operations beneath the habitat features, e.g. locating long wall panels away from geological features of significance or water dependent plant communities and their supporting aquifers	Not applicable
Locating the project to avoid severing or interfering with corridors connecting different areas of habitat, migratory flight paths to important habitat or preferred local movement pathways	The development site is located within a highly urbanised environment. The vegetation within the development site is fragmented by major arterial roads which limits migratory/foraging connectivity and exchange of genetic material of flora species and less mobile fauna species between patches of vegetation. The development passes directly in front of a known winter roost site for the Large Bent-winged Bat and is located in the flight path of Large Bent-winged Bats as they are entering and leaving the roost. Options to locate the pathway outside of the Hawthorne Canal corridor, as per the current route used by pedestrians and cyclists were investigated. Retaining the current arrangement where pedestrian and cycle traffic are directed through Cadigal Reserve to Grosvenor Street footpath to Longport Street pedestrian crossing was considered to represent an unreasonable risk to human safety given the large increase in pedestrian and cycle traffic predicted to occur with construction of the pathway. The option of building an overpass over Longport Street was also considered but costs and practicalities of construction and operation were prohibitive.
Optimising project layout to minimise interactions with threatened and protected species and ecological communities, e.g. designing turbine layout to allow buffers around features that attract and support aerial species, such as forest edges, riparian corridors and wetlands, ridgetops and gullies	The development has undergone several designs to minimise interactions to the known roosting site for threatened microbats. Where possible the design has utilised existing cleared or low condition vegetation where possible to minimise interactions with threatened species habitat and retained vegetation which may provide habitat for threatened species. The pathway has been located so that it is approx. 10-15 m away from the roost entrance to provide airspace for the bats to enter and exit. The pathway will be enclosed for a length of 12-15 m in front of the roost to minimise noise and light spill and interactions between dispersing bats and users of the pathway. There will be some clear and protected air space beneath the pathway (1-3 m), and above the pathway (<5 m) around which bats can navigate as they disperse from the roost. Further controlled studies evaluating the effect of new structures, light, noise and human / companion animal presence in the vicinity of the roost entrance, and comparative activity and usage studies at other known roosts have been recommended. These studies will inform adaptive management plans which will include final detailed design of features constructed within 50m of bat roost, regular monitoring of the roost prior to construction, throughout construction and post construction and trigger thresholds for actions if and when impacts form the proposed development are identified.
Locating the project to avoid direct impacts on water bodies. Design of the project to maintain hydrological processes that sustain threatened species and TECs.	The design does not involve the interactions on water bodies. Hawthorne Canal is located within the development site; however, no direct impacts will occur to this artificial canal. The proposed works does not involve alteration in the hydrological processes that sustain this canal. There is potential that the proposed works may result in an increase in water flow into the canal and

Approach	How addressed and justification
	decrease in water quality due to rubbish. Mitigation measures such as additional waste recycling units will be required to minimise this risk.
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	Hawthorne Canal is connected to Parramatta River, located approximately 1.5 km north of the development site. The proposed works does not involve substantial earth works or soil disturbance such that downstream environments will be impacted. Mitigation measures will be implemented such as permanent sediment and water quality control measures installed during and after construction to prevent offsite impacts to downstream waterways and water dependent communities in Parramatta River. It is recommended to install stormwater quality improvement devices to prevent long-term impacts to downstream waterbodies.
Engineering solutions, e.g. proven techniques to minimise fracturing of bedrock underlying features of geological significance, water dependent communities and their supporting aquifers; proven engineering solutions to restore connectivity and favoured movement pathways	Not applicable.

5.2.5 Mitigating and managing impacts

Measures proposed to mitigate and manage impacts at the development site before, during and after construction are outlined in Table 26.

Table 26: Measures proposed to mitigate and manage impacts

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	Moderate	Minor	Install No Go fencing prior to construction works around entire development site to prevent impacts to adjacent vegetation.	Vegetation to be retained outside of the Development Site boundary and retained vegetation within the Development Site will not be disturbed/impacted	Fencing to be set up prior to any works occurring on site and to remain and be maintained throughout duration of construction works	Project Manager
Sediment barriers or sedimentation ponds to control the quality of water released from the site into the receiving environment	Minor	Negligible	Appropriate controls will be utilised and maintained to manage exposed soil surfaces and stockpiles to prevent sediment discharge into waterways	Erosion and sedimentation will be controlled	For the duration of construction works	Project Manager
Design protocols developed for elevated pathway to maintain bat flightpaths to and from roost	High	Moderate	Consider conducting investigations into the effect of soft barriers replicating elevated pathway on bat flight paths to inform final design specifications and location, designing and locating elevated pathway so that there are minimal impacts to bat flight paths, scheduling construction for periods when bats are not in residence (Nov to end Feb), ensuring bat flight paths to / from roost remain open at all times, monitoring response of bats to elevated pathway	Minimal impact to bat flight paths and emergence patterns	Prior to, during and post construction	Project Manager, Contractor, Project Ecologist

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			during emergence. Detailed mitigation measures for design and construction will be outlined in AMDP and CMMP.			
Noise monitoring, installation of noise barriers, daily/seasonal timing of construction and operational activities to reduce impacts of noise	High	Moderate	Daily timing of construction activities is recommended in accordance with Table 1 of Interim Noise Guidelines (2009). Impacts of noise on the Large Bent-winged Bat roost will be addressed in the adaptive management plans (AMDP and CMMP) that must be developed prior to construction. Measures being considered include scheduling construction activities in the vicinity of the roost to coincide with periods when bats are not in residence (Nov – end Feb), installing noise barriers that do not block flight paths of bats during construction, building the elevated pathway with noise buffering / absorbing materials. obtaining baseline background noise levels within the roost and at the roost entrance prior to construction, during construction and post construction. Detailed mitigation measures for design and construction will be outlined in AMDP and CMMP.	Understanding existing acoustic environment, minimising impacts form noise to roosting microbats and documenting changes that occur due to construction and operation of proposed works	Prior to, during and post construction	Project Manager, Contractor, Project Ecologist
Light level monitoring, daily/seasonal timing of construction and use of low impact lighting design.	High	Moderate	Scheduling construction activities in the vicinity of the roost to coincide with periods when bats are not in residence (Nov – end Feb). Timing of construction activities to ensure light spill does not occur within 50 m of roost entrance from	Understanding existing light levels at the site, minimising light spill into area within 50 m of roost entrance and documenting changes in light levels that occur due to	Prior to, during and post construction	Project Manager, Contractor, Project Ecologist

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			1 hour prior to sunset until 1 hour after sunrise daily throughout construction between Longport St and Parramatta Rd. Installation of low emission lights, light spill barriers, use of materials that block light spill from the elevated pathway, timers on lighting in area within 50m of roost entrance, reduction in lighting of areas within 50 m of roost entrance as part of lighting design and operation. Detailed mitigation measures for design and construction will be outlined in AMDP and CMMP.	construction and operation of proposed works		
Vibration monitoring and use of minimum vibration construction techniques	Moderate	Minor	Timing of construction activities to ensure piling for elevated pathway and construction of jacked box culvert beneath Longport St coincides with periods when bats are not in residence (Nov – end Feb). Use of lowest vibration equipment and techniques when excavating / piling / tunnel boring beneath Longport St, active monitoring of vibration levels and bat arousals during piling and tunnel boring. Limiting active piling and tunnel boring daily work hours and including stop work periods throughout the day to provide some relief from vibrations if impacts on bats are being detected. No piling or tunnel boring to be conducted within 50 m of roost entrance from 1 hour prior to sunset until 1 hour after sunrise daily throughout	Understanding existing vibrational environment , minimising impacts of vibration during construction and documenting changes that occur due to construction and operation of proposed works	Prior to, during and post construction	Project Manager, Contractor, Project Ecologist

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			construction. Detailed mitigation measures for construction will be outlined in AMDP and CMMP.			
Adaptive dust monitoring programs to control air quality	Minor	Negligible	Dust suppression measures will be implemented during construction works to limit dust on site	Mitigate dust created during construction activities	For the duration of construction works	Project Manager
Temporary fencing to protect significant environmental features such as riparian zones	High	Minor	Install fencing prior to commencement of any works	Access to retained vegetation restricted	For the duration of construction works	Project Manager
Ensure secure fencing is maintained to exclude members of the public from area within 50 m of roost entrance	Moderate	Minor	Retain existing locked fencing in area between southern boundary of Cadigal Reserve beneath main Western Rail Line and Longport St so access to bat roost and area surrounding it remains restricted. Future activation of this area to view historical Whipple Truss is considered high risk as an impact to roosting bats.	Continued protection of bat roost from visitation by members of the public	For the duration of construction works and operational phase of project	Project Manager
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	Moderate	Minor	Vehicles, machinery and building refuse associated with the development construction should remain only within construction footprint areas, avoiding weed or pathogen related impacts to vegetation outside of the development site	Prevent spread of weeds or pathogens	For the duration of construction works	Project Manager
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	Minor	Negligible	All staff working on the development will undertake an environmental induction as part of their site familiarisation. This induction will include items such as:	All staff entering the development site are fully aware of the presence of threatened species and native vegetation in the development	To occur for all staff entering/working at the Development Site. Site briefings should be updated based on phase of	Project Manager

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			- avoiding indirect impacts to offsite adjacent vegetation - correct storage of chemicals to prevent runoff into adjacent vegetation	site and understand what to do in case of any environmental emergencies	the work and when environmental issues become apparent.	
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	Minor	Negligible	Temporary fencing to be placed around the perimeter of the development site to prevent impacts to adjacent vegetation.	Protect vegetation and habitat adjacent to development site.	During operational phase	Client
Making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site	Minor	Negligible	Any landscape planting in the development site is to use locality derived native species and those found within PCT 1281 or PCT 1231.	Areas within the development site will be landscaped using appropriate species	Following completion of construction activities.	Project Manager

5.2.6 Adaptive management plan

In accordance with Section 8.5 of the BAM 2020 an Adaptive Management Plan can be used to address impacts that are infrequent or difficult to measure. An Adaptive Management Plan includes monitoring works during construction and operational phase and thresholds for triggering adaptive management measures. In order to address the gaps in knowledge and uncertainties around the level of potential impacts from the proposed development on the Large Bent-winged Bats winter roost several strategies are required.

The first strategy will be preparation of an Adaptive Microbat Design Plan (AMDP), which will include gathering baseline data on environmental variables such as noise and light. It should also include carefully planned investigations to quantify the effects on roosting and emerging bats to barriers erected within the flight space at the location of the proposed walkway, exposure to lighting / noise at varying distances from the roost and to lights / noises of different types. The results of these investigations will aid in the detailed design of the pathway through Cadigal Reserve. Studies and surveys to provide information to inform the AMDP may include the following:

- Installation of remote infra-red or thermal cameras and ultrasonic recording devices within the roost to record levels of arousal / activity prior to construction and during experimental disturbances of different kinds
- Monitoring and / or reviewing monitoring data gathered from several other Large bent-winged Bat roost sites (control sites) within the Sydney Basin that are not subject to impacts from construction to place results in context
- Searches of up to 10 of the closest nearby suitable potential roost habitat locations outside the alignment to be accompanied by ultrasonic surveys
- Extensive ultrasonic surveys at the roost during autumn and early winter to determine whether mating activity could be taking place (Gonsalves and Law 2018)
- Banding of bats and harp trapping at the roost and other known roost sites to determine levels of movement between roosts
- Obtaining all survey data from Inner West Council and Sydney University throughout the next year.

Following preparation of the AMDP, preparation of a Microbat Management Plan (MMP) to outline monitoring protocols to be undertaken prior to construction, during construction and for at least two years into operation to identify changes in the behaviour of bats in and around the roost (if any) will be required. The MMP will be prepared for the proposed works and include the methodology described within Section 8.5 of the BAM 2020 as set out below.

- Description of the proposed development and affected microbat species
- Summary of the survey and results obtained to date
- Baseline data against which monitoring will occur
- Monitoring approach, including frequency, timing and reporting: monitoring program with timeframes (e.g. minimum two-year pre -impact and post impact monitoring), and design requirements (e.g. control sites to ensure that changes in indicators are a result of the development activity as opposed to natural variability)
- Seasonal changes to the resource or relevant to the impacts being monitored

- Information that will be necessary to measure the impact over time
- Measurable thresholds at which impacts are likely to affect the target entities (e.g. quantifiable changes in light levels, noise and human visitation within 2 years of the commencement of the project operational phase)
- Indicators to detect impacts on the target entities (e.g. ultrasonic call activity levels, number of roosting bats, timing of arrival and departure from site, daily timing of emergence, pattern of emergence, changes to flight paths, species condition monitoring)
- Trigger values for the commencement of adaptive management actions
- Adaptive management actions and contingency measures proposed to reduce or eliminate the impact
- Protocols for capturing and releasing healthy microbats
- Protocols for dealing with injured or dead microbats
- Protocols for avoiding exposure to Australian Bat Lyssavirus (ABLV)
- Roles and responsibilities
- Consideration of how the results of the monitoring program could be used to inform ongoing operations in order to reduce the extent of indirect impacts
- Steps to be undertaken once impact thresholds have been triggered (e.g. reporting, results to the consent authority, review of results by an independent panel, changes to future layout to avoid further impacts)
- The process to calculate, and retire, an offset requirement if thresholds are exceeded and impacts occur.

Elements of the MMP relevant to timing and monitoring of construction activities must be included in the Construction Environmental Management Plan (CEMP) or written as a Construction Microbat Management Plan (CMMP) to highlight actions required to minimise impacts to the roost during construction. The CEMP / CMMP will recommend that construction of the elevated pathway and boring of the tunnel housing the jacked box culvert under Longport Street is scheduled for a time of year and time of day when no bats or very few bats are present at the roost

These plans will be implemented to ensure that impacts to bats during the construction and operational phase are minimised, monitored and can be adaptively managed.

5.2.7 Serious and Irreversible Impacts (SAII)

The Large Bent-winged Bat and Little Bent-winged Bats are both listed as candidates for Serious and Irreversible Impacts (SAII) under the BioNet Atlas. SAII for the Little and Large Bent -winged Bat are considered only in relation to breeding habitat for these species. As described in previous sections, the current definition for breeding habitat only includes roosts where pregnant or lactating females, or females carrying young or juvenile bats are present or have previously been recorded. None of these entities were recorded at the site or have previously been recorded at the site. The development site does not contain breeding habitat for these species. Therefore, the development site does not contain SAII entities.

Additionally, PCT 1232 and PCT 1281 are also listed as SAII, however the development site does not contain vegetation which is considered part of the TEC. Therefore, the vegetation within the development site does not contain SAII.

5.3 Impact summary

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

5.3.1 Serious and Irreversible Impacts (SAII)

The development does not contain candidate SAII values as discussed in Section 5.2.7.

5.3.2 Biodiversity credits for prescribed impacts

In accordance with Section 8.6 of the BAM 2020 the retirement of biodiversity credits may be used in conjunction with other conservation measures to mitigate prescribed impacts or indirect impacts of a proposal on areas of native vegetation, TECs and/or threatened species or their habitat adjacent to the development site. Additionally, where actions are described in an adaptive management plan for a prescribed impact which are considered high risk, measures to secure offsets in the event of failure can be proposed in the BDAR. These measures may include the retirement of credits or conservation measures that may benefit the threatened entity.

The project has considered the impacts of the proposed development on threatened entities, in particular the impacts of the development on Large Bent-winged Bat and Little Bent-winged Bat. The response of the bats to the development is considered an unknown factor and difficult to measure. If the Large Bent-winged Bats abandon the Cadigal Reserve roost site as a result of the proposed works, there is currently no acceptable means of offsetting this impact (i.e. providing alternative roosting habitat for the displaced bats). Large Bent-winged Bats are not known to inhabit bat boxes in large aggregations. Although there are a number of other Large Bent-winged Bat roost sites across the Sydney Basin, the status, security and ability of these roosts to absorb any bats displaced from the Cadigal Reserve roost is unknown. The implementation of the AMDP and MMP (which will follow a similar methodology as an adaptive management plan with some additional components) will incorporate some basic comparative studies of other known Large Bent-winged Bat roosts and allow for the project to identify if additional conservation measures are required which will benefit this species. Therefore, this BDAR has not recommended the retirement of credits for these species at this stage but considers it an option to be discussed and agreed upon if circumstances require it.

5.3.3 Impacts requiring offsets

The impacts of the development requiring offset for native vegetation are outlined in Table 27 and shown in Figure 22.

Table 27: Impacts to native vegetation that require offsets

Veg Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
1	1232	Coastal Freshwater Swamp Forest	Coastal Swamp Forests	Forested Wetlands	0.04
2	1281	Sydney Turpentine-Ironbark Forest	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	0.23

5.3.4 Impacts not requiring offsets

The impacts of the development not requiring offset for native vegetation are outlined in Table 28 and shown on Figure 24.

Table 28: Impacts to native vegetation that do not require offsets

Veg zone	PCT ID	PCT name	Vegetation Class	Vegetation Formation	Direct impact (ha)	Rationale
3	1281	Sydney Turpentine-Ironbark Forest	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	0.10	The vegetation integrity score 4.4 was below the minimum threshold (20) above which an offset is required where the PCT is not a representative of a critically endangered ecological community

5.3.5 Areas not requiring assessment

Areas not requiring assessment are shown on Figure 26. These areas have been cleared of native vegetation and do not contain habitat for threatened species. These areas include built environments such as existing concrete pathways (0.33 ha), exotic weeds (0.35 ha), exotic landscape plantings (0.28 ha) and planted native vegetation (0.28 ha) within the development footprint.

5.3.6 Credit summary

The number of ecosystem credits required for the development are outlined in Table 29. A biodiversity credit report is included in Appendix E.

Table 29: Ecosystem credits required

Veg zone	PCT ID	PCT Scientific Name	Credit class	Direct impact (ha)	Credits required
1	1232	Coastal Freshwater Swamp Forest	Coastal Swamp Forests ≥ 90% cleared group (including Tier 1 or higher threat status)	0.04	1
2	1281	Sydney Turpentine-Ironbark Forest	Northern Hinterland Wet Sclerophyll Forests ≥ 90% cleared group (including Tier 1 or higher threat status)	0.23	8

Figure 22: Impacts requiring offset North

Figure 23: Impacts requiring offset South

Figure 24: Impacts not requiring offset North

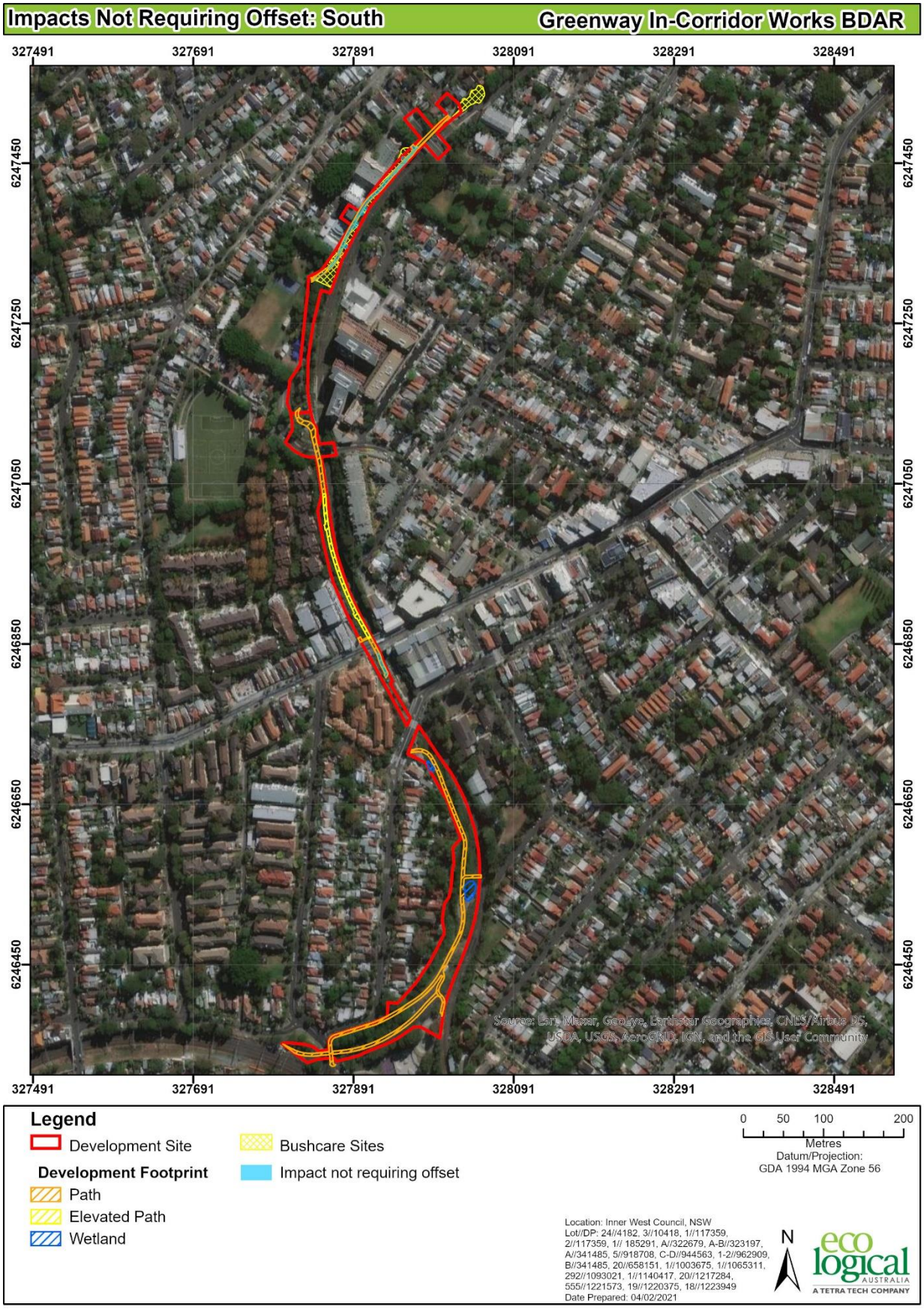

Figure 25: Impacts not requiring offset South

Figure 26: Areas not requiring assessment North

Figure 27: Areas not requiring assessment South

6. Consistency with legislation and policy

6.1 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The EPBC Act establishes a process for assessing the environmental impact of activities and developments where 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 Agriculture, Water and the Environment (DAWE), which is responsible for administering the EPBC Act.

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 (formerly DotEE 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 was undertaken and the following MNES were assessed in accordance with the Significant Impact Guidelines 1.1:

- Grey-headed Flying-fox.

6.1.1 *Pteropus poliocephalus* (Grey-headed Flying-fox)

Grey-headed Flying Fox is listed as a vulnerable species under the BC and EPBC Acts. The species is endemic to the east coast of Australia with a distribution from Bundaberg in the north to Melbourne in the south, from the western slopes of the Great Dividing Range to the coast.

Grey-headed Flying-fox is a highly mobile species whose migration patterns are determined by the availability of flowering food resources. The species is a canopy-feeding frugivore, blossom-eater and nectivore, and occurs in rainforest, woodlands, paperbark swamps and Banksia woodlands. This species feeds in particular on the nectar and pollen of native trees, especially *Eucalyptus* spp., *Melaleuca* spp. and *Banksias* spp., and fruits of rainforest trees and vines. During times when native food resources are limited, Grey-Headed Flying-foxes forage on fruit crops and cultivated gardens (DPIE 2020b).

Roosting camps are generally located next to rivers or creeks and occur in a range of vegetation communities including rainforest, wet sclerophyll forest, *Melaleuca* woodland, *Casuarina* forest or mangroves (DPIE 2020b). These sites have a dense canopy, providing them with the moist, humid microclimate they require. Campsites are critical for mating, birthing, rearing of young and as diurnal refuge from predators. Urban gardens, cultivated fruit crops and roadside verges may also provide temporary roosting habitat for this species

This species is threatened by a number of processes including loss of foraging habitat, disturbance of roosting sites, unregulated shooting, and electrocution on powerlines (DPIE 2020b).

One individual Grey-headed Flying-fox was recorded during the field survey. This species has been previously recorded within the development site from literature review and database records.

Vegetation impacted by the proposed works are likely to provide foraging resources for this species. The development site does not contain current or historic campsites. The nearest roost site or 'camp'

to the development site is Wolli Creek (500 – 2,499 individuals recorded in August 2019) less than 3 km away (DAWE 2020b). One individual was observed roosting in the development site during field surveys.

Table 30: EPBC Act Assessment of Significance - 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 Grey-headed Flying-fox is considered one population due to the constant exchange of genetic material between individuals and its movement between camps throughout its entire geographic range (DAWE 2020c). Maternity or other roosting habitat is considered important habitat for this species. No roosting habitat (i.e. camps) have been recorded within the development site. According to the National Flying-fox Monitoring Program, no camps currently occur or have ever been recorded within the development site (DAWE 2020b). The nearest active Grey-headed Flying-fox camp occurs approximately 3 km to the south-east of the development site, within Wolli Creek (DAWE 2020b). The development site contains 0.31 ha of potential foraging habitat (vegetation zone 1-2) for the Grey-headed Flying-fox. Additional foraging habitat was recorded within the broader locality of the development site, this includes parklands and urban space. Given the proximity of more suitable habitat within the locality of the development site, the removal of this potential foraging habitat would not lead to the long-term decrease in the size of an important population of Grey-headed Flying-fox.
2)	reduce the area of occupancy of an important population	The proposed development will reduce the extent of available foraging habitat for the Grey-headed Flying-fox. About 0.31 ha of potential foraging habitat will be removed. The vegetation within the development site may provide supplementary foraging habitat for this species. The development site does not contain breeding or sheltering habitat (i.e. bat camps). However, one individual was located roosting temporarily within the development site. The Grey-headed Flying-fox is known to fly long distances (up to 50 km per night) and move between bat camps. As such this species is likely to utilise a large extent of habitat around the Wolli Creek camp which may include some habitat within the development site. Due to the extent of habitat within a 50 km radius of the known bat camp at Wolli Creek, the removal of a small amount of native planted vegetation is unlikely to significantly reduce the extent of occupancy for this species.
3)	fragment an existing important population into two or more populations	The proposed development will result in the loss of 0.31 ha of potential foraging habitat in the form of planted native species within the development site. The proposed works will not affect camps. Additionally, due to the planted and highly urbanised nature of the vegetation within the development site, it is likely that the vegetation affected by the development is considered marginal or supplementary foraging habitat for this species. The Grey-headed Flying-fox is a highly mobile species and is considered part of one large population. As the vegetation within the development site is considered supplementary habitat for this species, it is unlikely that the proposed works will result in the fragmentation of populations for this highly mobile species.

Criterion	Question	Response
4)	adversely affect habitat critical to the survival of a species	The Draft Recovery Plan for the Grey-headed Flying-fox 2017 identifies 'a continuous temporal sequence of productive foraging habitats, linked by migration corridors or stopover habitats, and suitable roosting habitat within nightly commuting distance of foraging areas' as habitat critical to the survival of the species. No camps will be affected by the proposed action. The proposed action will remove 0.31 ha of vegetation, some of which comprises suitable foraging habitat for the Grey-headed Flying-fox. The Grey-headed Flying-fox is recorded as travelling long distances (50 km) on feeding forays and suitable habitat is available outside of the development site.
5)	disrupt the breeding cycle of an important population	The proposed action will remove 0.31 ha of vegetation, some of which comprises suitable foraging habitat for the Grey-headed Flying-fox. The proposed action will not disrupt the breeding cycle of the Grey-headed Flying-fox given that no camps will be impacted by the proposed action and suitable foraging habitat is available adjacent to the development site.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will remove 0.31 ha of vegetation, including foraging habitat for the Grey-headed Flying-fox. Grey-headed Flying-fox camps will not be removed, or disturbed, and suitable habitat is available outside of the development site.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action is unlikely to result in the establishment of an invasive species that is harmful to the Grey-headed Flying-fox.
8)	introduce disease that may cause the species to decline, or	Grey-headed Flying-fox are reservoirs for the Australian bat lyssavirus and can cause clinical disease and mortality in Grey-headed Flying-fox. The proposed action would not increase the incidence of this disease.
9)	interfere substantially with the recovery of the species.	A Draft National Recovery Plan for the Grey-headed Flying-fox was developed in 2017. The relatively small amount of foraging habitat to be removed is unlikely to substantially interfere with the recovery of this species.
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on the Grey-headed Flying-fox for the following reasons: • No camps will be removed by the proposed action. More suitable foraging habitat for this highly mobile species is available outside of the development site.

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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 development site. In cases where multiple populations occur in the development site or a population occupies part of the development site, 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
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.
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.

Terminology	Definition
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 Species list

Family	*Species Name*	Common Name	Exotic (*)
Altingiaceae	*Liquidambar styraciflua*	American Sweetgum	*
Apiaceae	*Foeniculum vulgare*	Fennel	*
Apocynaceae	*Araujia sericifera*	Moth Vine	*
Apocynaceae	*Nerium oleander*	Oleander	*
Araliaceae	*Hedera helix*	English Ivy	*
Arecaceae	*Phoenix canariensis*	Canary Island Date Palm	*
Asparagaceae	*Yucca* sp.		*
Asteraceae	*Ageratina adenophora*	Crofton Weed	*
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*
Asteraceae	*Hypochaeris radicata*	Flatweed	*
Asteraceae	*Lactuca* sp.		*
Asteraceae	*Senecio madagascariensis*	Fireweed	*
Asteraceae	*Sonchus asper*	Prickly Sowthistle	*
Basellaceae	*Anredera cordifolia*	Madeira Vine	*
Binoniaceae	*Jacaranda mimosifolia*	Jacaranda	*
Brassicaceae	*Brassica* spp.		*
Cannabaceae	*Celtis sinensis*	Japanese Hackberry	*
Casuarinaceae	*Casuarina cunninghamiana*	River Oak	
Casuarinaceae	*Casuarina glauca*	Swamp Oak	
Chenopodiaceae	*Chenopodium album*	Fat Hen	*
Commelinaceae	*Commelina cyanea*	Scurvy Weed	
Commelinaceae	*Tradescantia fluminensis*	Trad	*
Convolvulaceae	*Dichondra repens*	Kidney Weed	
Convolvulaceae	*Ipomoea indica*	Morning Glory	*
Cunoniaceae	*Callicoma serratifolia*	Black Wattle	
Cuppressaceae	*Sequoia sempervirens*	Coastal Redwoods	*
Dilleniaceae	*Hibbertia* sp.		
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash	
Euphorbiaceae	*Ricinus communis*	Castor Oil Plant	*
Euphorbiaceae	*Triadica sebifera*	Chinese Tallow	*
Fabaceae (Faboideae)	*Acacia implexa*	Hickory Wattle	
Fabaceae (Faboideae)	*Dillwynia retorta*		
Fabaceae (Faboideae)	*Erythrina x sykesii*	Coral Tree	*
Fabaceae (Faboideae)	*Genista monspessulana*	Montpellior Broom	*

Family	*Species Name*	Common Name	Exotic (*)
Fabaceae (Faboideae)	*Glycine clandestina*	Love Creeper	
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla	
Fabaceae (Faboideae)	*Kennedia rubicunda*	Dusky Coral Pea	
Fabaceae (Faboideae)	*Senna pendula*		*
Fabaceae (Faboideae)	*Trifolium repens*	White Clover	*
Fabaceae (Mimosoideae)	*Acacia decurrens*	Black Wattle	
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally Wattle	
Fabaceae (Mimosoideae)	*Acacia myrtifolia*	Red-stemmed Wattle	
Fabaceae (Mimosoideae)	*Acacia parramattensis*	Parramatta Wattle	
Fabaceae (Mimosoideae)	*Acacia saligna*	Golden Wreath Wattle	*
Lamiaceae	*Westringia fruticosa*	Coastal Rosemary	
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*
Liliaceae	*Lilium formosanum*	Formosan Lily	*
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	
Malvaceae	*Brachychiton populneus*	Kurrajong	
Malvaceae	*Malva parviflora*	Small-flowered Mallow	*
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*
Moraceae	*Ficus coronata*	Sandpaper Fig	
Moraceae	*Ficus macrophylla*	Moreton Bay Fig	
Moraceae	*Morus alba*	Mulberry	*
Myrtaceae	*Acmena smithii*	Lilly Pilly	
Myrtaceae	*Angophora costata*	Smooth-barked Apple	
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush	
Myrtaceae	*Callistemon salignus*	Willow Bottebrush	
Myrtaceae	*Corymbia eximia*	Yellow Bloodwood	
Myrtaceae	*Corymbia maculata*	Spotted Gum	
Myrtaceae	*Eucalyptus amplifolia* subsp. *amplifolia*	Cabbage Gum	
Myrtaceae	*Eucalyptus botryoides*	Bangalay	
Myrtaceae	*Eucalyptus microcorys*	Tallowwood	
Myrtaceae	*Eucalyptus paniculata*	Grey Ironbark	
Myrtaceae	*Eucalyptus punctata*	Grey Gum	
Myrtaceae	*Eucalyptus saligna*	Syndey Blue Gum	

Family	*Species Name*	Common Name	Exotic (*)
Myrtaceae	*Eucalyptus sideroxylon*	Mugga Ironbark	
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	
Myrtaceae	*Kunzea ambigua*	Tick Bush	
Myrtaceae	*Leptospermum parvifolium*		
Myrtaceae	*Lophostemon confertus*	Brush Box	
Myrtaceae	*Melaleuca decora*	White-feathered Honey Myrtle	
Myrtaceae	*Melaleuca quinquenervia*	Prickly-leaved Paperbark	
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Paperbark	
Myrtaceae	*Syncarpia glomulifera*	Turpentine	
Myrtaceae	*Tristaniopsis laurina*	Water Gum	
Ochnaceae	*Ochna serrulata*	Mickey Mouse Plant	*
Oleaceae	*Ligustrum lucidum*	Broad-leaf Privet	*
Oleaceae	*Ligustrum sinense*	Small-leaf Privet	*
Oleaceae	*Olea europaea subsp. cuspidata*	African Olive	*
Oxalidaceae	*Oxalis spp.*		
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree	
Pittosporaceae	*Bursaria spinosa* subsp. *spinosa*	Blackthorn	
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	
Plantaginaceae	*Plantago lanceolata*	Plantain	*
Platanaceae	*Platanus x hybridus*	London Plane Tree	*
Poaceae	*Arundo* sp.		*
Poaceae	*Bromus catharticus*	Prairie Grass	*
Poaceae	*Cenchrus clandestinus*	Kikuyu	*
Poaceae	*Chloris gayana*	Rhodes Grass	*
Poaceae	*Cortaderia selloana*	Pampas Grass	*
Poaceae	*Ehrharta erecta*	Vasey Grass	*
Poaceae	*Eragrostis curvula*	African Lovegrass	*
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass	
Poaceae	*Microlaena stipoides*	Weeping Meadow Grass	
Poaceae	*Oplismenus aemulus*	Australian Basket Grass	
Poaceae	*Paspalum dilatatum*		*
Poaceae	*Phyllostachys aurea*	Bamboo	*
Poaceae	*Poa annua*	Annual Poa	*
Poaceae	*Setaria parviflora*	Slender Pigeon Grass	*

Family	*Species Name*	Common Name	Exotic (*)
Poaceae	*Themeda triandra*	Kangaroo Grass	
Polygonaceae	*Acetosa sagittata*	Turkey Rhubarb	*
Primulaceae	Anagallis arvensis	Scarlet Pimpernel	*
Proteaceae	*Banksia integrifolia*	Coast Banksia	
Proteaceae	*Grevillea robusta*	Silky Oak	
Rosaceae	*Cotoneaster glaucophyllus*	Cotoneaster	*
Rosaceae	*Rubus fruticosus*	Blackberry	*
Rubiaceae	*Galium aparine*	Cleavers	*
Sapindaceae	*Cardiospermum grandiflorum*	Balloon Vine	*
Solanaceae	*Cestrum parqui*	Green Cestrum	*
Solanaceae	*Solanum mauritianum*	Wild Tobacco	*
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*
Ulmaceae	*Ulmus parvifolia*	Chinese Elm	*
Urticaceae	*Parietaria judaica*	Asthma Weed	*
Verbenaceae	*Lantana camara*	Lantana	*
Verbenaceae	*Verbena bonariensis*	Purple Tops	*

Appendix C Vegetation plot data

Table 31: Species matrix (species recorded by plot)

Stratum	Form	Scientific name	Exotic (*)	High Threat Weed	Cover % Plot 1	Cover % Plot 2	Cover % Plot 3	Cover % Plot 4
M	Tree (TG)	*Acacia decurrens*				0.2		
M	Shrub (SG)	*Acacia falcata*						0.5
M	Shrub (SG)	*Acacia implexa*				0.5		
M	Shrub (SG)	*Acacia longifolia subsp. sophorae*				0.4	0.3	0.1
M	Shrub (SG)	*Acacia myrtifolia*						0.1
M	Tree (TG)	*Acacia parramattensis*					0.3	
M	Shrub (SG)	*Acacia suaveolens*					0.1	
G		*Acetosa sagittata*	*	1	0.1	45		0.1
U	Tree (TG)	*Acmena smithii*				0.4		
G		*Ageratina adenophora*	*	1	0.1			0.2
M	Tree (TG)	*Allocasuarina torulosa*				0.2	0.1	
U	Tree (TG)	*Alphitonia excelsa*						0.3
G		*Ambrosia spp.*	*		0.1			
G		*Andropogon virginicus*	*	1				0.2
U	Tree (TG)	*Angophora costata*				0.3	0.3	
G		*Anredera cordifolia*	*	1	2			
G		*Araujia sericifera*	*	1		0.1		
G		*Avena barbata*	*					0.3
G		*Bidens pilosa var. pilosa*	*		0.1	0.1	0.1	0.1
M	Shrub (SG)	*Breynia oblongifolia*					0.2	
G		*Bromus catharticus*	*		3			
G	Forb (FG)	*Brunoniella australis*					0.1	

Stratum	Form	Scientific name	Exotic (*)	High Threat Weed	Cover % Plot 1	Cover % Plot 2	Cover % Plot 3	Cover % Plot 4
M	Shrub (SG)	*Bursaria spinosa subsp. spinosa*					0.1	
M	Shrub (SG)	*Callistemon citrinus*				0.2	0.2	
M	Tree (TG)	*Callistemon viminalis*				0.3		
G	Grass & grasslike (GG)	*Carex appressa*					0.1	
G		*Carex divulsa*	*		0.1			
U	Tree (TG)	*Casuarina glauca*				10		
M		*Celtis sinensis*	*		2	0.2	0.1	
G		*Cenchrus clandestinus*	*	1	0.1			
M		*Cestrum parqui*	*	1	0.5	5		
G		*Chenopodium album*	*				0.1	
U		*Cinnamomum camphora*	*	1	0.2			5
G	Other (OG)	*Cissus antarctica*					0.1	
G	Other (OG)	*Clematis aristata*					0.1	
G	Forb (FG)	*Commelina cyanea*			0.1		0.2	
G		*Conyza bonariensis*	*		0.1	0.1		0.1
M		*Cortaderia selloana*	*	1				0.1
U	Tree (TG)	*Cupaniopsis anacardioides*					0.1	
G	Grass & grasslike (GG)	*Cymbopogon refractus*						0.2
G		*Cyperus involucratus*	*		0.2			
G	Forb (FG)	*Dianella caerulea var. caerulea*				0.2	0.3	1
G	Forb (FG)	*Dichondra repens*					5	
G		*Dipogon lignosus*	*			0.1		0.1
M	Shrub (SG)	*Dodonaea triquetra*						0.2
G		*Ehrharta erecta*	*	1	15	0.5	10	0.2

Stratum	Form	Scientific name	Exotic (*)	High Threat Weed	Cover % Plot 1	Cover % Plot 2	Cover % Plot 3	Cover % Plot 4
G	Grass & grasslike (GG)	*Entolasia marginata*					0.1	
G		*Eragrostis curvula*	*	1	0.2			
U	Tree (TG)	*Eucalyptus punctata*					7	
G		*Euphorbia peplus*	*				0.2	
U	Tree (TG)	*Ficus rubiginosa*				0.2	0.3	
M		*Foeniculum vulgare*	*					0.1
G	Grass & grasslike (GG)	*Gahnia clarkei*					0.2	
G		*Galium aparine*	*		0.1			
G		*Gamochaeta calviceps*	*		0.1			
G	Forb (FG)	*Geranium homeanum*					0.2	
M	Tree (TG)	*Glochidion ferdinandi var. ferdinandi*					4	
G		*Gomphocarpus fruticosus*	*					0.3
M	Tree (TG)	*Grevillea robusta*			3			
M	Shrub (SG)	*Hakea dactyloides*					0.2	
G	Other (OG)	*Hardenbergia violacea*						0.2
G		*Hedera helix*	*	1	0.1			
G	Other (OG)	*Hibbertia scandens*					0.1	
M	Shrub (SG)	*Homalanthus populifolius*				0.2	0.2	
G		*Hypochaeris radicata*	*					0.1
M	Shrub (SG)	*Indigofera australis*					0.1	
G	Grass & grasslike (GG)	*Isolepis spp.*						0.1
G	Grass & grasslike (GG)	*Juncus usitatus*					0.1	0.1

Stratum	Form	Scientific name	Exotic (*)	High Threat Weed	Cover % Plot 1	Cover % Plot 2	Cover % Plot 3	Cover % Plot 4
M	Shrub (SG)	*Kunzea ambigua*				0.2		0.5
G		*Lactuca saligna*	*					0.1
M		*Lantana camara*	*	1				0.5
M	Shrub (SG)	*Leptospermum polygalifolium subsp. polygalifolium*					0.3	
M	Other (OG)	*Livistona australis*					0.2	
G	Forb (FG)	*Lobelia purpurascens*					0.1	
G	Grass & grasslike (GG)	*Lomandra longifolia*				0.2	2	0.6
U	Tree (TG)	*Lophostemon confertus*			35		5	
M	Shrub (SG)	*Melaleuca decora*					5	
M	Shrub (SG)	*Melaleuca hypericifolia*					0.1	
M	Tree (TG)	*Melaleuca quinquenervia*					0.3	
M	Shrub (SG)	*Melaleuca styphelioides*					0.5	
M	Tree (TG)	*Melia azedarach*				0.1		
G		*Melinis repens*	*					0.3
G	Grass & grasslike (GG)	*Microlaena stipoides var. stipoides*					0.4	
M		*Morus alba*	*			0.1		
M		*Ochna serrulata*	*	1	0.2			0.2
G	Grass & grasslike (GG)	*Oplismenus aemulus*					3	
G		*Oxalis corniculata*	*		0.1			
M	Shrub (SG)	*Ozothamnus diosmifolius*						0.2
G		*Panicum capillare var. capillare*	*					0.1
G		*Parietaria judaica*	*		0.5	10		0.1
G		*Physalis peruviana*	*			1		

Stratum	Form	Scientific name	Exotic (*)	High Threat Weed	Cover % Plot 1	Cover % Plot 2	Cover % Plot 3	Cover % Plot 4
G	Shrub (SG)	*Pimelea linifolia subsp. caesia*					0.1	
M	Shrub (SG)	*Pittosporum undulatum*				0.3	1	
G		*Plantago lanceolata*	*		0.1			
G		*Poa annua*	*		0.1			
G		*Polygonum arenastrum*	*		0.2			
G		*Rumex conglomeratus*	*				0.1	
G		*Sida rhombifolia*	*			0.1		0.1
M		*Solanum nigrum*	*			0.1		0.1
M		*Solanum seaforthianum*	*	1			0.1	
G		*Soliva sessilis*	*		0.1			
G		*Sonchus oleraceus*	*		0.1			
U	Tree (TG)	*Symplocos thwaitesii*					6	
U	Tree (TG)	*Syncarpia glomulifera subsp. glomulifera*					1	
U	Shrub (SG)	*Syzygium australe*					10	
G		*Taraxacum officinale*	*		0.2			
G	Grass & grasslike (GG)	*Themeda triandra*					0.1	
G		*Toxicodendron succedaneum*	*					0.3
G		*Triadica sebifera*	*	1			0.1	
G		*Trifolium repens*	*		0.1			
M	Tree (TG)	*Tristaniopsis laurina*						1
G		*Verbena bonariensis*	*					0.1
G		*Verbena rigida var. rigida*	*			0.2		

Key: U = Upper, M= Middle, G = Ground. EG = Fern, FG = Forb, GG = Grass & grasslike, OG = Other, SG = Shrub, TG = Tree.

Table 32: Plot location data

Plot no.	PCT	Vegetation Zone	Condition	Zone	Easting	Northing	Bearing (°)
1	1281	0	Native vegetation	56	327928	6246389	258
2	1232	1	Planted	56	328735	6248566	352
3	1281	2	Planted	56	328379	6248354	136
4	1281	3	Shrubs	56	327904	6246842	113

Table 33: Vegetation integrity data (Composition, Structure and function)

Composition (number of species)						
Plot no.	Tree	Shrub	Grass	Forb	Fern	Other
1	2	0	0	1	0	0
2	8	6	1	1	0	0
3	11	15	8	6	0	4
4	2	6	4	1	0	1

Structure (Total cover %)						
Plot no.	Tree	Shrub	Grass	Forb	Fern	Other
1	38	0	0	0.1	0	0
2	11.7	1.8	0.2	0.2	0	0
3	24.4	18.4	6	5.9	0	0.5
4	1.3	1.6	1	1	0	0.2

Function												
Plot no.	Large Trees (DBH > 50 cm)	Hollow trees	Litter Cover (%)	Length Fallen Logs (m)	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 Stem 80+ cm	Tree Regen	High Threat Weed Cover (%)
1	6	0	64.6	0	0	0	0	1	1	1	0	18.5
2	1	0	51.6	0	1	1	1	1	1	0	0	54.3
3	1	0	11	1	1	1	1	1	1	0	1	10.2
4	0	0	60.4	0	0	0	0	0	0	0	1	6.5

Note: For stem size classes: 0 = Absence, 1 = Presence.

Appendix D EPBC Act Likelihood of Occurrence

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Only species listed under the EPBC Act were included in the assessment. Species listed only under the BC Act were assessed as part of determining credit species included in the BAMC. 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:

- "known" = 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.

A test of significance was conducted for threatened species that were recorded within the development site or had a higher likelihood of occurring and were not recorded during the site visit. It is noted that some threatened fauna species that are highly mobile, wide ranging and vagrant may use portions of the development 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, a test of significance in reference to Commonwealth legislation was not considered necessary.

The records column refers to the number of records occurring within 5 km of the development site, as provided by the Atlas of NSW Wildlife (BioNet) and Protected Matters Search Tool database search.

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

Table 34: Likelihood of occurrence assessment for threatened flora and fauna species.

Scientific name	Common name	EPBC Act	Distribution and Habitat	BioNet records within 5 km	Likelihood of occurrence within development site	Impact Assessment Required
			FAUNA			
Actitis hypoleucos	Common Sandpiper	M	Summer migrant. In NSW, widespread along coastline and also occurs in many areas inland. Coastal wetlands and some inland wetlands, especially muddy margins or rocky shores. Also estuaries and deltas, lakes, pools, billabongs, reservoirs, dams and claypans, mangroves.	3	Unlikely – marginal habitat present within the site boundary of Sydney Science Park, but no local records, not observed during targeted migratory bird survey.	No
Anthochaera phrygia	Regent Honeyeater	CE	Inland slopes of south-east Australia, and less frequently in coastal areas. In NSW, most records are from the North-West Plains, North-West and South-West Slopes, Northern Tablelands, Central Tablelands and Southern Tablelands regions; also recorded in the Central Coast and Hunter Valley regions. Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of *Casuarina cunninghamiana*.	2	Unlikely – marginal habitat present within the development site, but no local records, not observed during surveys.	No
Apus pacificus	Fork-tailed Swift	M	Recorded in all regions of NSW. Riparian woodland., swamps, low scrub, heathland, saltmarsh, grassland, Spinifex sandplains, open farmland and inland and coastal sand-dunes.	1	Unlikely – marginal habitat present within the development site, but no local records, not observed during surveys.	No
Botaurus poiciloptilus	Australasian Bittern	E	Found over most of NSW except for the far north-west. Permanent freshwater wetlands with tall, dense vegetation, particularly *Typha* spp. (bullrushes) and *Eleocharis* spp. (spikerushes).	2	Unlikely – marginal habitat present within the site boundary of Sydney Science Park, but no local records, not observed during targeted migratory bird survey.	No
Chalinolobus dwyeri	Large-eared Pied Bat	V	Recorded from Rockhampton in Qld south to Ulladulla in NSW. Largest concentrations of populations occur in the sandstone escarpments of the Sydney basin and the NSW north-west slopes. Wet and dry sclerophyll forests, Cyprus Pine dominated forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country.	0	Unlikely - no nearby roosting habitat in the form of caves, cliffs or sandstone overhangs, no local records, not identified during targeted microbat surveys.	No

Scientific name	Common name	EPBC Act	Distribution and Habitat	BioNet records within 5 km	Likelihood of occurrence within development site	Impact Assessment Required
Dasyurus maculatus	Spotted-tailed Quoll	E	Found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Qld. Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	0	Unlikely - habitat connectivity is fragmented within the urbanised locality such that this species is unlikely to be present, no local records	No
Gallinago hardwickii	Latham's Snipe	M	Migrant to east coast of Australia, extending inland west of the Great Dividing Range in NSW. Freshwater, saline or brackish wetlands up to 2000 m above sea-level; usually freshwater swamps, flooded grasslands or heathlands.	6	Unlikely – suitable habitat for this species was not recorded within the development site.	No
Grantiella picta	Painted Honeyeater	V	Widely distributed in NSW, predominantly on the inland side of the Great Dividing Range but avoiding arid areas. Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	0	Unlikely - preferred vegetation type not present, abundant mistletoe not present at require density, no local records.	No
Heleioporus australiacus	Giant Burrowing Frog	V	South eastern NSW and Victoria, in two distinct populations: a northern population in the sandstone geology of the Sydney Basin as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	0	Unlikely - suitable habitat not present, species prefers sandstone influenced soils.	No
Hirundapus caudacutus	White-throated Needletail	M	All coastal regions of NSW, inland to the western slopes and inland plains of the Great Divide. Occur most often over open forest and rainforest, as well as heathland, and remnant vegetation in farmland.	4	Unlikely – marginal habitat present within the development site, but no local records, not observed during surveys.	No
Lathamus discolor	Swift Parrot	CE	Migrates from Tasmania to mainland in Autumn-Winter. In NSW, the species mostly occurs on the coast and south west slopes. Box-ironbark forests and woodlands.	0	Unlikely – marginal foraging habitat available within the development site, however preferred vegetation type not present, no local records.	No

Scientific name	Common name	EPBC Act	Distribution and Habitat	BioNet records within 5 km	Likelihood of occurrence within development site	Impact Assessment Required
Litoria aurea	Green and Golden Bell Frog	V	Since 1990, recorded from ~50 scattered sites within its former range in NSW, from the north coast near Brunswick Heads, south along the coast to Victoria. Records exist west to Bathurst, Tumut and the ACT region. Marshes, dams and stream-sides, particularly those containing *Typha* spp. (bullrushes) or *Eleocharis* spp. (spikerushes). Some populations occur in highly disturbed areas.	208	Unlikely – species not detected during targeted surveys.	No
Merops ornatus	Rainbow Bee-eater	M	Distributed across much of mainland Australia, including NSW. Open forests and woodlands, shrublands, farmland, areas of human habitation, inland and coastal sand dune systems, heathland, sedgeland, vine forest and vine thicket.	0	Unlikely – marginal habitat present within the development site, but no local records, not observed during surveys.	No
Monarcha melanopsis	Black-faced Monarch	M	In NSW, occurs around the eastern slopes and tablelands of the Great Divide, inland to Coutts Crossing, Armidale, Widden Valley, Wollemi National Park and Wombeyan Caves. It is rarely recorded farther inland. Rainforest, open eucalypt forests, dry sclerophyll forests and woodlands, gullies in mountain areas or coastal foothills, Brigalow scrub, coastal scrub, mangroves, parks and gardens.	0	Unlikely – suitable habitat not present within the development site, no local records.	No
Motacilla flava	Yellow Wagtail	M	Regular summer migrant to mostly coastal Australia. In NSW recorded Sydney to Newcastle, the Hawkesbury and inland in the Bogan LGA. Swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land, lawns.	0	Unlikely – marginal habitat present within the development site, but no local records, not observed during surveys.	No
Myiagra cyanoleuca	Satin Flycatcher	M	In NSW, widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains. Eucalypt-dominated forests, especially near wetlands, watercourses, and heavily-vegetated gullies.	0	Unlikely – marginal habitat present within the development site, but no local records, not observed during surveys.	No
Numenius madagascariensis	Eastern Curlew	CE, M	Summer migrant to Australia. Primarily coastal distribution in NSW, with some scattered inland records. 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 within the development site, no local records.	No

Scientific name	Common name	EPBC Act	Distribution and Habitat	BioNet records within 5 km	Likelihood of occurrence within development site	Impact Assessment Required
Petrogale penicillata	Brush-tailed Rock-wallaby	V	In NSW they occur from the Qld border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.	0	Unlikely – suitable habitat not present within the development site, no local records.	No
Pseudomys novaehollandiae	New Holland Mouse	V	Fragmented distribution across eastern NSW. Open heathlands, woodlands and forests with a heathland understorey, vegetated sand dunes.	0	Unlikely – suitable habitat not present within the development site, no local records.	No
Pteropus poliocephalus	**Grey-headed Flying-fox**	**V**	**Along the eastern coast of Australia, from Bundaberg in Qld to Melbourne in Victoria. Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.**	**1299**	**Recorded within the development site**	**Yes**
Rhipidura rufifrons	Rufous Fantail	M	Coastal and near coastal districts of northern and eastern Australia, including on and east of the Great Divide in NSW. Wet sclerophyll forests, subtropical and temperate rainforests. Sometimes drier sclerophyll forests and woodlands.	0	Unlikely – suitable habitat not present within the development site, no local records.	No
Tringa nebularia	Common Greenshank	M	Summer migrant to Australia. Recorded in most coastal regions of NSW; also widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes, and north-west regions. 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).	1	Unlikely – marginal habitat present within the site boundary of Sydney Science Park, but no local records, not observed during targeted migratory bird survey.	No
			FLORA			

Scientific name	Common name	EPBC Act	Distribution and Habitat	BioNet records within 5 km	Likelihood of occurrence within development site	Impact Assessment Required
Acacia bynoeana	Bynoe's Wattle	V	Found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. Heath or dry sclerophyll forest on sandy soils.	3	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	No
Acacia pubescens	Downy Wattle	V	Restricted to the Sydney region around the Bankstown-Fairfield-Rookwood and Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Open woodland and forest, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Occurs on alluviums, shales and at the intergrade between shales and sandstones.	7	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	No
Acacia terminalis subsp. *terminalis*	Sunshine Wattle	E1	Limited mainly to near-coastal areas from the northern shores of Sydney Harbour south to Botany Bay. It grows in coastal scrub and dry sclerophyll woodland on sandy soils.	2	Unlikely. Suitable habitat not present due to high level of modified vegetation of the development site.	No
Allocasuarina glareicola		E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Castlereagh woodland on lateritic soil. Found in open woodland with *Eucalyptus parramattensis, E. fibrosa, Angophora bakeri, E. sclerophylla* and *Melaleuca decora.*	0	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	No
Caladenia tessellata	Thick Lip Spider Orchid	V	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. Grassy sclerophyll woodland on clay loam or sandy soils, or low woodland with stony soil.	2	Unlikely. Suitable habitat not present due to high level of modified vegetation of the development site.	No
Cryptostylis hunteriana	Leafless Tongue Orchid	V	It is known from a range of vegetation communities including swamp-heath and woodland. The larger populations typically occur in woodland dominated by *Eucalyptus sclerophylla* (Scribbly Gum), *E. sieberi* (Silvertop Ash), *Corymbia gummifera* and *Allocasuarina littoralis* (Black Sheoak); where it appears to prefer open areas in the understorey of this community and is often found in association with *C. subulata* (Large Tongue Orchid) and *C. erecta* (Tartan Tongue Orchid).	0	Unlikely. Suitable habitat not present due to high level of modified vegetation of the development site.	No

Scientific name	Common name	EPBC Act	Distribution and Habitat	BioNet records within 5 km	Likelihood of occurrence within development site	Impact Assessment Required
Darwinia biflora	-	V	Woodland, open forest or scrub-heath on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone.	0	Unlikely. Suitable habitat not present due to high level of modified vegetation of the study area.	No
Eucalyptus camfieldii	Camfield's Stringybark	V	Narrow band from the Raymond Terrace area south to Waterfall. Grows In coastal heath on shallow sandy soils overlying Hawkesbury sandstone, mostly on exposed sandy ridges.	0	Unlikely. Suitable habitat not present due to high level of modified vegetation of the study area.	No
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	Grassy open forest or woodland on poor sandy loams, most commonly on gently sloping or flat sites.	2	This species does not occur locally.	No
Genoplesium baueri	Bauer's Midge Orchid	E	Has been recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. Dry sclerophyll forest and moss gardens over sandstone.	0	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	No
Melaleuca deanei	Deane's Paperbark	V	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. Heath on sandstone.	8	Unlikely. Suitable habitat not present due to high level of modified vegetation of the study area.	No
Melaleuca biconvexa	Biconvex Paperbark	V	Only found in NSW, populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Damp places, often near streams or low-lying areas on alluvial soils.	0	Unlikely. Suitable habitat not present due to high level of modified vegetation of the study area.	No
Persicaria elatior	Tall Knotweed	V	In south-eastern NSW recorded from Mt Dromedary, Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). Beside streams and lakes, swamp forest or disturbed areas.	0	No - species not observed during targeted survey.	No
Persoonia hirsuta	Hairy Geebung	E	Scattered distribution around Sydney, from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to	2	No - suitable habitat not recorded within the development site, species	No

Scientific name	Common name	EPBC Act	Distribution and Habitat	BioNet records within 5 km	Likelihood of occurrence within development site	Impact Assessment Required
			the west. Sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.		not observed during surveys, no local records.	
Pimelea curviflora var. curviflora		V	Confined to the coastal area of the Sydney and Illawarra regions between northern Sydney and Maroota in the north-west and Croom Reserve near Albion Park in the south. Woodland, mostly on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes.	1	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	No
Pimelea spicata	Spiked Rice-flower	E	Two disjunct areas; the Cumberland Plain (Marayong and Prospect Reservoir south to Narellan and Douglas Park) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). Well-structured clay soils. Eucalyptus moluccana (Grey Box) communities and in areas of ironbark on the Cumberland Plain. Coast Banksia open woodland or coastal grassland in the Illawarra.	0	No - species not observed during targeted survey.	No
Prostanthera marifolia	Seaforth Mintbush	CE	Only known from the northern Sydney suburb of Seaforth. In or in close proximity to the endangered Duffys Forest ecological community, on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses.	1	Unlikely. Suitable habitat not present due to high level of modified vegetation of the study area.	No
Syzygium paniculatum	Magenta Lilly Pilly	V	Only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. Subtropical and littoral rainforest on gravels, sands, silts and clays.	19	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	No
Tetratheca juncea	Black-eyed Susan	V	Occurs on predominantly low nutrient soils with a dense grassy understorey of grasses although it has been recorded in heathland and moist forest (DPIE 2020b). It is associated with dry open forest or woodland habitats dominated by *Corymbia gummifera*, *Eucalyptus capitellata*, *E. haemastoma* and *Angophora costata*. *Themeda australis* is generally the dominant ground cover. *T. juncea* also displays a preference for southern aspect slopes, although is slopes with different aspects (DPIE 2020b). Flowers July to December.	15	Unlikely. Suitable habitat not present due to high level of modified vegetation of the study area.	No

Scientific name	Common name	EPBC Act	Distribution and Habitat	BioNet records within 5 km	Likelihood of occurrence within development site	Impact Assessment Required
Thesium australe	Austral Toadflax	V	In eastern NSW it is found in very small populations scattered along the coast, and from the Northern to Southern Tablelands. Grassland on coastal headlands or grassland and grassy woodland away from the coast.	0	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	No

Key: M = Migratory, CD = Conservation Dependent, CE = Critically Endangered, E = Endangered, V = Vulnerable, X = Extinct

Appendix E : Biodiversity credit report

BAM Credit Summary Report

Proposal Details

Assessment Id 00023273/BAAS18159/20/00023274	Proposal Name Greenway	BAM data last updated * 21/12/2020
Assessor Name Belinda Jane Failes	Report Created 05/02/2021	BAM Data version * 36
Assessor Number BAAS18159	BAM Case Status Open	Date Finalised To be finalised
Assessment Revision 0	Assessment Type Part 5 Activities	

* 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	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Coastal freshwater swamp forest											
1	1232_planted	Not a TEC	25.3	25.3	0.04			High Sensitivity to Potential Gain	2.50		1
										Subtotal	**1**

BAM Credit Summary Report

Sydney Turpentine - Ironbark forest											
2	1281_planted	Not a TEC	54.3	54.3	0.23			High Sensitivity to Potential Gain	2.50		8
3	1281_shrubs	Not a TEC	4.4	4.4	0.1			High Sensitivity to Potential Gain	2.50		0
										Subtotal	**8**
										Total	**9**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits

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