Biodiversity Development Assessment Report Demolition Stage

Lot 61 DP 737386
55 Coonara Avenue
West Pennant Hills
The Hills LGA

For: Mirvac

REF: HiSC 15-770

8th August 2021

Keystone Ecological Pty Ltd
abn 13 099 456 149
PO Box 5095 Empire Bay NSW 2257
telephone 1300 651 021
email office@keystone-ecological.com.au

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08.10.2020	2.1	Final report (BAM 2017) - for issue
26.02.2021	3.0	Updated report (BAM 2020) - for issue
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Authors:
Elizabeth Ashby and Ashleigh McTackett

Team contributions:

Accredited Assessor	BOAMs Assessor number	Main role	BDAR contribution
Elizabeth Ashby	BAAS17045	Lead Assessor	• Field surveys – flora and fauna in accordance with BAM 2020 • Drafting and editing of BDAR • Final review of BDAR (all components) • Finalising BDAR
Ashleigh McTackett	BAAS20028	Assisting Assessor	• Field surveys and survey assistant for BAM related surveys (BAM plots, Powerful Owl surveys) • Assembling BDAR in accordance with Appendix L of BAM • Drafting of BDAR in accordance with Table 28 of BAM (Chapters 1 to 12 and Appendices).

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Keystone Ecological
Flora and Fauna Specialists

Mail: PO Box 5095 Empire Bay NSW 2257
Telephone: (02) 4368 1106
Email: office@keystone-ecological.com.au
ABN: 13 099 456 149

Cover photograph: View of planted native vegetation within the demolition footprint.

Photo: E. Ashby

DEFINITIONS

Some terms require definition for the Biodiversity Development Assessment Report and largely include those as per the *Biodiversity Conservation (BC) Act 2016* and Biodiversity Assessment Method (2020) for matters listed under NSW legislation.

BAM: The Biodiversity Assessment Method (2020).

Critically endangered ecological community (CEEC): an ecological community specified as critically endangered in Schedule 2 of the *BC Act 2016* and/or listed under Part 13, Division 1, Subdivision A of the *EPBC Act 1999*.

Development: has the same meaning as development at section 4, or an activity in Part 5, or development as defined in section 115T of the *NSW Environmental Planning and Assessment Act 1979* (*EPA Act 1979*).

Development footprint / demolition footprint: the area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials. It is also taken to include the clearing footprint, except where the reference is to a small area development or major project development.

Development site: an area of land that is subject to a proposed development that is under the *EPA Act 1979*. It is also taken to include the clearing footprint, except where the reference is to a small area development or major project development.

DIWA: Directory of Important Wetlands.

Endangered ecological community (EEC): an ecological community specified as endangered in Schedule 2 of the *BC Act 2016*, or listed under the *EPBC Act 1999*.

Habitat: an area or areas occupied, or periodically or occasionally occupied, by a species or ecological community, including any biotic or abiotic component.

Habitat component: the component of habitat that is used by a threatened species for either breeding, foraging, or shelter.

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. Also referred to as high threat weeds or high threat exotic vegetation. Plants considered to be high threat weeds are listed on the high threat weeds list published in the BAM-C.

Hollow-bearing tree: a living or dead tree that has at least one hollow. A tree is considered to contain a hollow for the purposes of the BAM if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1 metre above the ground. Trees must be examined from all angles. Trees with basal hollows are still considered as hollow habitat but not included in the BAM-C.

IBRA region: a bioregion identified under the Interim Biogeographic Regionalisation for Australia (IBRA) system, which divides Australia into bioregions on the basis of their dominant landscape-scale attributes.

IBRA subregion: a subregion of a bioregion identified under the IBRA system.

Major project: State Significant Development and State Significant Infrastructure.

Native ground cover: all native vegetation below 1 metre in height, including all such species native to NSW (i.e. not confined to species indigenous to the area).

Native ground cover (grasses): native ground cover composed specifically of native grasses.

Native ground cover (other): native ground cover composed specifically of non-woody native vegetation (vascular plants only) less than 1 metre in height that is not a grass (e.g. herbs, ferns).

Native ground cover (shrubs): native ground cover composed specifically of native woody vegetation less than 1 metre in height.

Native mid-storey cover: all vegetation between the overstorey stratum and a height of 1 metre (typically tall shrubs, understorey trees and tree regeneration) and including all species native to NSW (note that native species not local to the area can contribute to midstorey structure).

Native over-storey cover: the tallest woody stratum present (including emergent) above 1 metre and including all species native to NSW (note that native species not local to the area can contribute to overstorey structure). In a

woodland community the over-storey stratum is the tree layer, and in a shrubland community the over-storey stratum is the tallest shrub layer. Some vegetation types (e.g. grasslands) may not have an over-storey stratum.

Native vegetation: species endemic to NSW as defined in Section 1.6 of the BC Act 2016 and Section 60B of the LLS Act 2013.

Number of trees with hollows: a count of the number of living and dead trees that are hollow bearing.

Planted native vegetation:

Prescribed impact: means the prescribed impacts identified in clause 6.1 of the BC Regulation. Prescribed impacts can be direct or indirect impacts.

Remnant vegetation: native trees or patch of native vegetation that remains in the landscape after removal of most or all of the native vegetation in the immediate vicinity.

Subject lot: Lot 61 DP 737386.

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PREAMBLE – REPORT STRUCTURE

Keystone Ecological has been contracted by Mirvac to prepare an assessment of the likely impacts upon biodiversity matters of the proposed development works at Lot 61 DP 737386, 55 Coonara Avenue, West Pennant Hills in The Hills Local Government Area (LGA).

This Biodiversity Development Assessment Report (BDAR) has been prepared in accordance with the *Biodiversity Conservation (BC) Act 2016* and the *Biodiversity Conservation (BC) Regulation 2017*. Specifically, this BDAR follows the procedures detailed in the Biodiversity Assessment Method (BAM) as declared in Appendix L of the *Biodiversity Assessment Method 2020.*

This BDAR reflects the format required for the Streamlined Assessment module – planted native vegetation in accordance with Appendix L of BAM 2020[1] and also includes assessment of Matters of National Environmental Significance (MNES) under the *EPBC Act 1999*:

- Section 1 - Introduction
- Section 2 - Planted Native Vegetation
- Section 3 - Landscape Context
- Section 4 - Native Vegetation
- Section 5 - Threatened Species Habitat (planted native vegetation)
- Section 6 - Prescribed Impacts
- Section 7 - Avoid and Minimise Impacts
- Section 8 - Assessment of Impacts
- Section 9 - Mitigation and Management of Impacts
- Section 10 - Impact Summary
- Section 11 – Conclusions
- Section 12 - References
- Appendix 1 – Figures
- Appendix 2 – Photographs
- Appendix 3 – Tables
- Appendix 4 – MNES Assessments

The *BC Regulation 2017* sets out threshold levels for when the Biodiversity Offsets Scheme will be triggered, and thus the necessity for the preparation of a BDAR. The first of these thresholds is whether the impacts occur on an area mapped on the Biodiversity Values map published by the (then) Chief Executive of the NSW Office of Environment and Heritage. The second threshold is whether the amount of native vegetation being cleared exceeds the threshold area for the minimum lot size (or actual lot size if no minimum identified). The minimum lot size on site is less than 1 hectare and therefore as per the *BC Regulation 2017,* the applicable clearing threshold here is 0.25 hectares. However, the threshold is set for the clearing of native vegetation and does not translate to areas of planted native vegetation in accordance with Appendix D of the BAM (see Section 2).

This BDAR is triggered as a result of the site being mapped (albeit incorrectly) as High Biodiversity Value[2] (see Figure 1 in Appendix 1). However, a Streamlined Assessment for Planted Native Vegetation was considered the appropriate BDAR given the history of landscaping and development within the demolition footprint, and confirmation from BAM support that planted native vegetation greater than the clearing threshold can be assessed in accordance with Appendix L of the BAM (see Section 2).

[1] The items to be addressed within each Stage of the BDAR are detailed in Table 28 of the BAM.
[2] BVMATT map available at https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap.

1 INTRODUCTION

1.1 The Site and Proposal

The development site is within Lot 61 DP 737386, 55 Coonara Avenue, West Pennant Hills, in The Hills LGA. The subject lot is approximately 26 hectares in extent, and houses the now-vacated headquarters for IBM, which was then zoned as B7 Business Park. The subject lot is now rezoned with a mixture of R3 and R4 Residential, and E2 Environmental Conservation lands, reflecting the environmental values and development potential of the site. The subdivision also reflects this zoning.

The subject lot is situated on a long steep south-facing slope with its highest point at 170 metres ASL in the north near Castle Hill Road, down to its lowest point at 100 metres ASL in the lot's south-eastern corner near Darling Mills Creek.

The current operational footprint is concentrated in the subject lot's higher parts in the central and northern section of the site, occupying approximately 14 hectares. This represents approximately half of the subject lot, and comprises the development footprint associated with the IBM headquarters, namely:

- several large purpose-built office buildings with security basement sections;
- car parking facilities for 1,670 vehicles across several open-air car parks and a multi-storey car park;
- a ring road circling the developed part;
- stormwater control features (dams and detention basins); and
- landscaped areas of Australian native trees in two general locations (dominated by species that are out of their natural geographic and / or natural ecological range) -
    - immediately surrounding the existing buildings; and
    - as narrow islands within and around the open-air car parks.

Prior to the development in the 1980s of the current commercial buildings and associated infrastructure, the site was used to grow citrus trees, and contained a series of large orchards, open paddocks, small buildings, and bushland. The IBM Business Park was located mostly within the already cleared parts of the site where aerial photography from 1943[3] shows a well-established orchard. Thus, the current pattern of development reflects the European land use history of the site, with the remaining approximately 12 hectares of the subject lot being occupied by natural vegetation of varying ages and disturbance history.

Historical aerial imagery of the site from 1943, 1985 and the most recent aerial imagery is shown in Figure 2 in Appendix 1. A topographic map of the subject lot is shown in Figure 3 in Appendix 1 and a map of the subject land using the latest aerial imagery shown in Figure 4 in Appendix 1.

In order to redevelop the site in line with the new zoning, the existing buildings need to be demolished; this BDAR addresses the demolition phase. The scope of the demolition works has

[3] Available at SIX Maps https://maps.six.nsw.gov.au/.

been provided by Mirvac and the Demolition Development Application (DA) includes the following:

- Establishment of the works site and security including A Class Hoarding along the Coonara Avenue boundary with gates for vehicle and pedestrian access;
- Installation of site security fencing and temporary services to the perimeter of the demolition area;
- Installation of stormwater and environmental controls to the site to manage stormwater flows and sediment runoff, including treatment, prior to discharge into the creek downstream;
- Isolation and disconnection of existing services entering the site. Services will be disconnected and cables removed back to the site boundary or nearest Authority connection point. A substation kiosk will be constructed for works. Services to be isolated and terminated are:
    - electrical high voltage
    - telecommunications
    - water and gas
- Removal of the existing trees and other associated vegetation required to safely facilitate the demolition works to the building(s);
- Removal of all internal building materials and disposal off site. Where possible, materials will be recycled and/or re-used;
- Demolition and removal of existing buildings and ancillary structures. This includes the removal of the existing slabs and footings up to 1 metre below the underside of the existing slab surface, services, and vegetation;
- Mirvac will be looking to remove and stockpile landscaping boulders and sandstone retaining wall blockwork for reuse in the future development landscaping; and
- It is Mirvac's intent to leave as much carpark hardstand as possible within the demolition areas to provide protection for the natural underlying earth material from destabilisation until such time Mirvac develop these areas as part of a future development application, with the exception of the service entrance hardstand area which contains the generator diesel tanks earmarked for removal.

The demolition works will not contain a post-development 'operational' footprint and the construction footprint in this instance is the demolition footprint. The proposed works have been delineated by the proposed demolition footprint shown in a Site Map in Figure 5 in Appendix 1 and a fine-scale Location Map shown in Figure 6 in Appendix 1. The demolition footprint is illustrated in Photographs 1 to 6 in Appendix 2.

Temporary construction facilities - including stockpiles - are to be located within the existing development footprint. The existing ring road will be retained, with the proposed demolition footprint totalling approximately 6.2 hectares. The extent of the proposed operational footprint for demolition works is shown in Figure 6 in Appendix 1. This footprint contains existing buildings, hardstand, and landscaped gardens.

1.2 Information Sources

The following project plans and consultant reports were relied upon for this BDAR:

- **Civil plans prepared by Northrop and Mirvac Design**
  - general arrangement and specifications (NE-CD-DWG-9200, -9201, -9204);
  - tree removal plan (NE-CD-DWG-9205);
  - demolition plans (NE-CD-DWG-9210 to -9220); and
  - erosion and sediment controls and stormwater management (NE-CD-DWG-9230 to -9233)
- **Arboricultural reports prepared by Footprint Green:**
  - Arboricultural Impact Assessment part 2, impact assessment associated with demolition – 55 Coonara Avenue, West Pennant Hills, dated 27th July 2020; and
  - Arboricultural Assessment – proposed sewer repairs– 55 Coonara Avenue, West Pennant Hills, Revision 4, dated 18th February 2021.
- **Ecological reports prepared by Keystone Ecological:**
  - Development Constraints and Opportunities (Ashby, E. 2016);
  - Revised Ecological Assessment (Ashby, E. and McTackett, A. 2017);
  - Vegetation Zone Analysis (Ashby, E. and McTackett, A. 2018);
  - Biodiversity Assessment (Ashby, E. 2018); and
  - Flora and Fauna Assessment for Sewer Upgrade (Ashby, E. and McTackett, A. 2020).

The following historical information related to the original IBM development were relied upon for this BDAR:

- Site Sustainability Study (1979) prepared by Devine Erby and Mazlin, architects / landscape consultants for the original IBM proposal;
- Extracts of landscape treatments around headwalls and drainage pits attached to letter dated 6 March 1984 to Baulkham Hills Shire Council from Landscan;
- Landscape Plan (1985) for the Phase 3 Carpark (the multi-storey car park) prepared by Landscan landscape architects;
- Technical Specifications for Landscape Works Phase 3 (October 1985) prepared by Landscan landscape architects;
- Plan extracted from IBM Environmental and Services Manual (1987) titled Management Areas Landscaped Area, drawing number 8 prepared by Landscan; and
- Detail and Contour Survey (1993 or earlier) prepared by McNiff Dive and Associates.

The following external sources of information were relied upon for this BDAR:

- BioNet Vegetation Classification (formerly known as the NSW Vegetation Information System Classification Database);
- BioNet Threatened Biodiversity Data Collection (TBDC, formerly known as the Threatened Species Profile Database);
- BioNet Atlas (formerly known as the NSW Wildlife Atlas);
- Directory of Important Wetlands in Australia;

- BioNet NSW (Mitchell) Landscapes – Version 3.1;
- NSW Interim Biogeographic Regions of Australia (IBRA region and subregion) – Ver 7;
- Biodiversity Assessment Method (2020). Biodiversity Assessment Method, Environment, Energy and Science, Department of Planning Industry and Environment, October 2020, Sydney NSW;
- NearMaps (2015-2021) NearMaps aerial imagery tool. Latest access of imagery 1st February 2021. (http://maps.au.nearmap.com/);
- NSW Government (2015-2021) SIXMaps Aerial Imagery Tool. Latest access of imagery 1st February 2021. (https://maps.six.nsw.gov.au/);
- SEED (2020) Sharing and enabling environmental data online portal. NSW Government, Sydney. (https://www.seed.nsw.gov.au/edphome/home.aspx); and
- The Hills Shire Council (2020) Online mapping tool. (http://mapping.thehills.nsw.gov.au/IntraMaps90/).

Published databases identified in section 1.4.1 of the BAM 2020 have been appropriately interrogated.

2 PLANTED NATIVE VEGETATION

2.1 Decision-making Key

The demolition footprint occurs within areas containing existing buildings and carparks that were previously landscaped as part of the construction of the IBM site in the 1980s. The demolition footprint is shown in Photographs 1 to 6 in Appendix 2.

Given the history of the site and the restriction of the demolition works to areas of existing development and gardens immediately surrounding the development, the proposed demolition footprint was reviewed against Appendix D of the BAM.

The application of the decision-making key provided in Appendix D of the BAM is shown below with answers outlined in red, followed by an explanation of each step:

D.1 Decision-making key

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.

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 or a threatened plant species population 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.

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**

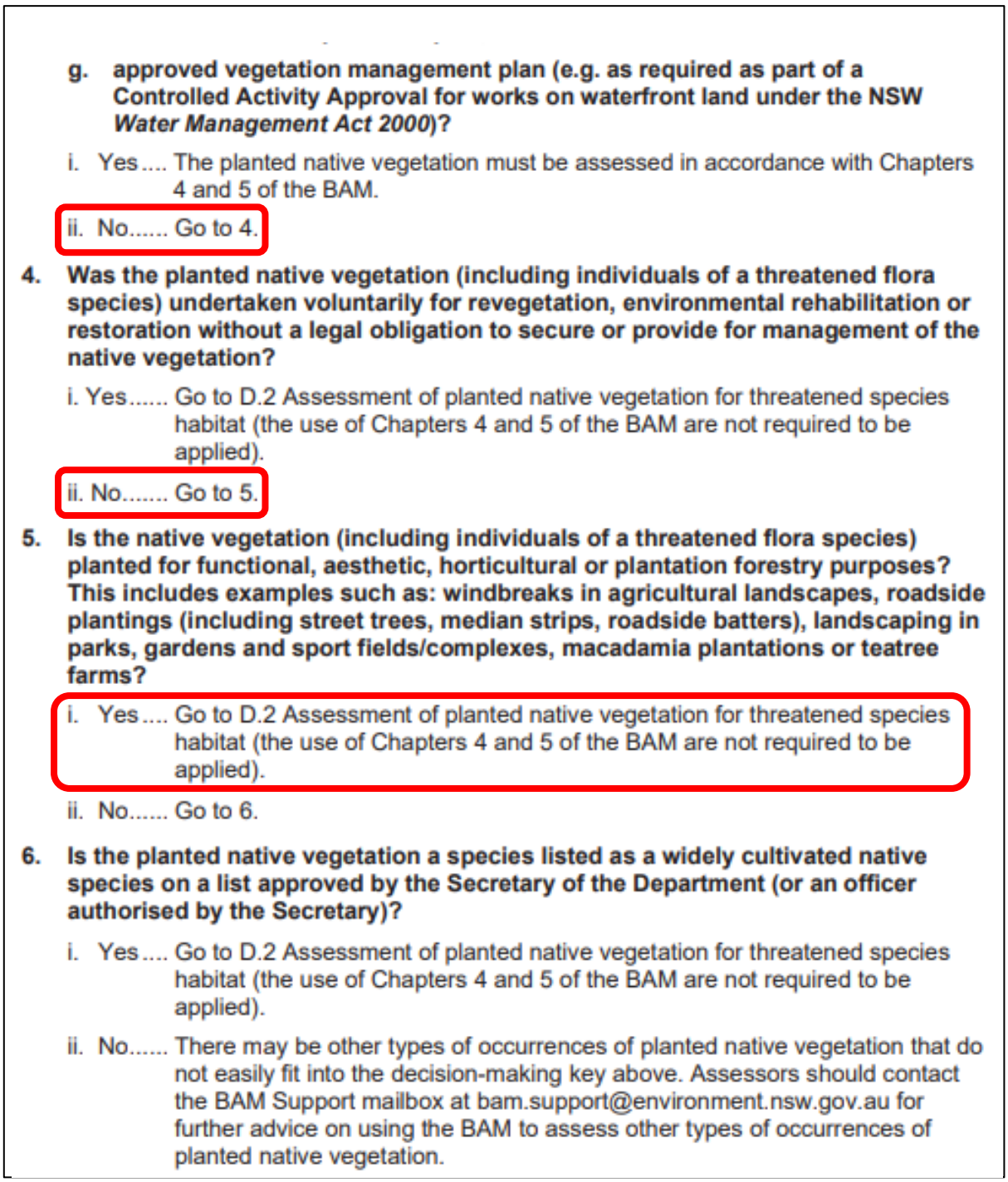
   b. ***Saving our Species* project**

   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 or 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.

ii. No..... Go to 4.

4. **Was the planted native vegetation (including individuals of a threatened flora species) undertaken voluntarily for revegetation, environmental rehabilitation or restoration without 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).

ii. No..... Go to 5.

5. **Is the 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, roadside plantings (including street trees, median strips, 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.

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. Assessors should contact the BAM Support mailbox at bam.support@environment.nsw.gov.au for further advice on using the BAM to assess other types of occurrences of planted native vegetation.

In order to determine if the observed vegetation can be assigned to a PCT, the floristics and structure of the BAM plots along with the tree species mix recorded by the Project Arborist were compared to candidate PCTs in the BioNet Vegetation Classification database, using the filtering tools available in that module. The database was filtered sequentially, adding factors at each step from tree data and BAM plot data, with the resultant PCTs interrogated at each stage for best fit.

Of the 1,208 trees of 45 species identified by the Project Arborist within the demolition area, almost three quarters (73%) are represented by only 6 dominant tree species:

- 266 x *Casuarina glauca* Swamp Oak – 22%
- 199 x *Pittosporum undulatum* Sweet Pittosporum – 16%
- 171 x *Corymbia maculata* Spotted Gum - 14%
- 89 x *Corymbia citriodora* Lemon-scented Gum - 7%
- 76 x *Eucalyptus saligna* Sydney Blue Gum – 6%
- 76 x *Syncarpia glomulifera* Turpentine – 6%

The BAM plots reflected this mix:

- RDP16 dominated by *Syncarpia glomulifera* Turpentine (12% cover) and *Corymbia citriodora* Lemon-scented Gum (10% cover)
- RDP 17 dominated by *Casuarina glauca* Swamp Oak (40% cover) and *Corymbia citriodora* Lemon-scented Gum (12% cover)

The understorey across the Vegetation Zone was more variable, being reflective of the degree and type of horticultural management. Some areas were tended less regularly and had a very weedy understorey; this is evident in RDP 17 with the high threat weed *Ehrharta erecta* Panic Veldtgrass at 50% cover and *Sonchus oleraceus* Common Sowthistle at 25% cover. Recent rain also resulted in germination of a number of species in some areas not previously recorded in the gardens. This is evidenced in the high species diversity in RDP 16, with the ground layer dotted by small young plants.

There are no PCTs in NSW that contain *Corymbia citriodora* Lemon-scented Gum, as it is a species native to Queensland. Therefore, no best fit PCT for Vegetation Zone 4a can take into account one of the dominant species.

The natural soils on this protected south-facing slope are moderately fertile (see soil landscape descriptions), the site experiences relatively high rainfall (1,003 mm annual average),[4] and the surrounding natural vegetation is of the Wet Sclerophyll Forest formation. Therefore the first filter imposed was of Wet Sclerophyll Forest PCTs within the Sydney Basin Bioregion.

The next filters added were the three most common canopy species: *Casuarina glauca* Swamp Oak *Pittosporum undulatum* Sweet Pittosporum, and *Corymbia maculata* Spotted Gum. None of the resultant PCTs matched all factors (formation and 3 dominant species within the Bioregion), primarily because *Casuarina glauca* Swamp Oak occurs naturally in saline soils, and principally in wetlands and swamp forests. The presence of *Pittosporum undulatum* Sweet Pittosporum adds little information to the vegetation analysis, as it is a very weedy species, spreading into all vegetation types due to two profound changes wrought on urban bushland by surrounding development - the absence of fire, and the addition of nutrients.

[4] Rainfall data from Castle Hill (Kathleen Avenue) Station number 067100, latitude 33.72^{0}S longitude 150.99^{0}E, elevation 90 metres ASL, sourced from Climate Data Online, Bureau of Meteorology http://www.bom.gov.au/climate/data

The addition of *Eucalyptus saligna* Sydney Blue Gum and then *Syncarpia glomulifera* Turpentine to the species filters returned the same set of 3 PCTs from the Cumberland subregion with the highest number of matches (being 4). These PCTs are described below:

- PCT 1245 Illawarra Escarpment Blue Gum wet forest (Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion). This PCT extends southwards from the Hacking River valley along the escarpment to Nowra, where it is distributed between 60 and 300 metres above sea level on Narrabeen group sediments or Illawarra Coal Measures. It occurs on sheltered slopes in gullies and on escarpments with loamy soils. It is a very tall eucalypt forest marked by multiple layers of rainforest trees, palms and shrubs. It is not associated with any listed threatened ecological communities;
- PCT 1841 Coastal enriched sandstone moist forest (Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region). It is a tall open forest on Hawkesbury sandstone slopes and gullies, enriched by the presence of shale bands on the slope or on the ridges above. It occurs at elevations between 10 and 120 metres ASL, with mean annual rainfall of 850-1,250 millimetres. It is not associated with any listed threatened ecological communities; and
- PCT 1915 Coastal Flats tall moist forest (Blue Gum-Bangalay - Turpentine / Cheese Tree - Lilly Pilly tall moist forest on coastal flats of the northern Sydney basin). This is a tall eucalypt community with layers of small rainforest trees and mesic shrubs that is found on coastal flats and adjoining toe slopes. This tall forest receives more than 1,150 millimetres of mean annual rainfall and is situated on elevations less than 40 metres above sea level. The alluvial soils on which it grows are sourced from Narrabeen sediments and are clay rich. Outside the Sydney area it is found along the larger coastal river systems north to Newcastle. It is not associated with any listed threatened ecological communities.

Additional permutations were also explored using other filtering factors such as the Cumberland subregion, understorey species from the BAM plots, and canopy species mix from the BAM plots only. However, no other PCTs resulting from these investigations were considered to be a better fit than the three PCTs listed above.

Nevertheless, none of these candidate PCTs are considered to be a good fit as they do not reflect the combination of biotic and abiotic factors observed on site. The vegetation within the demolition footprint cannot be reasonably assigned to a PCT known to occur in the same IBRA subregion.

The vegetation within the proposed demolition footprint has not been planted for a conservation or restoration project, rather it is "*native vegetation (including individuals of a threatened flora species) planted for functional, aesthetic, [or] horticultural … purposes*" (per Question 5).

The evidence for the vegetation in question being planted and not natural has come from a number of sources:

- land use history as indicated by historical records including old survey plans, parish maps, and land grant records. These show that at least part of the site was incorporated into a very early land grant and cleared for farming;
- historical aerial photography from 1943 through to the 1980s shows the clearing and excavation of the subject area for the IBM development (see Figure 2 in Appendix 1);
- a discussion with Mr David Louden, the Landscape Architect for the IBM development project established the scope of landscape works and the planting palette; and
- consideration of literature produced by the National Trust specific to the management of the vegetation of the IBM site;
- detailed tree identification and mapping by the Project Arborist across the proposed works area; and
- analysis of the floristic composition in the works area. The combination of species reflect the planting palette (most often of species outside of their ecological or geographic range) and not a locally-native vegetation community. For example, *Casuarina glauca* Swamp Oak (the most dominant species of tree in the demolition area) grows naturally in low-lying habitats on saline soils, not on rich soils on hillsides of the Hornsby Plateau. Another dominant tree species in the demolition area is *Corymbia citriodora* Lemon-scented Gum, which is native to Queensland.

The information from these sources and the vegetation patterns of the site are further discussed in Section 4 of this BDAR although the positive response to Question 5 also means that Chapters 4 and 5 of the BAM are not required.

Confirmation was sought from the Department of Planning, Industry, and the Environment (DPIE) regarding the ramification of clearing more than 0.25 hectares of planted native vegetation, specifically if it triggered a full BDAR. It was confirmed by DPIE[5] that proposed clearing of planted native vegetation that exceeds the thresholds do not trigger the requirement to undertake a full BDAR, and that the planted native vegetation can be assessed in accordance with Appendix D and a Streamlined BDAR prepared in accordance with Appendix L of the BAM.

Section D.2 of Appendix D of the BAM addresses the procedure for assessing the value of the planted native vegetation to fauna, wherein it states:

> *'The assessor must assess the suitability of the planted native vegetation for use by threatened species and record any incidental sightings or evidence (e.g. scats, stick nests) of threatened species credit species (flora and fauna) using, inhabiting or being part of the planted native vegetation.*
> *If there is evidence that threatened species are using the planted native vegetation as habitat, the assessor must apply Section 8.4 of the BAM to mitigate and manage impacts on these species. Species credits are not required to offset the proposed impacts.'*

Due to the scale of the fauna habitats across the whole site, its context (being adjacent to other extensive areas of fauna habitat), and known records of threatened species, it was determined that fauna surveys should not be restricted to incidental evidence and sightings as per Appendix

[5] In email answer to BSM-1669 (new ref BSM1676) received 28th January 2021.

D of the BAM. Therefore, additional surveys were undertaken for species considered highly likely to occur or known to occur, in order to provide a comprehensive assessment of threatened species habitats (see Section 5 of this BDAR).

2.2 Additional Information

In Council's review of BDAR version 3.0 (the update prepared in accordance with BAM 2020), more information was requested regarding the decision to treat the landscaped areas within the demolition footprint as Planted Native Vegetation (depicted as Vegetation Zone 4a). In addition to the analysis provided above in Section 2.1, a comprehensive reply was provided that relied partially upon material not previously available for version 3.0. For the sake of completeness, that additional analysis has been included here.

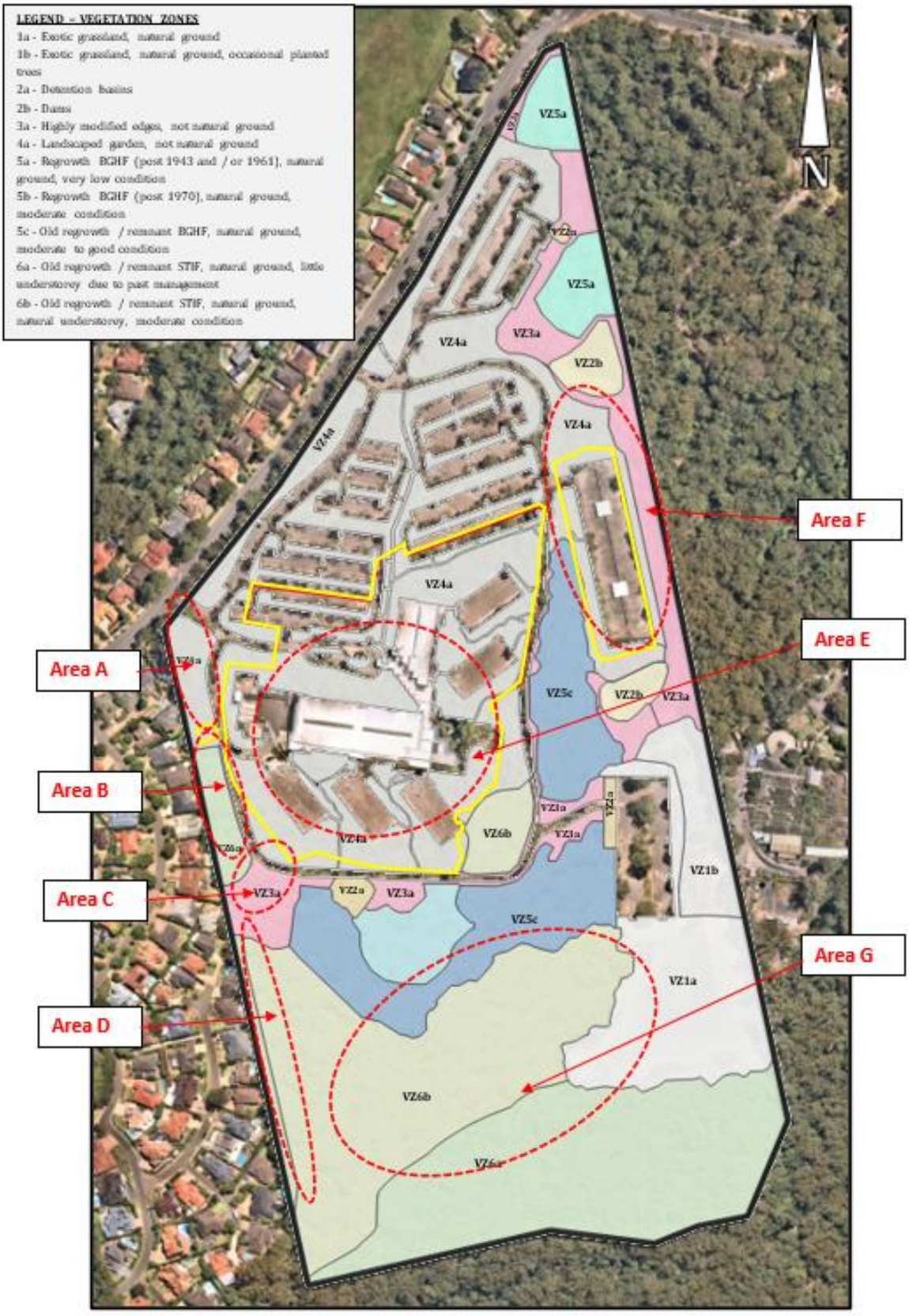
Council's questions have been paraphrased below (shown in italics), followed by a response. The figures relied upon in each response have been included in the text to facilitate comprehension, while tables of data are provided in Appendix 3.

1. *At the northern end of the vegetation along the western boundary, trees are visible in the aerial photography series from 1943 to the present day and there is no evidence of clearing and earthworks in that series.*
2. *The Landscape Masterplan for the IBM development shows a rough line of trees along the western boundary, as further evidence of existing vegetation.*

Response:

These matters are dealt with together, as they are all interrelated. For the sake of clarity and brevity, areas referred to in this response are marked up in a figure (overleaf) that shows the Vegetation Zones.

- Area A is at the northern end of the vegetation along the western boundary, and has been classified and mapped as VZ4a.
- Area B is to the south of Area A, and has been classified and mapped as VZ6a, Sydney Turpentine Ironbark Forest (STIF) with little understorey due to past management practices.
- Area C is to the south west of the corner of the perimeter road, and has been classified and mapped as VZ3a Highly modified edges, not on natural ground.
- Area D is at the strip of vegetation along the southern end of the vegetation along the western boundary, and has been classified and mapped as VZ6a and VZ6b, which are both STIF with understorey in different conditions.
- Area E comprises the planted garden areas around the buildings that have been classified and mapped as VZ4a.
- Area F is made up of the vegetated areas around the multi-storey car park and between the two dams, and is a mixture of VZ3a, VZ4a, and VZ5c Blue Gum High Forest (BGHF) in moderate to good condition.
- Area G comprises the areas of natural forest occupied by BGHF (VZ5) and STIF (VZ6).

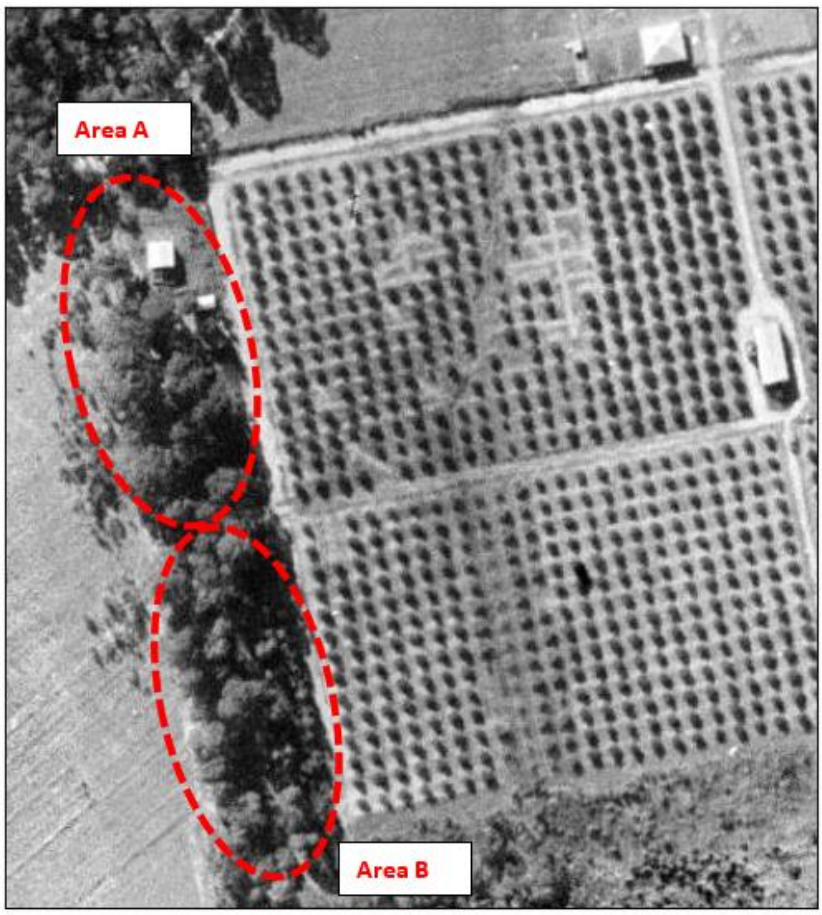


The determination of the Vegetation Zones was an iterative process, with the mapped polygons amended in accordance with the best available evidence at hand. Since receiving Council's request, additional historical information has come to light, the most relevant

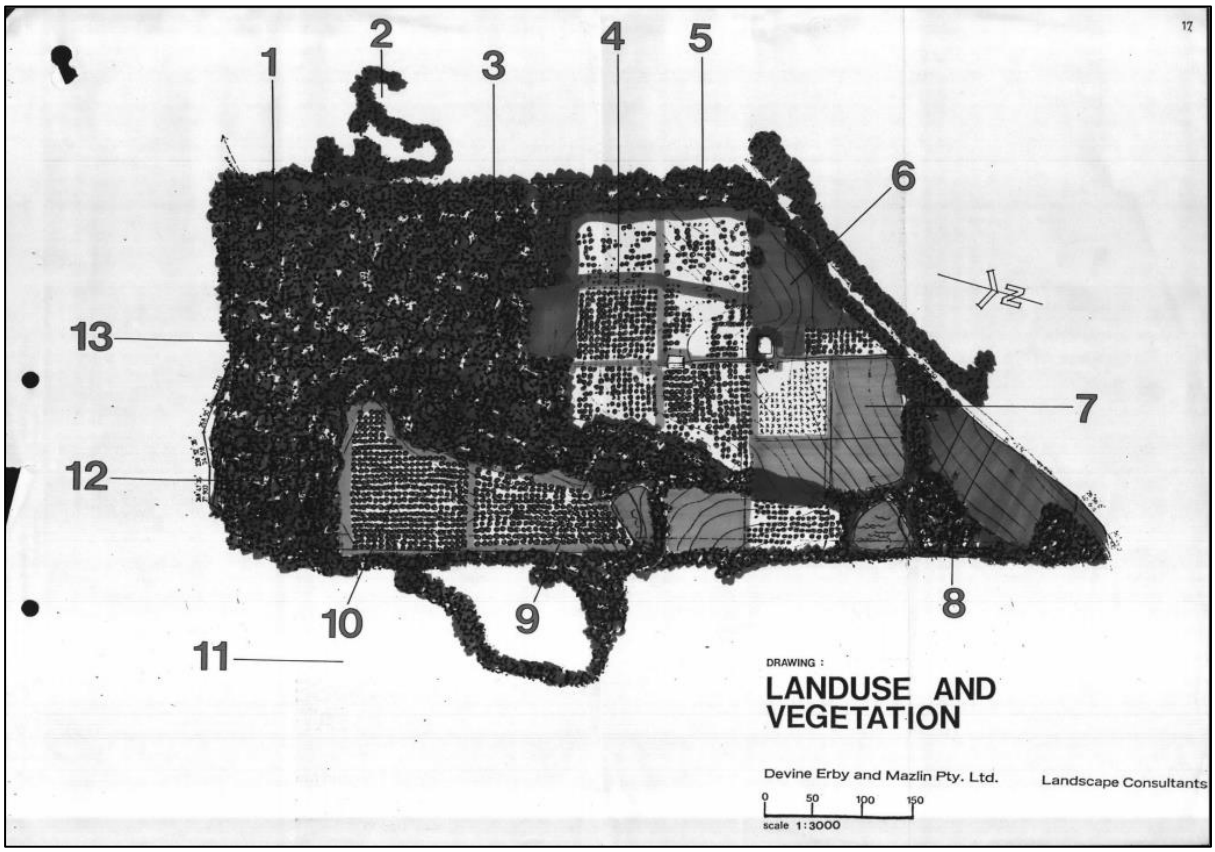
being:

- High resolution aerial photography dated 1943 of the western boundary vegetation.
- Site Sustainability Study (1979) prepared by Devine Erby and Mazlin, architects / landscape consultants for the original IBM proposal.
- Extracts of landscape treatments around headwalls and drainage pits attached to letter dated 6 March 1984to Baulkham Hills Shire Council from Landscan.
- Landscape Plan (1985) for the Phase 3 Carpark (the multi-storey car park) prepared by Landscan landscape architects.
- Technical Specifications for Landscape Works Phase 3 (October 1985) prepared by Landscan landscape architects.
- Plan extracted from IBM Environmental and Services Manual (1987) titled Management Areas Landscaped Area, drawing number 8, prepared by Landscan.
- Detail and Contour Survey (1993 or earlier) prepared by McNiff Dive and Associates.

Council is concerned that the areas defined as VZ4a along the western boundary are in error. The high resolution 1943 aerial photograph (see below) shows that at that time the northern section of Area A was cleared of woody vegetation and was occupied by buildings. Trees occurred along the boundary between the orchard and the open paddock to the west.



The Site Sustainability Study of 1979 mapped "Landuse and Vegetation", and classified the site into 13 areas, with their Area 5 probably equivalent to Areas A and B:



The vegetation within Area 5 was described thus:

AREA 5

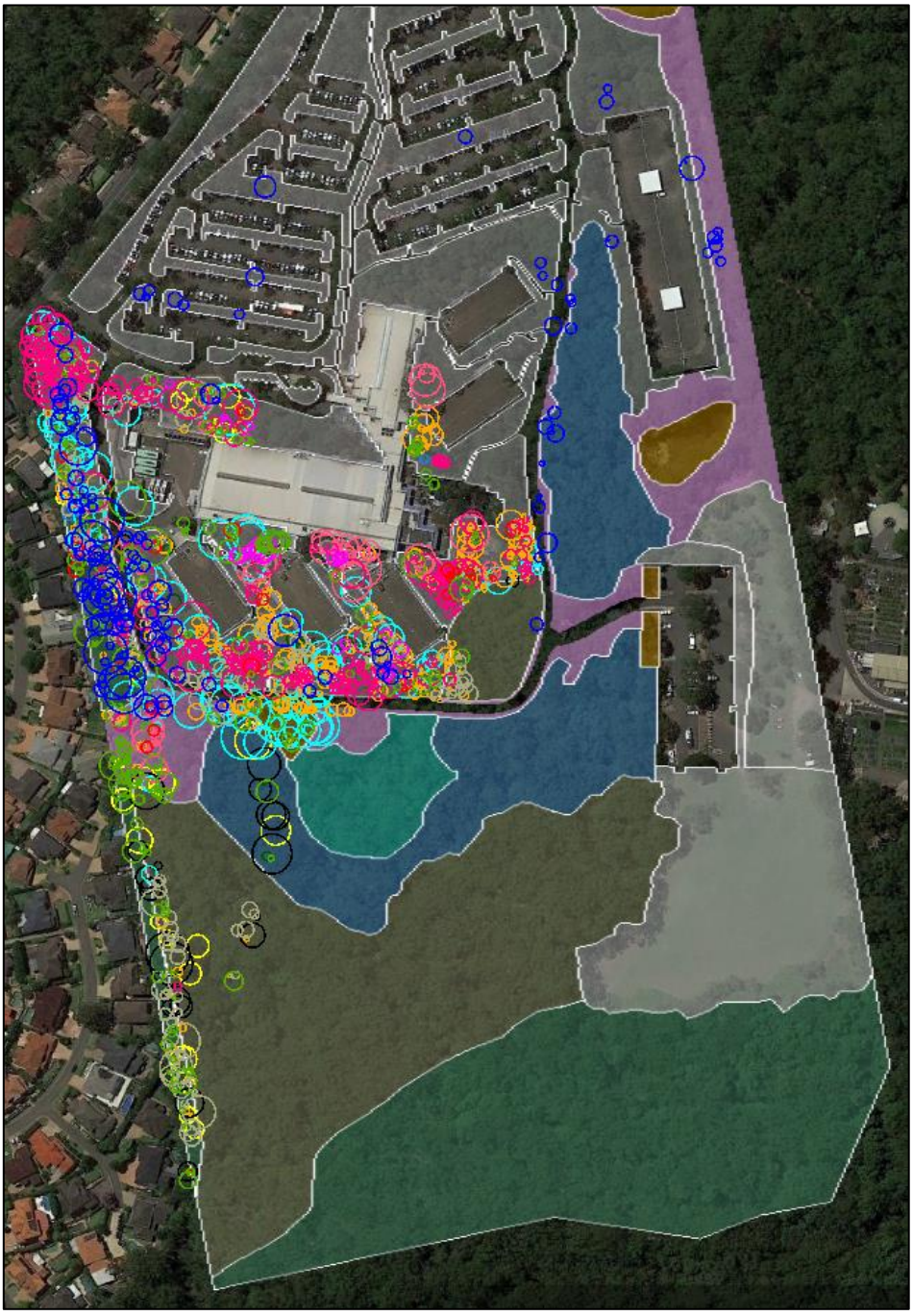
Overcanopy trees dominated by Blue Gum (E.saignus), 60% Grey Ironbark (E.paniculata), possibly introduced Spotted Gum (E.anaculata). Shrubs and small trees have been cleared probably by stock grazing. Groundcover of grasses and invasion of Paddy's Lucerne, Black Nightshade (Solanum nigrum), Sweetbriar (Rosa rubiginosa) and Fleabane (Erigeron spp.), etc.

[Note that "E. saignus" is *Eucalyptus salignus* Sydney Blue Gum, and "E. anaculata" is *Corymbia maculata* Spotted Gum.]

These observations indicate that Areas A and B were used as part of the farm. The observation that the Spotted Gums were possibly introduced is considered correct, as they do not occur naturally in the vegetation types (BGHF and STIF) that occupy shale ridge tops in the local area.

The question to be addressed therefore is whether the remainder of the vegetation in Areas A and B are natural. This has been investigated by the comparison of the 1979 description with the

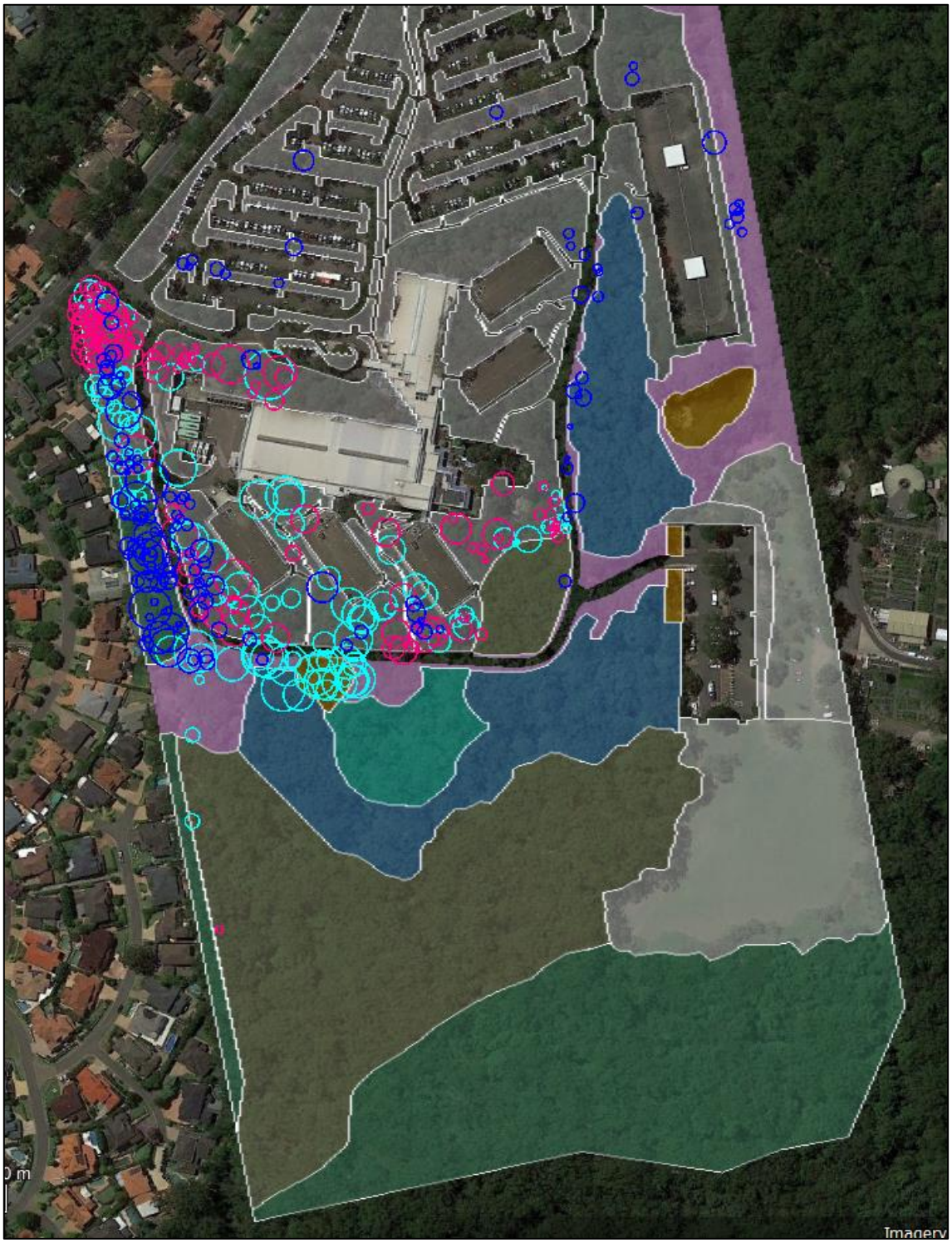
current tree species composition of parts of the site that have been excavated then landscaped (Areas C, E, F), and with areas that are undoubtedly natural (Areas D and G). These tree data have been collected by the Project Arborist Footprint Green and are shown below against the Vegetation Zones. The data comprise all of the trees within Areas A, B, C, and E; all of the trees located in Area D and that part of Area G investigated as part of the sewer upgrade; and the distribution of *Eucalyptus paniculata* Grey Ironbark and / or *Eucalyptus fibrosa* Red Ironbark in Area F and across the rest of the site. This colour-coded tree data set is shown below, and the colours immediately demonstrate that the the natural areas have a different tree composition to the planted parts.



The species composition of trees in Area G is also supplemented with tree data collected by the

Project Arborist in 3 quadrats (each of 400 square metres) located in the STIF forest (provided at Table 7 in Appendix 3), as well as vegetation plot data collected for this BDAR.

The distribution of only the tree species referred to in the 1979 description in and around the demolition area is shown below. Spotted Gums are pink, Sydney Blue Gums are light blue, and Ironbarks are dark blue:



This figure shows that:

- **Spotted Gums** occur almost exclusively within VZ4a. The only exception is one small tree in the southern part of the site that may represent the natural spread of this species into the adjoining endangered ecological community. No Spotted Gums were found in the BDAR vegetation plots or elsewhere in the natural areas on site during random meander, or in the Project Arborist's 3 forest quadrats (see Table 7 in Appendix 3).

  This pattern indicates that this species has been planted on site, and is not a natural component of the vegetation. The high concentration in the northern end of Area A is likely to reflect plantings observed in 1979, plus probably further enrichment plantings, as this was one of the 59 species on the planting list extracted from the historical material (see Table 8 in Appendix 3).

- **Grey Ironbark and Red Ironbark** occur in very high density in Areas A and B, and at much lower densities in other areas of VZ4a. No Ironbarks occur among the trees located by the Project Arborist in Areas D or G (despite being characteristic species of BGHF and STIF), nor were any Ironbarks recorded in the Project Arborist's 3 forest quadrats. In the BDAR vegetation plots, Grey Ironbark was recorded in BGHF at the northern tip of the lot site (near a cluster of planted specimens), and as a single very small sapling in VZ4a along the Coonara Avenue frontage.

  It is also a species known to be planted, being listed in the planting schedule extracts.

  This pattern suggests that this species is planted on site, and is not naturally a component of the vegetation in such high numbers, despite the prevalence of STIF across the southern half of the site and Ironbarks being a key species of this endangered ecological community.

- **Sydney Blue Gums** occur in a cluster in Area A, and are also a common component of the remainder of the landscaped gardens and the rehabilitated Area C. It is a species listed in the extracted planting schedule.

  Although trees have not been mapped in the areas of natural BGHF, Sydney Blue Gum is a very common element of that vegetation type, being the nominative species of the endangered ecological community. It also represents 1% of the tree composition of the Project Arborist's 3 forest quadrats.

  Sydney Blue Gums occur both naturally and as planted specimens across the site. Their distribution in Areas A and B sandwiched between planted Spotted Gums and planted Grey Ironbarks suggest that they are also likely to have been planted in this location.

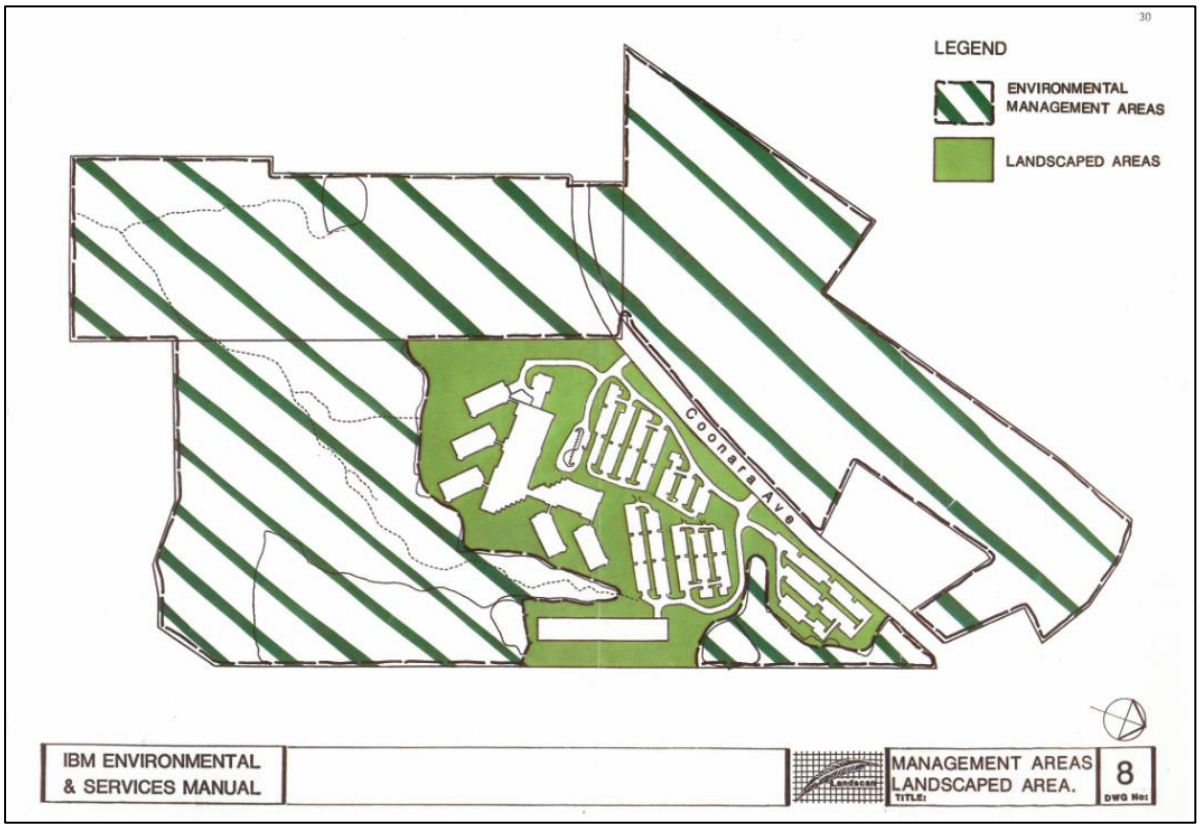
Other tree species within these data sets considered to be planted include those outside of their natural distribution, cultivars, and those species popular in horticulture. These species are listed below, notated in Table 8 in Appendix 3, and their distribution shown in the figure overleaf.

Species also on the plantings list have a superscript 'P'.

Species out of their geographic range (light pink in Figure above)	Species out of their ecological range (lolly pink in Figure above)
Corymbia citriodora P	*Archontophoenix cunninghamiana*
Eucalyptus microcorys P	*Callistemon viminalis*
Grevillea robusta	*Casuarina glauca* P
Leptospermum petersonii	*Corymbia maculata* P
	Kunzea ericoides
	Melaleuca armillaris P
	Syzygium paniculatum

Exotics known to be used in horticulture (red in Figure below)	Native cultivars (pale purple in Figure below)
Celtis australis	*Acmena smithii* 'minor'
Harpephyllum caffrum	*Callistemon* 'Captain Cook'
Jacaranda mimosifolia	
Sapium sebiferum	

This figure shows that the species most likely to have been planted are generally restricted to the areas identified as VZ4a or VZ3a, but also occur in Area B, an area that has been identified as VZ6a (STIF with a modified understorey). Instead of putting into question the classification of Area A as VZ4a, this analysis instead raises the question as to whether Area B has been correctly identified as natural STIF. The potential for Area B to have been incorrectly mapped is further suggested by the 1987 plan produced by Landscan as part of the IBM Environmental and Services Manual, shown below. This plan clearly shows that the landscaped part of the site wholly incorporates Areas A, B, and C.



The decision to classify Area B as VZ6a was driven by the dominance of Grey Ironbark and Red Ironbark in this area, the fact that these Ironbark species are characteristic species of STIF, and the absence of evidence of clearing since the 1943 photographs. However, the absence of these Ironbarks in natural circumstances elsewhere on the site, its super-abundance in Area B , and the observations in 1979 of farming activity in this area weaken these assumptions.

There is no evidence that Area A or Area B have been excavated to bedrock as have the areas of

VZ4a around the buildings. However, large parts of Area A have been excavated for the installation of water infrastructure, including a large tank, pipeline, and hydrant booster valve. These are shown below in the extract of the survey plan in relation to the Vegetation Zones and the demolition footprint (yellow). The photographs also illustrate the degree and magnitude of disturbances in this area.

The ground disturbance to the VZ4a in Area A illustrated above is considered sufficient to maintain its classification as VZ4a.

If any amendment to the vegetation mapping is suggested by this additional information, it is that VZ6a (Area B) is instead more correctly and better classified as a new sub-type of native planted vegetation - VZ4b Landscaped Garden on natural ground. However, given that there are no actions proposed for Area B, and therefore no consequences arising from altering the mapping and classification, for the purposes of this BDAR the classification as natural vegetation remains.

Council further challenges the nature of VZ4a:

3. *Locally-native species that are characteristic of the endangered ecological communities on site occur within VZ4a and have naturally regenerated / self-seeded from adjacent bushland or from top soil that was stockpiled and re-used during the IBM development.*
4. *The areas surrounding the buildings should be assessed against the Final Determinations for Blue Gum High Forest and Sydney Turpentine Ironbark Forest.*

Response:

These questions will be addressed together.

While natural regeneration has had the opportunity to occur in the landscaped areas, it is unlikely to have originated from the topsoil used in the IBM landscape works.

The available landscape technical specifications[6] detailed the collection, treatment, and re-use of topsoil. The topsoil was stripped from the orchard and paddocks, and at the time of clearing there was *"prolific weed growth"*; these weeds were turned into the topsoil stockpiles.

The excavated areas intended for planting were filled with a mixture of screened orchard topsoil, mixed with sand, gypsum, bark, and an organic matter admix (comprising composted bark, duck manure, coffee grounds, spent mushroom compost, and composted hardwood sawdust). The sub-grade was broken up by backhoe, and the soil mixture filled to a depth of 150 millimetres, into which the plants were installed, and then mulched with pine bark to a depth of 75 millimetres.

The Site Sustainability Study[7] describes the areas that were developed for the IBM facility variously as a cleared gully with weeds, a grazing paddock with Kikuyu and horses, a crop paddock with poor soil structure due to overcropping, and a neglected orchard overrun with Lantana and Rabbits. No forested areas were cleared, and this topsoil source is not likely to have included a native forest seedbank of consequence if any at all, and its subsequent treatment was not particularly conducive to germination of locally-native species.

However, it is known that locally-native species were actually planted as part of the landscape treatment and reflected today in the patterns seen in VZ4a and VZ3a. The available extracts of the planting schedules lists a total of 59 species (see Table 8 in Appendix 3), of which 31 are locally-native species; and 14 of these are in turn characteristic of one or other of the two endangered ecological communities on site (12 BGHF species and 9 STIF species).

The planting schedules extracts are incomplete, and are likely to have included many more locally-native species. Council's letter stated that subsequent bush regeneration work by the National Trust also included planting of natives, but unfortunately there are no records to indicate the species, numbers or locations.

[6] Technical Specifications for Landscape Works Phase 3 (October 1985) prepared by Landscan landscape architects.
[7] Site Sustainability Study (1979) prepared by Devine Erby and Mazlin, architects / landscape consultants for the original IBM proposal

Therefore, the mere presence of a locally-native species not on the (incomplete) planting lists cannot be assumed to be naturally occurring.

Plantings have also continued to the present day, long after the initial landscape works, and so a small size is also not a reliable indicator for a self-propagated individual. For example, the photograph below (taken 4th December 2018) shows plantings in VZ4a along the Coonara Avenue frontage that are recent enough for the protective plastic bags to still be intact. These later plantings are also undocumented.

It is not possible to distinguish with certainty which of the individual locally-native plants that occur in the garden areas around the buildings may be self-seeded. Some species that are not commonly used in horticulture but are known to volunteer in gardens are undoubtedly self-sown, such as *Commelina cyanea* Scurvy Weed and *Cayratia clematidea* Native Grape noted growing in the mulch after good rain (see photograph below). However, it is an impossible task to map out such self-sustaining occurrences at this scale within the context of a much larger garden that is known to be planted, and that has been maintained as a garden for the last 40 years.

Nevertheless, Council has requested that an analysis be provided of the planted areas around the buildings compared with BGHF and STIF.

The trees are the most robust and longest living component of the plantings, and the arborist data set is the most complete that is available for comparison. Note however that the absence of a species from the planting schedules is no guarantee that the species was not planted, or that the occurrence observed is not progeny of planted material. This is exemplified by *Lomandra longifolia*, a species that is clearly mass planted in VZ4a but is not on the extracts of the planting schedules.

Nevertheless, an analysis has been undertaken of all available vegetation data collected from close around the buildings regarding its relationship with BGHF and STIF.

BGHF analysis

The characteristic species of BGHF per the NSW Scientific Committee's Final Determination, their presence within the VZ4a areas around the buildings and likely provenance are detailed in Table 9 in Appendix 3.

The distribution of tree species within the VZ4a areas around the buildings that are characteristic of BGHF (per the NSW Scientific Committee Final Determination) are shown below:

Of the 53 species listed in the Final Determination as characteristic of BGHF, 18 were observed within the garden areas in the tree data set and in vegetation sample plots. The majority of these observed BGHF species were trees (11 of 18, or 61%), and a majority of the 11 tree species observed (8 of 11, or 73%) are on the known planting schedule.

Two BAM plots were located within VZ4a and collectively there were 50 species in these 2 plots,

with the following affinities:

- 12 characteristic BGHF species (10 of these 12 occur in one plot and 4 of the 12 in the other)
    - 3 of these 12 BGHF species are on the planting schedule, and are all trees:
        - *Eucalyptus paniculata* Grey Ironbark
        - *Eucalyptus pilularis* Blackbutt
        - *Pittosporum undulatum* Sweet Pittosporum
    - At least another 3 of the 12 BGHF species are likely to have been in the planting palette
        - *Lomandra longifolia* Spiky-headed Mat-rush
        - *Dianella caerulea* Flax Lily
        - *Alphitonia excelsa* Red Ash
    - The remaining 6 species are common in the natural BGHF areas and unlikely to have been planted or progeny from planted stock
        - *Pseuderanthemum variabile* Pastel Flower
        - *Glochidion ferdinandi* Cheese Tree
        - *Eustrephus latifolius* Wombat Berry
        - *Entolasia marginata* Bordered Panic
        - *Oplismenus aemulus* Basket Grass
        - *Gynochthodes* (was *Morinda*) *jasminoides* Sweet Morinda
- 14 exotic species (including many serious weeds)
- 4 species undoubtedly planted (such as cultivars and species from Queensland)
- 20 species made up of a mixture:
    - 2 tree species and 1 vine species on the planting schedule
        - *Acacia elata* Cedar Wattle
        - *Syncarpia glomulifera* Turpentine
        - *Hardenbergia violacea*
    - 2 tree species nominated by the landscape architect as in the planting palette
        - *Eucalyptus punctata Grey Gum*
        - *Eucalyptus tereticornis Forest Red Gum*
    - 1 tree species that is widely planted, easily spread, and whose local provenance is controversial
        - *Brachychiton acerifolius* Illawarra Flame Tree
    - 1 unidentified *Acacia* species
    - 12 locally-native species species that are generally rarely recorded on site except for in the VZ4a areas, comprising a tree, shrubs, ground covers, and vines.

Therefore, only 6 of the 50 species recorded are likely to be self-perpetuating naturally-occurring regrowth BGHF species, while the majority of the species observed in the VZ4a areas (44 of 50) do not represent BGHF being definitely or more than likely planted, exotic, or local species that occur commonly across the landscape and are of no particular conservation significance.

STIF analysis

The characteristic species of STIF per the NSW Scientific Committee's Final Determination, their presence within the VZ4a areas around the buildings and likely provenance are detailed in Table 10 in Appendix 3.

The distribution of tree species within the VZ4a areas that are characteristic of STIF are shown below:

STIF is a much more diverse community than BGHF, with 112 characteristic species listed in its Final Determination. Of these, 16 were observed within the garden areas in the tree data set and in vegetation sample plots. Half of these observed STIF species were trees (8 of 16, or 50%), and a majority of the 8 tree species observed (6 of 8, or 75%) are on the known planting schedule.

Two BAM plots were located within VZ4a and collectively there were 50 species in these 2 plots, with the following affinities:

- 10 characteristic STIF species (all 10 occur in one plot and 3 of the 12 in the other)
    - 3 of these 10 BGHF species are on the planting schedule, and are all trees:
        - *Eucalyptus paniculata* Grey Ironbark
        - *Syncarpia glomulifera* Turpentine
        - *Pittosporum undulatum* Sweet Pittosporum
    - At least another 2 of the 10 STIF species are likely to have been in the planting palette
        - *Lomandra longifolia* Spiky-headed Mat-rush
        - *Dianella caerulea* Flax Lily
    - The remaining 5 species are common in the natural STIF areas and unlikely to have been planted or progeny from planted stock
        - *Pseuderanthemum variabile* Pastel Flower
        - *Bursaria spinosa* Blackthorn
        - *Polyscias sambucifolia* subsp. long leaflets Elderberry Panax
        - *Entolasia marginata* Bordered Panic
        - *Oplismenus aemulus* Basket Grass
- 14 exotic species (including many serious weeds)
- 4 species undoubtedly planted (such as cultivars and species from Queensland)
- 22 species made up of a mixture:
    - 1 tree species and 1 vine species on the planting schedule
        - *Acacia elata* Cedar Wattle
        - *Hardenbergia violacea*
    - 2 tree species nominated by the landscape architect as in the planting palette
        - *Eucalyptus punctata Grey Gum*
        - *Eucalyptus tereticornis Forest Red Gum*
    - 1 tree species that is widely planted, easily spread, and whose local provenance is controversial
        - *Brachychiton acerifolius* Illawarra Flame Tree
    - 1 unidentified *Acacia* species
    - 4 locally-native species species that are commonly recorded in the natural areas on site:
        - *Eucalyptus pilularis Blackbutt*
        - *Glochidion ferdinandi* Cheese Tree
        - *Eustrephus latifolius* Wombat Berry
        - *Gynochthodes* (was *Morinda*) *jasminoides* Sweet Morinda
    - 12 locally-native species species that are generally rarely recorded on site except for in the VZ4a areas, comprising trees, shrubs, ground covers, and vines.

Therefore, only 5 of the 50 species recorded are likely to be self-perpetuating naturally-occurring regrowth STIF species, while the majority of the species observed in the VZ4a areas (45 of 50) do not represent STIF being definitely or more than likely planted, exotic, or local species that occur commonly across the landscape and are of no particular conservation significance.

An additional tool has also been applied in answer to Council's request.

To aid in the recognition of vegetation communities of south east NSW, Tozer et al. (2010)[8] has developed a quantitative analytical tool using diagnostic species.[9] The resultant thresholds predict the likelihood of the data set representing that Map Unit with a 95% confidence interval, meaning that that five percent of plots sampled (1 in 20 plots) in a Map Unit may contain fewer than the threshold number of positive diagnostic species.

For their Map Unit WSF p153 (equivalent to BGHF), a 0.04 hectare plot located in this Map Unit is expected to contain at least 15 positive diagnostic species, provided that the total number of native species in the plot is 39 or greater.

By comparison, the applicable threshold for Map Unit WSF p87 (STIF) is the 23 diagnostic species in a 0.04 hectare plot, provided the presence of 40 or more native species in that plot.

The floristic composition component of the BAM vegetation plots are 0.04 hectares in area, and so the diagnostic rules are directly applicable. However, the plots in VZ4a (RDP 16 and RDP 17) only contain 18 and 14 locally-native species respectively – even when including species that have undoubtedly been planted (such as *Lomandra longifolia*). Therefore these data do not satisfy the basic premise of the model as neither reach the required 39 or 40 native species.

The number of diagnostic species relevant to each of the Map Units also fall short of the thresholds, even if expanded to include planted native species:

Plot #	Number of native species			Number of diagnostic species			
	0.04 ha plot	Threshold for		0.04ha plot		Threshold for	
		BGHF	STIF	BGHF	STIF	BGHF	STIF
RDP_16	18	39	40	14	20	15	23
RDP_17	14			5	8		

These analyses have demonstrated that some of the planted species and some of the potentially self-established species in VZ4a are characteristic or diagnostic of the natural vegetation surrounding the gardens. This is to be expected, particularly for species that are easily spread

[8] M.G. Tozer, K. Turner, D.A. Keith, D. Tindall, C. Pennay, C. Simpson, B. MacKenzie, P. Beukers and S. Cox (2010) Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* 11(3):359-406

[9] This procedure is based on the probability of sampling positive diagnostic species that occur more frequently within the target unit than in all survey sites combined. The minimum expected number of positive diagnostic species was calculated for each map unit based on the available survey data. New plots may belong to any candidate map unit for which counts of diagnostic species exceed this minimum number, although these inferences are subject to 5% statistical error rate (i.e. one out of 20 inferences will be incorrect). Conversely, the presence of fewer than the minimum expected number of positive diagnostic species may be considered evidence that the sample plot does not belong to the map unit under consideration, subject to 5% statistical errors. If applied correctly, this procedure will narrow the identification of a stand of vegetation to a few plausible alternative units. If a sample plot contains the minimum expected number of positive diagnostic species for more than one map unit, the number of species by which the minimum was exceeded may be used to assess the closeness of the match to each of the possible candidates.

such as those species with soft shiny fruits that are attractive to mobile species such as birds or bats.

However, the species mix cannot reasonably be assigned as equivalent to either of the natural communities that occur on site, being otherwise dominated by planted species or species with no affinity to these communities.

5. *If these additional investigations establish that the areas denoted as VZ4a are in fact a "mosaic of planted and remnant vegetation and which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal", then the application of a Streamlined BDAR is invalid and biodiversity credit offsets will need to be calculated as part of a full BDAR assessment for those areas.*

Response:

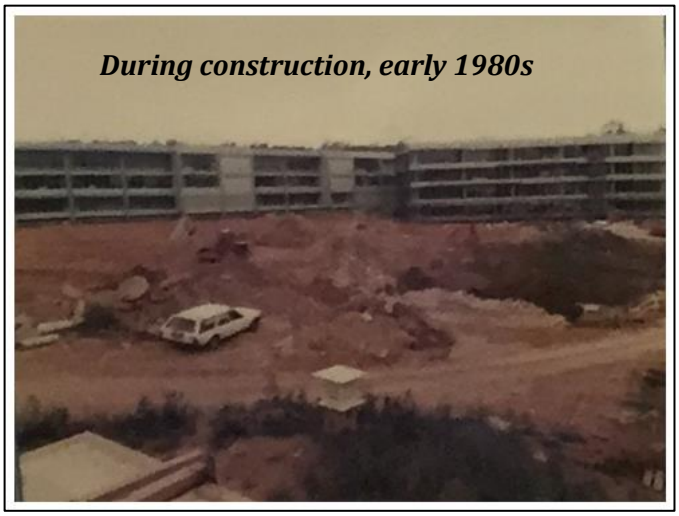
BAM 2020 provides a mechanism for properly assessing planted native vegetation, and the decision-making key in Appendix D is intended to aid in the determination of whether an area suspected of being a planted garden is in fact garden and can be treated as such.

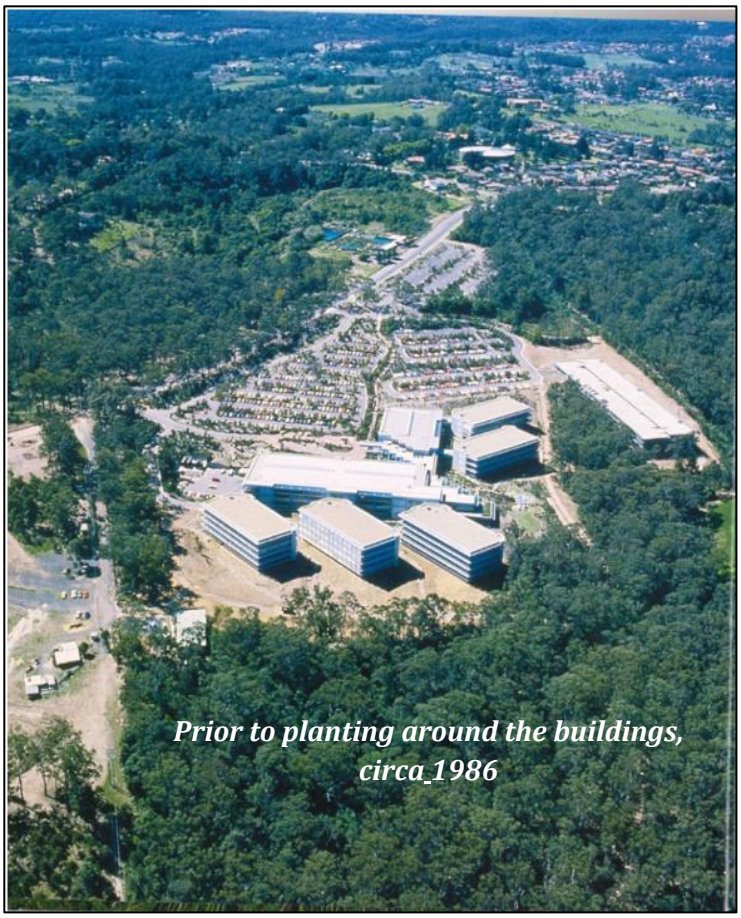
In this case, the investigation requires few assumptions as the history of the site has been well-documented and is well known. The areas mapped as VZ4a were established as landscaped gardens as part of the IBM development, and they have been maintained as such in the intervening 40 years.

The genesis of these landscaped areas is seen in the aerial photos in Appendix 2 and in additional photos from the 1980s reproduced overleaf. They show where and how profoundly the gardens around the buildings were excavated; and their subsequent treatments are detailed in the technical specifications prepared by the landscape architect for the IBM development. The mapping prepared at that time for the environmental management plan for the site clearly show that the built form was embedded in an uninterrupted matrix of landscaped gardens, including Areas A and B along the western boundary.

The gardens around the buildings and along the western boundary artificially resemble the natural composition of the natural communities within the subject lot to some degree as a result of deliberate planting and sporadic volunteers (some of which may be progeny of planted material of unknown provenance). However, the resultant overall species mix is not representative of these natural communities.

According to BAM 2020, for VZ4a **not** to be classified as Planted Native Vegetation, the area must be a *"mosaic of planted and remnant vegetation **and*** [emphasis added] *which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal".* While there is evidence of the area being a mosaic of planted and **regrowth** vegetation, there is no evidence of it being planted and **remnant** vegetation, as is evidenced in the photographs taken during construction. Also, the vegetation cannot be reasonably assigned to a local PCT because the majority of species observed are not related to any such PCT, and the majority of those species that are affiliated with a local PCT are known or likely to have been planted.





This additional investigation of the vegetation has served to support the original decision to apply the Streamlined Assessment module to the Demolition BDAR.

3 LANDSCAPE CONTEXT

In accordance with Section 3.2 of the BAM, streamlined assessments for planted native vegetation do not require assessment of native vegetation cover in a buffer area. However, some elements of that type of analysis are included in this section to more fully describe the context.

3.1 Site Description

The local area (within 1.5km of the site) is dominated by a highly urbanised complex of residential and commercial development, with major roadways in the north (Castle Hill Road), east (Pennant Hills Road), and south (M2 Motorway). Residential development is comprised of small to medium residential style lots with commercial development including small community shopping districts (see Figure 3 in Appendix 1).

The most significant area of vegetation in the local area (other than that on the subject lot) is in Cumberland State Forest, immediately to the east of the subject lot. This is made up of natural and planted vegetation and is a managed forest. Other than this area, the extent and pattern of bushland in the buffer region is typical of this part of The Hills LGA, being largely restricted to creek lines and gullies. It includes the heads of gullies within the Bidjigal Reserve and George Thornton Reserve to the south west (based on Darling Mills Creek and Bellbird Creek respectively), gully vegetation in Currawong Reserve to the south (based on Bellamys Creek), and the top of the gullies of the Berowra Valley National Park to the north east (based on Berowra Creek and Nyrippin Creek). Small patches of ridge top vegetation occur in Koala Park and West Pennant Hills Park closer to the subject lot to the east and north east. Otherwise, native vegetation is highly fragmented, and restricted to occasional and isolated trees planted along street verges and in the larger gardens (see Figure 4 in Appendix 1).

The 6.2 hectares of the demolition footprint is made up of approximately 3.3 hectares of existing development (53% of the demolition footprint) and 2.9 hectares (47% of the demolition footprint) of landscaped gardens.

The extent of the demolition footprint and the nature of the areas within it are illustrated in Figure 5 in Appendix 1.

3.2 Topography

The subject lot is situated on a long steep south-facing slope with its highest point at 170 metres ASL in the north near Castle Hill Road, down to its lowest point at 100 metres ASL in the lot's south-eastern corner near Darling Mills Creek.

3.3 Geology and Soils

Information regarding soils and geology is maintained in a number of spatial databases, including SEED, eSPADE 2.0, and within the local council mapping. The available data are sourced mainly

from the NSW Soil and Land Information System (SALIS) and includes soil hazards and soil landscape mapping.

The available soil landscape mapping of the Sydney 1:100,000 map sheet reveals the underlying patterns of geology and landform, and also describes the vegetation and land uses it supports.[10]

The subject lot is located on a south-facing upper slope. It contains a narrow band of West Pennant Hills soil landscape at the top, with Glenorie soil landscape across the remaining majority of the site down the slope up to and including the creek line at its southern boundary. An extract of this soil landscape mapping is shown in Figure 7 in Appendix 1 and illustrates that the demolition footprint is partially within both soil landscapes.

The **West Pennant Hills** soil landscape is a stable colluvium soil type that occurs as steep, narrow, south-west facing hill slopes on the Hornsby plateau. It is underlain by Wianamatta Group shales that give rise to friable clay loams.

Typical topography is steep-sided slopes generally greater than 20% and ranging up to 40%. This steep topography combined with the clay-loam soil gives rise to major limitations of the hazards of mass movement, soil erosion, localises seasonal waterlogging, and impermeable subsoil.

Natural vegetation on this soil landscape is tall open wet sclerophyll forest characterised by *Eucalyptus saligna* Sydney Blue Gum and *Eucalyptus pilularis* Blackbutt with other common species including *Syncarpia glomulifera* Turpentine, *Eucalyptus paniculata* subsp. *paniculata* Grey Ironbark and *Eucalyptus globoidea* White Stringybark. This vegetation has been extensively cleared, with the tall forests of the shale soils on the Hornsby Plateau being exploited by Europeans in the early days of the colony for the building of Sydney town.

The **Glenorie** soil landscape is an erosional soil landscape that occurs generally north of the Parramatta River on the Hornsby Plateau and is underlain by Wianamatta Group shales. Typical topography includes undulating to low rolling hills that support tall open-forest, most of which has been extensively cleared. It is often adjacent to West Pennant Hills soil landscape and contains similar soil materials. However, Glenorie soil landscape is less steep, and is not subject to mass movement.

The vegetation on this soil landscape is characteristically dominated by *Eucalyptus saligna* Sydney Blue Gum and *Eucalyptus pilularis* Blackbutt, although other species are common such as *Syncarpia glomulifera* Turpentine and *Eucalyptus paniculata* subsp. *paniculata* Grey Ironbark, *Eucalyptus globoidea* White Stringybark and *Angophora floribunda* Rough-barked Apple.

There are no areas of formally or informally recognised geological significance within the buffer area or on the subject lot.

[10] Chapman and Murphy (1989) Soil landscapes of the Sydney 1:100,000 sheet.

3.4 Rivers and Streams

Rivers and streams recognised under the *Water Management Act 2010* are those shown as blue lines on 1:25,000 topographic maps. The significance of the streams and the protections they attract are determined by their stream order, according to the Strahler system. In essence, this is defined by the number and types of upper branches.

There are a number of mapped streams in the local area as shown on the 9130-4S Hornsby 1:25,000 topographic map extract in Figure 3 in Appendix 1.

The subject lot is mapped as containing a first order stream running from an existing dam in the north of the site to the south and south west, before joining Bellamys Creek, approximately 475 metres downslope of the lot (see Figure 4 in Appendix 1). A second order stream runs along the southern boundary of the site, arising in the adjacent Cumberland State Forest.

There are no wetlands recognised under the *State Environmental Planning Policy Coastal Management 2018* within the buffer area or otherwise nearby.

3.5 Connectivity Features

The more connected that habitats are, the more valuable they are to biodiversity. This is partially a result of a larger area of habitat being available, which may support more individuals simply due to its greater size. However, a larger area of habitat may also provide for a more diverse suite of species, due to the chance of it supporting a greater diversity of habitat niches. Larger areas may also cater for species that require large home ranges, such as owls.

Linked habitats also provide movement corridors for dispersing young or plant propagules, or for refuge from catastrophic events such as fire. This is particularly so for species that have limited mobility, such as snails or some plants.

Separated patches of habitat also have value as “stepping stones” for highly mobile species such as birds and bats.

The local area (1.5km buffer) is overwhelmingly an urban landscape, with major barriers to movement of fauna and flora in the expanses of residential areas and major roads. The vegetated parts of the subject lot and the adjacent Cumberland State Forest contain the most valuable areas for biodiversity by virtue of their size and diversity of habitats contained therein. Otherwise, direct connectivity of habitats is provided by narrow corridors of vegetation concentrated in riparian zones.

3.6 IBRA Regions

The demolition footprint is wholly within the Sydney Basin IBRA bioregion, and the Cumberland IBRA subregion. The site is also entirely within the NSW Mitchell Landscape Pennant Hills Ridges, with the Port Jackson Mitchell Landscape occurring on the lower slopes to the south.

The Sydney Basin IBRA Bioregion[11] occupies over 3.6 million hectares and extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee. It includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems, all of the smaller catchments of Lake Macquarie, Lake Illawarra, Hacking, Georges and Parramatta Rivers, and smaller portions of the headwaters of the Clyde and Macquarie rivers.

The Cumberland IBRA subregion[12] contains low rolling hills and wide valleys in areas of rain shadows below the Blue Mountains on Triassic Wianamatta shales and sandstones. It has intrusions by small volcanic vents that are partly covered by tertiary river gravels and sands, with quaternary alluvial soils occurring along the main streams.

Soils are typically red and yellow with brown clays on volcanics. At least three terrace levels are evident in gravel splays with volcanics occurring from low hills in shale landscapes. Swamps and lagoons occur in floodplain areas of the Nepean River.

Vegetation is typically divided by soil influences. *Eucalyptus moluccana* Grey Box, *Eucalyptus tereticornis* Forest Red Gum, *Eucalyptus crebra* Narrow-leaved Ironbark woodland with some *Corymbia maculata* Spotted Gum occurs on rolling shale hills. *Eucalyptus sclerophylla* Hard-leaved Scribbly Gum, *Angophora floribunda* Rough-barked Apple and *Banksia serrata* Old Man Banksia on alluvial sands and gravels. *Angophora subvelutina* Broad-leaved Apple, *Eucalyptus amplifolia* Cabbage Gum, and *Eucalyptus tereticornis* Forest Red Gum with abundant *Casuarina glauca* Swamp Oak occur on river flats, with tall rushes with *Eucalyptus parramattensis* Parramatta Red Gum in lagoons and swamps.

3.7 Areas of High Biodiversity Values

The site is mapped as containing high biodiversity values across much of the development demolition footprint and the subject lot in general (see Figure 1 in Appendix 1 for an extract from the BVMATT mapping tool).[13] These areas have been identified in the BVMATT mapping as containing "threatened species or communities with potential for serious and irreversible impacts", despite capturing planted trees in the open carparks and other landscaped gardens.

It is most likely that the areas have been so mapped due to the normally authoritative Sydney Metropolitan vegetation mapping that has erroneously identified all of these areas as Blue Gum High Forest,[14] a Critically Endangered Ecological Community (see Figure 8 in Appendix 1).

Other important features worthy of consideration for landscape context are Areas of Outstanding Biodiversity Values (AOBVs) and specific areas of Important Habitat mapped by the Department.

[11] Sydney Basin Bioregion, at http://www.environment.nsw.gov.au/bioregions/SydneyBasinBioregion.htm
[12] Sydney Basin – subregions, at http://www.environment.nsw.gov.au/bioregions/SydneyBasin-Subregions.htm
[13] Biodiversity Offsets Scheme Threshold map available at https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMATMap
[14] Vegetation Map - Sydney Metro Area v3.1 2016 – E-VIS 4489, available at https://geo.seed.nsw.gov.au/Public_Viewer/index.html?viewer=Public_Viewer&locale=en-AU

No AOBVs are yet recognised on the subject lot or in the buffer area. At the time of writing, the four areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995* are the first and only AOBVs in NSW:

- Gould's Petrel – critical habitat declaration;
- Little Penguin population in Sydney's North Harbour - critical habitat declaration;
- Mitchell's Rainforest Snail in Stotts Island Nature Reserve - critical habitat declaration; and
- Wollemi Pine - critical habitat declaration.

Similarly, none of the current suite of Important Habitat mapped are on the subject lot or in the buffer area:

- Swift Parrot - The closest mapped important lands occur approximately 10 kilometres south east of the site near Chatswood East and 13 kilometres south west of the site near Prospect Reservoir;
- Migratory Shorebird habitat - The closest mapped areas occur along tributaries of the Parramatta River, approximately 8 kilometres south of the site; and
- Regent Honeyeater - The closest mapped habitat occurs approximately 29 kilometres north of the site near Maroota and 36 kilometres west of the site near Warragamba.

4 VEGETATION

In accordance with Appendix D of the BAM, Chapter 4 'Native Vegetation' is not required as part of the streamlined assessment module for planted native vegetation. However, assessment of the planted native vegetation has been included to provide clarity and a comprehensive assessment of the demolition footprint.

4.1 Background Information

A number of sources of information were used to aid in the sampling and identification of vegetation in the demolition footprint in general:

- land use history as indicated by historical records including old survey plans, parish maps, and land grant records;
- historical aerial photography from 1943 through to the 1980s;
- a discussion with Mr David Louden, the Landscape Architect for the IBM development project;
- consideration of literature produced by the National Trust specific to the management of the vegetation of the IBM site;
- recent high quality aerial photography;
- the published scientific literature, particularly papers and reports that refer to vegetation mapping of the area (including Cumberland State Forest); and
- scientific databases, particularly
    - BioNet atlas of NSW Wildlife - for records of common and threatened species; and
    - BioNet Vegetation Classification – formerly known as the Vegetation Information System (VIS). This is the standard database for plant community types for NSW, and underpins the analytical tools applied as part of the BAM. The database facilitates vegetation classification by a series of queries of critical features (e.g. structure, location, canopy dominants), and inspection of all related data relevant to each recognised plant community type.

4.2 European Land Use History

European settlement of the Pennant Hills area was early, swift, and destructive. The extensive stands of tall forests that occurred on the rich shale soils of the Hornsby plateau were cleared and turned into farmland within 30 to 50 years of the Europeans claiming and distributing land to ex-convicts, settlers, and their offspring.

Despite its distance from Sydney town, land grants were first made in this district in 1799 - only 11 years after the arrival of the First Fleet. For example, 100 acre (40 hectare) parcels were granted to the Reverend Samuel Marsden and Dr Thomas Arndell near the present day Thompsons Corner (Rowland 2008).

This area came to European attention due to its extensive forests of tall straight construction timber (Blue Gum, Blackbutt), timber for marine applications (Turpentine), timber for roof shingles (Forest Oak), and timber for fine joinery and furniture (Red Cedar). A government logging

camp was set up in 1816 less than 2 kilometres to the east of the subject lot, and clearing was rapid. By 1830 the majority of the best timber of these tall forests of the shale soils had been cut for the construction of Sydney town (Benson and Howell 1990). Timber-getting then gave way to the establishment of farms and orchards (Rowland 2008), which was the general pattern of land use until the rapid post-war urbanisation seen in the second half of the twentieth century.

The subject lot was undoubtedly part of the extensive Bellamy landholdings in the local area, which began in 1804 with the granting of 100 acres (40 hectares) to William Bellamy after he gained his ticket of leave. The southern part of this grant was located where modern-day Aiken Road occurs, and so the landholding may have incorporated some of the southern bushland of the subject lot and / or Cumberland State Forest.[15] By 1807 he had 27 acres under cultivation and 103 acres of pasture; he subsequently accumulated more land grants and distributed them amongst his children, including his son James.

Some time prior to 1824, James Bellamy had also been granted - and had cleared - 60 acres (24 hectares) of land that comprised the current subject lot. At that time he petitioned for and was granted a further 60 acres (24 hectares) to provide more pasture for his cattle and horses.[16]

William Bellamy became a well-known and influential orchardist, and at least part of his son James' landholding contained fruit orchards. James' landholding and orchards most likely included the subject lot, as his homestead was built in the 1880s on the crown of the hill on the corner of Coonara Avenue and Castle Hill Road, opposite the current subject lot (Hornsby Shire Council, no date).

Aerial photography from 1943 (the earliest available) shows clearly that the northern half of the subject lot was a well-established orchard with the southern half occupied by bushland (see Figure 2 in Appendix 1). Given the pattern of land grants and the reported areas under cultivation and / or grazing land, this bushland is almost certainly regrowth and not remnant forest, having been cleared at least once, and initially by the Bellamy clan.

The orchard evident in the 1943 aerial photograph was still a going concern in the early 1980s at the time of its redevelopment as headquarters for IBM (personal communication, David Louden, Landscape Architect for the IBM project). The pattern of clearing established for the orchard was largely mirrored by the IBM development, although the landscape was altered considerably with deep excavation, substantial terracing down the slope, the building of a perimeter road around the development, and the establishment of two dams and other stormwater management infrastructure (see Figure 2 in Appendix 1).

[15] Australian Royalty, historical database curated by Marion Purnell, available at https://australianroyalty.net.au/tree/purnellmccord.ged/individual/I49105/William-Bellamy, viewed 27 June 2020

[16] Australian Royalty, historical database curated by Marion Purnell, available at https://australianroyalty.net.au/tree/purnellmccord.ged/individual/I44714/James-Zadok-Bellamy, viewed 27 June 2020

4.3 Vegetation Mapping

The vegetation of this area has been addressed partially by NSW NPWS (Tozer 2003), then by The Hills Shire Council (2008), and most recently by the NSW Office of Environment and Heritage (2013 and 2016).

The most recent of these mapping exercises is the latest attempt at a comprehensive and standardised treatment of the vegetation of the Sydney Metropolitan Area, with version 2 of the reports (OEH 2013) and version 3.1 of the digital maps (OEH 2016) referred to in this BDAR. This version of the mapping depicts the subject lot and the demolition footprint as dominated by Plant Community Type (PCT) 1237 *Sydney Blue Gum – Blackbutt – Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby plateau, Sydney Basin Bioregion*. This PCT is representative of the Critically Endangered Ecological Community (CEEC) Blue Gum High Forest (BGHF). This mapping also includes PCT 1281 *Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion*, which is representative of Sydney Turpentine Ironbark Forest (STIF) CEEC in the southern part of the subject lot.

An extract of this mapping is provided in Figure 8 in Appendix 1.

This mapping was used to inform the sampling but was not relied upon uncritically.

4.4 Sampling

This Streamlined BDAR for the demolition footprint is part of a larger study across the entire subject lot. An initial desktop analysis was undertaken for the entire lot as well as for bushland in adjacent lands to help define the scope of on-ground assessment and survey. Preliminary site inspections and analyses of aerial photography followed, and these data were used to determine sampling locations across the subject lot and provide advice regarding the ecological constraints to the redevelopment of the site.

The vegetation zones were subsequently defined through sampling by extensive random meander and full floristic quadrats and transects in accordance with the BAM.

Floristic sampling occurred in all seasons over a 5-year period from September 2015 to April 2020.

The locations of the sampling quadrats and the random meander relevant to the demolition footprint are shown in Figure 9 in Appendix 1, and data sheets for floristic plot surveys are provided at Table 1 in Appendix 3. These plots were resurveyed in April 2020 to ensure the data were current for this analysis and also aimed to capture species that may have germinated after recent good rain. The tree data collected by Project Arborist were also used to supplement the floristic data collected in the BAM plots.

It is noteworthy that the plots were not located randomly and therefore not strictly in accordance with the BAM methodology. However, this was due to the landscaped areas being generally too small to accommodate the floristic plots and BAM plots, and so plots were located in garden areas

of sufficient size where the plot was not interrupted by paths, drains, or other infrastructure. This also necessitated the location of one plot outside of the demolition footprint, but still within a landscaped garden beds.

Sampling was intended to:

- Compile a comprehensive species list;
- Determine boundaries of PCTs and vegetation zones;
- Identify the condition of vegetation across the site;
- Identify indicator species for the vegetation communities;
- Better understand the context of the development site's vegetation and habitats by inspection of surrounding areas;
- Determine the extent of locally native trees that have likely been planted within the existing IBM site;
- Identify threatening processes; and
- Understand the habitat features of the development site and its relationship with surrounding lands.

All of the plant species observed during survey, as well as those tree species reported in the arboricultural assessment report, have been collated and are provided in Table 2 in Appendix 3.

4.5 Vegetation types

As part of the original IBM development, the areas surrounding the buildings were extensively landscaped and integrated with their intended function in the surrounding landscape (such as amenity plantings around the outdoor eating area, or an ersatz rocky gully for stormwater control). These areas were principally planted out with Australian native species, with some of the species selection guided by the nursery staff at the adjoining Cumberland State Forest (personal communication David Louden, Landscape Architect for the IBM project). Some parts of the natural riparian area adjacent to the buildings were also "enriched" with plantings of tree ferns and other terrestrial ferns, and understorey plantings were generally restricted to fast-growing species such as *Acacia* (probably *fimbriata*) (personal communication David Louden, Landscape Architect for the IBM project).

While these gardens have been regularly maintained by grounds staff, some areas now support high weed loads, and many exotic understorey species have also been planted (such as species of the African Iris *Dietes* in place of *Lomandra longifolia*). The understorey is generally sparse in the landscaped gardens, but with two exceptions:

- along the south western corner of the ring road where dense growth in the mid storey has arisen due to regular pruning. This pruning is necessary to allow for the safe passage of vehicles; and
- along an artificial gully constructed on the northern side of the main building as part of the stormwater management system.

As part of the IBM development and almost as an afterthought, the opportunity was taken to

soften the open-air car parks and counteract some of the heat island effect of the extensive areas of hard surfaces by planting trees in a series of narrow garden beds (personal communication David Louden, Landscape Architect for the IBM project). The car parking bays were interrupted by a series of narrow and shallow excavated troughs that were back-filled with (probably) 200 millimetres of soil and (probably) 500 millimetres of mulch, within which shade trees were planted (personal communication David Louden, Landscape Architect for the IBM project).

These troughs effectively formed impermeable sandstone containers: they were not designed to accommodate the growth of large trees but were instead designed by engineers for civil works. Together with the impact of the surrounding hard surfaces (e.g., heat generation, further restriction of root growth, prevention of percolation of water, prevention of gaseous exchange), and the addition of polluted runoff, tree growth has been constrained.

These landscaped gardens in the open-air car parks constitute the only vegetated parts in the demolition footprint. As these gardens have been confirmed as planted and regularly maintained, they are defined as planted native vegetation and have not been assigned to a PCT, per BAM 2020.

Eleven vegetation zones have been identified and mapped across the subject lot – see Figure 10 in Appendix 1. The vegetation within the demolition footprint is entirely part of Vegetation Zone 4a – Landscaped Gardens – see Figure 11 in Appendix 1.

The demolition footprint consists of built form and 2.9 hectares of Vegetation Zone 4a Landscaped Gardens.

The landscaped garden identified as **Vegetation Zone 4a** is variable across the site, being planted out according to a landscape plan driven by function, amenity, and an artistic vision. For example, some of the garden beds in the open-air car park only contain *Corymbia maculata* Spotted Gum over bare earth, while the artificial gully that forms part of the stormwater management system has been densely planted out with a different suite of species and has a more complex structure.

5 THREATENED SPECIES HABITAT (Planted Native Vegetation)

The Streamlined Assessment Module of BAM 2020 does not require formal survey for threatened species for planted native vegetation, relying instead on incidental survey. However, detailed targeted survey has been undertaken as part of the assessment of the biodiversity of the whole subject lot, and is therefore reported and relied upon here.

Background information was gathered on threatened species known to occur in the local area, principally an interrogation of BioNet for threatened species recorded within 10 kilometres of the site, further filtered to a buffer area of 1.5 kilometres radius.

Expert habitat assessments were undertaken across the entire subject lot and included the demolition footprint. A list of species has been compiled that were considered worthy of further survey, and survey was undertaken.

Survey and results for the relevant threatened species are detailed below.

5.1 Threatened Species Survey

Flora and fauna surveys were undertaken across the development site from 2015 to 2020 in all seasons, and included targeted surveys for the candidate species identified, as well as any other threatened species otherwise considered to have a high likelihood to occur.

Threatened species surveys included the following effort across the subject lot and in the demolition footprint where appropriate:

- **Flora** – targeted searches within suitable habitats specific to each species, BAM plots, and random meander;
- **Invertebrates** – targeted transects within areas of suitable habitat, random meander, opportunistic surveys;
- **Amphibians** – BAR audio recording, targeted surveys around dams and riparian lands, active listening, opportunistic surveys;
- **Reptiles** - Camera trapping, spotlighting, opportunistic, scat searches;
- **Diurnal Birds** – BAR audio recording, camera trapping, active listening, dawn surveys, dusk surveys, opportunistic;
- **Nocturnal Birds** - BAR audio recording, camera trapping, active listening, stagwatching, spotlighting, call broadcast;
- **Arboreal mammals** – BAR audio recording, camera trapping, stagwatching, spotlighting, habitat assessment, including scat searches and tree scratches;
- **Terrestrial mammals** – Camera trapping, spotlighting, opportunistic, scat searches;
- **Megachiropteran bats** – BAR audio recording, spotlighting, active listening, opportunistic;
- **Microchiropteran bats** – ultrasonic audio recording (Anabat) and analysis.

5.2 Flora

Threatened flora species were targeted for survey for the following reasons:

- they were strongly recommended by officers of the scientific division of the Department of Planning, Industry, and Environment for consideration; or
- they were generated by the BAM-C as requiring consideration as a result of the PCT, patch size and other landscape features identified on parts of the site outside of the demolition footprint; or
- they were considered to have a high likelihood to occur due to the habitats available; or
- they were considered likely to occur due to the currency and proximity of other reliable records; or
- there were records of the species on or near the subject lot.

The species targeted for survey in the demolition area was restricted to *Syzygium paniculatum* Magenta Lilly Pilly, as it had been identified in one of the landscaped garden beds by the Project Arborist.

Syzygium paniculatum Magenta Lilly Pilly is listed as Endangered under the New South Wales *Biodiversity Conservation Act 2016* and Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*.

5.2.1 Survey Considerations – Magenta Lilly Pilly

This species is naturally restricted to a 400 kilometre stretch of coastal habitat within NSW between Conjola National Park in the south to Upper Lansdowne in the north. In the Sydney area, the Sydney Metropolitan mapping project (OEH 2016) found this species occurring naturally in three vegetation types:

- Coastal Dune Littoral Rainforest -this vegetation is restricted to small, isolated stands of this rainforest occur in the Sydney area on the Kurnell Peninsula and Bundeena;
- Coastal Sand Bangalay Forest – this vegetation is found on flat, low-lying coastal marine sand deposits of the coastal zones; and
- Coastal Freshwater Swamp Forest – this vegetation occupies poorly drained substrates that are periodically inundated by fresh or brackish water across the coastal plain and hinterland of the Sydney metropolitan area. Examples have been mapped in the Kings Wetland at Brighton Le Sands, the Lachlan Swamps of Centennial Parklands, in the Warringah area, and near Wallacia.

Despite its natural rarity, it is widely cultivated in eastern Australia as an ornamental garden plant (Nicholson and Nicholson 1994, Wrigley and Fagg 1996, Floyd 2008 quoted in OEH 2012), is known by a number of common names, and a range of horticultural varieties have been developed by the nursery industry. The National Recovery Plan (OEH 2012) recognises that the plants in cultivation are hybrids or of unknown genetic origin and therefore should be excluded from "*all actions related to the conservation of the species in the wild*" (OEH 2012).

The deep magenta fruits, which may be spherical or egg-shaped, mature in May. It is polyembryonic, producing up to nine seedlings per seed (OEH 2012). Without fruit, it is difficult to differentiate this species from *Syzygium australe* Brush Cherry (NSW NPWS 2001) with which it often co-occurs.

5.2.2 Survey – Magenta Lilly Pilly

Survey was undertaken in the months of January, April, and December and included

- targeted random meander in all garden areas around the buildings;
- targeted searches within the landscaped garden areas where the Project Arborist had identified this species; and
- targeted random meander along the natural riparian habitats and gullies on the development site outside of the demolition footprint.

Flora survey efforts are shown in Figure 9 in Appendix 1.

5.2.3 Survey Results – Magenta Lilly Pilly

During surveys, a total of 18 individuals of Magenta Lilly Pilly were recorded within a landscaped drainage line immediately adjoining the existing IBM building. Another adult individual occurs in a garden bed outside of the Demolition footprint. The individuals range in age from mature trees that were planted as part of landscape works of the IBM site in the 1980s, to younger trees that may have seeded naturally.

This part of the garden has been constructed to mimic a gully and is part of the stormwater management system.

Their locations are shown in Figure 12 in Appendix 1.

Although this species is now probably self-seeding on site within the constructed drainage feature, these individuals are naturalised from the original planted specimens and do not constitute a naturally-occurring population in the sense used in conservation policy and regulation.

5.3 Fauna

Fauna surveys were conducted from 2015 to 2020 and were intended to sample the various habitats present on site and to detect any fauna species likely to use the development site. Suitable survey times for each of these threatened fauna species (as per their known detectability and according to the BAM calculator).

Survey techniques were appropriate for each fauna group, including the following:

Invertebrates

- Habitat searches;
- Targeted transects within areas of suitable habitat; and

- Opportunistic surveys.

Amphibians

- Active listening; and
- Audio recording in likely habitat; and
- Opportunistic survey during all times on site.

Reptiles

- Opportunistic survey during all times on site.

Diurnal Birds

- Timed survey at spot locations;
- Audio recording;
- Active listening; and
- Opportunistic survey during all times on site.

Nocturnal Birds

- Audio recording;
- Spotlighting;
- Call broadcast; and
- Habitat searches.

Terrestrial mammals

- Habitat searches;
- Spotlighting;
- Opportunistic survey occurred during all times on site; and
- Opportunistic scat searches.

Arboreal mammals

- Audio recording;
- Habitat searches;
- Spotlighting; and
- Specific habitat assessment for preferred Powerful Owl prey.

Megachiropteran bats

- Audio recording; and
- Spotlighting.

Microchiropteran bats

- Recording of microbats from dusk to dawn over 2 nights using 2 x Anabat Express at 2 locations in December 2017 (southern bushland and car park trees) and December 2018 (adjacent to dam, and car park trees). Microchiropteran bat calls were analysed using the Anabat 5.1 software package and compared to a known call library (Pennay et al. 2004)

Fauna survey efforts are shown in Figures 13A to 13F in Appendix 1 across the subject lot and in relation to the demolition footprint.

Three threatened fauna species were targeted for survey, because they were considered to have a reasonably high likelihood to occur (*Ninox strenua* Powerful Owl, *Pommerhelix duralensis* Dural Land Snail), and / or were of particular concern to the local community (*Phascolarctos cinereus* Koala). The survey for these species is detailed in Figures 13A to 13F in Appendix 1.

Surveys undertaken for Powerful Owl are detailed in Table 3 in Appendix 3 and survey undertaken for the Dural Land Snail is detailed in Table 4 in Appendix 3. Surveys for Koala have been detailed in Section 5.5.1 below.

A full list of the fauna species recorded during survey is provided at Table 5 in Appendix 3.

A total of 5 or 6 fauna species of conservation significance were recorded on or near the subject lot during survey:

- *Pommerhelix duralensis* Dural Land Snail – species credit species
- *Ninox strenua* Powerful Owl – breeding habitat represents species credits
- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat – ecosystem credit species
- *Micronomus norfolkensis* Eastern Coastal Free-tailed Bat - ecosystem credit species
- *Falsistrellus tasmaniensis* Eastern False Pipistrelle and / or *Scoteanax rueppellii* Greater Broad-nosed Bat (calls impossible to distinguish) – both ecosystem credit species

5.4 Powerful Owl

Ninox strenua Powerful Owl is listed as Vulnerable under Schedule 1 of the *Biodiversity Conservation Act 2016*. This species is not listed under the Schedules of the *Environment Protection and Biodiversity Conservation Act 1999*

5.4.1 Survey Considerations – Powerful Owl

The Powerful Owl can be detected in a number of ways:

- Direct observation in its diurnal roost;
- Heard calling, usually when it is establishing breeding territories;
- Calling or otherwise investigating in response to broadcast of calls;
- Direct observation around nest trees;
- White wash beneath roost trees or nest trees;
- Regurgitated pellets of undigested fur, feathers, and bones of prey dropped beneath feeding roosts;
- Dropped (usually headless) prey.

The Powerful Owl is a highly territorial species, but most particularly during breeding and can be very sensitive to disturbance at that time. Therefore, best practice survey guidelines now recommend that no active survey (e.g. broadcasting calls, spotlighting, inspection of nest trees, flash photography) is to occur early in the breeding season. Thus, the type of survey to be undertaken is dictated by their life cycle stage as well as their daily behaviour, according to the following seasonal pattern:

- **Territory establishment.** During early autumn (March), males can be heard calling while they establish (or re-establish) their territories. They usually call in the early evening but are known to call intermittently throughout the night. In this season, it is therefore most

easily detected at night through passive call recording. Adult males and females (and sometimes still dependent young) may be observed in day roosts;

- **Courting and mating** usually occurs throughout autumn, from late March to May. Males continue to call periodically through the night to their mate as well as to warn off other males. Survey must not interfere with this early breeding, and so they are again best detected at night through passive call recording, and otherwise observed in their day roosts;
- **Incubation.** The female is on the nest from early June to early September. She does not leave the nest tree during the 38-day incubation period, and is fed by the male. The male acts as both guard and provider during this period. His day roost is invariably near the nest tree, and usually from a vantage point with a good view of the entry to the hollow. Therefore, the male is best detected in his day roost, or observed entering and leaving the nest with prey items for his partner. Calls between the pair in this period are usually brief, so passive recording is not very effective as the recorder needs to be located close to a nest tree and recording conducted continuously from before dusk to after dawn;
- **Nestlings.** During early spring (September-October), newly-hatched nestlings can be heard in the nest. Both males and females forage and feed the young, but the females still spend most of their time in the nest with the vulnerable offspring. Therefore, in this season, Powerful Owls are best detected by direct observation of males in their day roosts, or of observation of feeding activity around the nest tree entrance;
- **Fledglings.** The young are fledged 7 to 8 weeks after hatching, and by mid to late spring are escorted by the parents to another part of the territory away from the nest tree. Therefore, from late spring to mid-summer, both parents and fledgling juveniles are best detected in day roosts. Fledglings may still be with and dependent on their parents to some degree until the autumn, when courtship begins for the next breeding season. Broadcast of calls at night from late spring to summer is generally unlikely to interrupt their behaviour and so this, along with the observation of animals at their day roosts, are the best survey methods at this time of year.

5.4.2 Survey – Powerful Owl

Biodiversity survey has been carried out on the subject lot by Keystone Ecological from winter 2015 to winter 2020. Targeted survey activities for Powerful Owls were informed by the following desktop investigations:

- Literature searches, the most relevant being the Species Impact Statement prepared for the Tree Tops Adventure Trail in Cumberland State Forest (Couston 2013);
- Interrogation of wildlife databases (BioNet, Atlas of Living Australia, eBird);
- Consultation with the Site Manager of Cumberland State Forest Mr Tim Liston; and
- Consultation with experts and colleagues, particularly Dr Stephen Ambrose (Ambrose Ecological Services), Dr Beth Mott (BirdLife Australia, convenor of the Powerful Owl Project), and Mr Corey Mead (Treehouse Ecology).

These investigations identified 2 trees on the subject lot that had been known to be used for nesting in the past, and possibly up to another 4 trees in the adjacent Cumberland State Forest. Birdlife Australia reported both successful and unsuccessful breeding attempts in 4 of these trees

in 2000, 2004, 2007, 2008, 2014, 2015, 2016, and 2017. The approximate locations and dates of breeding activities are shown in Figure 14 in Appendix 1.

This background information allowed for targeted survey on site to be confined to potential roosting habitat in the two gullies, and specifically around known nest trees. Supplementary survey was undertaken in Cumberland State Forest in winter and spring 2019 and autumn and winter 2020. In accordance with the sampling constraints detailed above, appropriate methodology has been employed in every sampling period, but comprehensive targeted survey was not implemented until spring 2017.

Survey details are shown in Figures 13A to 13F in Appendix 1 and Table 3 in Appendix 3. Survey activities comprised:

- Continuous nocturnal audio recording in 4 locations on site (in roosting habitat along the central gully and beneath nest tree #2);
- Call broadcast from 2 locations in the northern and southern parts of the site. Calls were broadcast within 1 hour of nightfall, repeated several times interspersed with quiet listening;
- Assessments were made of the habitat quality for arboreal mammals, but particularly for *Pseudocheirus peregrinus* Common Ringtail Possum. These assessments were made across at 14 locations across the subject lot, including in the demolition footprint. All habitat assessment plots were approximately 400 square metres in extent. Their locations are shown in Figure 13A to 13F in Appendix 1.

  The features measured at each of these habitat assessment points included:
  - the presence / absence of hollow-bearing trees;
  - the presence / absence of understorey; and
  - the nature / condition of that understorey.

  The areas of highest value are those with a number of hollow-bearing trees of various types, together with a dense native understorey. The areas of least value are those with no hollow-bearing trees and no understorey. A 5-point scale from 0 to 4 was established for understorey, and a point added to each plot if appropriate hollow-bearing trees were present:
  - 0 – little or no understorey
  - 1 – mid-dense exotic understorey
  - 2 – mid-dense native understorey
  - 3 –dense exotic understorey
  - 4 –dense native understorey
- Regular and repeated daytime inspection of canopy and sub-canopy trees in the roosting habitat in the gullies;
- Intensive searching beneath planted trees in developed parts. These areas were targeted as they are the areas proposed for development as per the Masterplan;
- Spotlighting around the developed and planted areas, along trails in the southern bushland, and along trails in Cumberland State Forest;
- Intensive searching for potential nest trees and the breeding pair in Cumberland State

Forest in autumn and winter 2020; and

- Regular and repeated inspections beneath nest trees #1 and #2 for signs of use (such as white wash or regurgitated pellets).

5.4.3 Survey Results – Powerful Owl

Results from survey for this BDAR, together with Birdlife Australia records and Forestry Corporation staff, indicate breeding activity in 5 nest trees in this area from 2000 to 2020. Two trees on the subject lot have been used on 4 occasions (2007, 2008, 2014, 2015) and at least 3 trees have been used in Cumberland State Forest on 7 occasions (2000, 2004, 2016, 2017, 2018, 2019, 2020).

Previously identified nest trees on the subject lot and associated 100 metre buffer areas are shown in Figure 14 in Appendix 1.

No individuals of the Powerful Owl were observed on the subject lot, including the demolition footprint during any of the targeted survey activities from 2017 to 2020. However, calls were recorded by the passive audio recording equipment placed near tree number 2 in December 2017 and again in July 2019.

In 2017 two short, faint calls of the Powerful Owl were recorded 5 minutes apart at dusk on 29th December. The even nature of each of the two hoots in each call indicates that it may be a male calling, and the timing indicates it may have been emerging from its day roost. Unfortunately, it is not possible to determine if the call was of a distant bird, or a very soft call from a bird close to the recording equipment.

At this time of year, a successful breeding pair should have recently-fledged young with them away from the nest. However, no owlets were observed during survey, and there are no reports of such activity published by eBird or BirdLife Australia at that time in or near that location.

Roosting habitat on site was regularly inspected throughout 2018 and 2019, but no animals were observed on site or evidence of their occupation found.

Forestry Corporation staff reported seeing 2 young birds in December 2018 in one of the gullies near the corporate buildings in the southern part of Cumberland State Forest (Mr Tim Liston, personal communication). The gully adjacent to Building D is also reportedly a regular diurnal roost site, and old regurgitated pellets were located in this gully indicating it was a roost site in the past. It is not known which tree was used for nesting in that season, but the absence of evidence of activity in trees and habitat within the subject lot indicate that trees 1 and 2 were not used.

In the audio sampling period of 2-9 July 2019, short faint calls were again recorded by the audio equipment located near tree number 2. The calls all occurred within a few minutes either side of the end of astronomical twilight, which is when the sky is dark and most nocturnal species become active. At this time of year, the female should be on eggs in the nest, and it is likely that the recording was of the male calling softly to her as he woke and emerged from his day roosting

habitat, prior to his first foraging foray.

In order to determine whether these calls were of the pair using tree number 2, this tree was watched on 18 July 2019 from a half hour before the start to a half hour after the end of astronomical twilight. No animals were observed to enter or emerge from nest tree number 2, but faint calls were recorded at 6.04 p.m.

At the same time as tree number 2 was being watched, another observer quietly surveyed the gullies around the Forestry Corporation buildings, listening for calling birds during twilight. Calls of the Powerful Owl were heard at 6.04 p.m. and although they were not loud or persistent, they were clearly emanating from a gully in the southern part of Cumberland State Forest and not from the subject lot. Animals were not observed, as the mid canopy in this part of the State Forest is very dense, and further investigations were not undertaken due to it being in a sensitive part of the breeding season.

Follow up survey was undertaken by bird specialist Dr Stephen Ambrose on 6, 8, and 9 September 2019, looking for likely nest trees in the gullies around the Forestry corporate buildings. No Powerful Owls were observed, and there were no obvious signs of current or recent Powerful Owl nesting activity at each of the previously known nest trees.

Therefore, it was concluded that the faint calls recorded by the recording equipment located at tree number 2 were of the Powerful Owl calling from Cumberland State Forest, and not from the subject lot.

Further investigations of the subject lot and Cumberland State Forest in autumn and winter 2020 discovered the breeding pair in Cumberland State Forest, in a gully to the north east of the multi-storey car park. Intensive daytime inspections of gullies in Cumberland State Forest in June 2020 revealed a combination of habitat features in one area that indicated further investigation was warranted: a potential nest tree with a suitable perch site nearby, and within good roosting habitat.

Quiet listening and watching at dusk revealed the male calling softly from the perch, clutching a dead Ringtail Possum. The female answered and emerged from the nest tree, the male passed the meal to her, and she then re-entered the nest. The male was subsequently observed roosting in the dense understorey canopy of this gully during the day.

Given the inaccurate locations of previous nest trees, it is possible that the tree observed to be used in 2020 is actually the same tree reportedly used in 2016 and 2017 – tree number 3. The observed location of the nest tree in 2020 is greater than 100 metres from the demolition footprint, which is the buffer distance around a nest tree that needs to be considered for impact to breeding habitat.

5.5 Koala

Phascolarctos cinereus Koala is listed as Vulnerable under the New South Wales *Biodiversity Conservation Act 2016* and Vulnerable under the *Environment Protection and Biodiversity*

Conservation Act 1999.

5.5.1 Survey Considerations - Koala

Koalas were surveyed as a result of community concern, and in accordance with best practice.

Although the Koala is iconic and easily-recognisable, it is often difficult to detect. They are very still and curled up during the day, sleeping high in the tree canopy, and not very active at night. They vocalise rarely, and usually only in the breeding season. It is best surveyed using indirect methods (such as scats and other signs) and, more recently, using specially-trained Dogs. Unfortunately, many records of Koalas in the BioNet database are of animals hit by cars or attacked by Dogs.

Suitable methods for surveying Koalas include:

- **Visual survey.** Direct observations of canopy trees using binoculars during diurnal survey or nocturnal spotlight survey.
- **Spot Assessment Technique (SAT).** The SAT (Phillips and Callaghan 2011) is a recommended standardised method for determining Koala habitat use. It is a point-based, tree sampling methodology that uses the presence or absence of Koala faecal pellets (or scats) within a prescribed search area around the base of trees to derive a measure of Koala activity.
- **Scat surveys.** Koala scats can be found beneath trees in which animals feed and rest. They can be identified by their size, shape, particle size of their contents, and the presence of grooming hair.
- **Scratches.** When climbing smooth-barked trees, Koalas leave scratches on the bark. Sometimes their very sharp long claws leave distinctive pock marks, associated with longer rake marks. However, scratches can be sometimes difficult to distinguish from marks made by Brushtail Possums or Lace Monitors. Nevertheless, scratches can provide further indicators of Koala activity in conjunction with other evidence.
- **Call broadcast.** Koalas (particularly males) will respond to calls being broadcast.
- **Audio recording.** Although relatively rare, vocalising Koalas can be recorded using audio recording equipment.

5.5.2 Survey - Koala

In addition to all other fauna survey activities that are compatible with observing Koalas (e.g. canopy inspections for tree identification and bird survey, spotlighting), targeted site investigations were undertaken on the 4th and 5th December 2018 and 9th May 2019 using four experienced personnel. This timing is optimal, as Koala activity is generally at its peak between December and January, and breeding females with joeys on their backs are most easily observed (Commonwealth of Australia 2014).

Survey efforts were concentrated in the area of existing development, which is the intended location for redevelopment, and therefore represents the area of direct impact. This was supplemented by survey of the forested areas in its immediate surrounds in four plots using the

Spot Assessment Technique (Phillips and Callaghan 2011). The locations of these survey activities are illustrated in Figures 13A to 13F in Appendix 1 and described below. Both indirect and direct survey methods were used.

- **Visual survey.** Binoculars were used to inspect the canopy of every tree within the survey area for the presence of Koalas. As the canopies of the trees in the developed area – particularly the demolition footprint - are generally low and sparse, this was considered to be a comprehensive and reliable survey.

  The search area was concentrated in the areas of potentially greatest impact, and extended to the trees in the forested parts alongside the existing developed areas, as well as further into the forest alongside the existing walking tracks.
- **SAT.** Four assessment plots were measured, three in the southern forested area and one near the dam adjacent to the multi storey car park.
- **Scat surveys.** The base of every tree in the developed part of the site was inspected for the presence of Koala scats. Any scats found were photographed, collected for identification (by specialist Barbara Triggs), and the trees tagged and mapped where scats were found. The canopies of trees were visually inspected again in the vicinity of any scats located.
- **Scratches.** All smooth-barked trees were inspected in the developed part of the site for scratches.
- **Call broadcast.** In order to elicit calls from Koalas on the subject lot, calls were broadcast from two locations on site in the early evening of the 4th December. Calls were broadcast in short bursts over a period of approximately 40 minutes after sunset (7:54 p.m. daylight savings time).
- **Spotlighting.** For an hour after the end of the call broadcast session, the canopy trees within the survey area were inspected by spotlighting. Spotlight survey was conducted on foot and through the sunroof of a slow-moving car. The spotlight routes are shown in Figures 13A to 13F in Appendix 1.
- **Audio recording.** Audio was recorded from dusk to dawn on a number of occasions from 2017 to 2020:
  - 29th to 31st December 2017 in the southern forest
  - 15th to 16th November 2018 in the eastern gully near tree number 2
  - 4th to 5th December 2018 near the central dam
  - 12th to 13th June 2019 near tree number 2
  - 2nd to 9th July 2019 near tree number 2
  - 18th to 23rd July 2019 near tree number 2
  - 6th to 9th September near tree number 2
  - 23rd to 28th April 2020 near tree number 2

5.5.3 Survey Results - Koala

- **Visual survey.** No Koalas were observed in any of the searches of the canopy trees.
- **SAT.** No scats of any kind were recorded beneath any of the trees sampled.
- **Scat surveys.** Scats were located beneath trees in only two locations, but these were not of Koala:

  - Beneath two trees in the northern car park in the area currently occupied by North Connex. These were subsequently identified by Barbara Triggs as *Trichosurus vulpecula* Common Brushtail Possum. Given the abundance of food scraps available in the North Connex camp, this is not surprising; and
  - On a log at the call broadcast location in the southern forest. These were also identified as Brushtail Possum.
- **Scratches.** Scratches were few, despite the dominance of smooth-barked species in the survey area. Old deep scratches were observed on the small number of *Eucalyptus punctata* Grey Gum planted near the southern open-air car park. While it is noted that this is a favoured food tree for Koalas, there was no corroborative evidence to suggest that Koalas were responsible for these scratched trees.

  The scratches observed were not of the characteristically long raking form, and do not show the pock marks made by the Koala clinging on with the ends of their very sharp claws. Although scratches on Grey Gum trunks can persist for many years, in the absence of a distinctive pattern and other evidence, these scratches are not considered likely to be made by Koalas.
- **Call broadcast.** No return calls were heard.
- **Spotlighting**. No Koalas were observed. The only arboreal mammal observed was *Pseudocheirus peregrinus* Common Ringtail Possum in the eastern gully. An albino *Tachyglossus aculeatus* Echidna was observed in this gully as well, and a number of *Pteropus poliocephalus* Grey-headed Flying-fox were heard chattering in trees to the north east of the demolition footprint and in trees near the Coonara Avenue entry.
- **Audio recording.** No vocalising Koalas were recorded in these audio files.

In summary, targeted surveys revealed no direct or indirect evidence of the presence of Koalas on the subject lot or within the demolition footprint. No individuals of this species were observed during day or night survey, no scats of this species were observed or collected, no calls were elicited by call broadcasting, and no calls were recorded in any of the passive audio recording sessions from 2017 to 2020.

5.6 Dural Land Snail

The Dural Woodland Snail is listed as Endangered under both the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*.

5.6.1 Survey Considerations - Dural Land Snail

Pommerhelix duralensis is a woodland snail with a strong preference for shale-influenced transitional landscapes with no individuals of this species confirmed outside such habitats (Ridgeway et al. 2014). This species is generally found in dry habitats resting during the day and foraging at night, typically foraging an hour after dusk through to the morning (NSW Scientific Committee 2016). It forages on hyphae and fruiting bodies of native fungi, and probably on other detritus of the forest floor (OEH 2021). It has not been observed to climb or burrow in nature (Ridgeway et al. 2014) but instead rests in exposed areas (such as on rock or leaf litter) and shelters under rocks, logs, bark and in leaf litter (Clark 2009).

To date, the ecological information available regarding this species is largely anecdotal and relies heavily on the study undertaken by Ridgeway et al. (2014). That work indicated that the natural density of animals was low (approximately 3 snails per hectare), that they rested in exposed habitat more often than expected, and that they are slow-moving (with a maximum per night travel distance of 167.1 centimetres).

However, these observations were based on a small number of samples taken under dry conditions: tracking data were collected from only two individuals, and the spool-tracking mechanism failed on 70% of the survey nights (Ridgeway et al. 2014). Therefore, their observations may not be generally applicable to different populations across different areas.

Recent serendipitous observations of a population in the Blue Mountains indicate that survey is best conducted in suitable habitat on wet, warm nights when the leaf litter is moist (personal communication Dr Stephanie Clark). That observation and subsequent surveys undertaken by Dr Clark during similar wet conditions has established that population densities are probably higher than that previously reported by Ridgeway et al. (2014), and survey guidelines are currently under review (personal communication Dr Stephanie Clark).

This species is known to occur within a number of National Parks and Council bushland reserves (NSW Scientific Committee 2016) including George Thornton Reserve in The Hills LGA (personal communication Dr Stephanie Clark). Due to its occurrence in areas transitional between shale and sandstone, it is also associated with several endangered ecological communities that also occur in that ecotonal habitat, including Blue Gum High Forest, Cumberland Plain Woodland, Sydney Turpentine Ironbark Forest, and Shale Sandstone Transition Forest (NSW Scientific Committee 2016).

5.6.2 Survey - Dural Land Snail

This species was included in targeted and incidental diurnal surveys from 2015 to 2020 using the ecological information available. Two empty shells of this species were found by this method, which prompted additional targeted survey for this species, carried out by Dr Stephanie Clark, an accredited specialist in this fauna group, and using her methodology.

This targeted survey concentrated in the areas to be impacted by the demolition works and in the subsequent development footprint, as well as in natural bushland on the subject lot and in immediately adjacent parts of Cumberland State Forest. In total, approximately 4.3 hectares of vegetation was surveyed over two nights (3rd and 14th December 2020) in this additional targeted survey.

Surveys conducted included diurnal searches of logs, rocks, ground debris, raking and searching of leaf litter and nocturnal spotlighting to search for active individuals. Samples of leaf litter were also collected for analysis. Survey efforts of this species are shown in Figures 13A to 13F in Appendix 1.

5.6.3 Survey Results - Dural Land Snail

A total of 18 live individuals of this species (comprising both adults and juveniles) were observed in the following 11 locations:

- 4 sites on and above the retaining wall to the north and east of the multi storey car park where one empty shell was found previously;
- 3 sites immediately adjacent and to the east of the car park in Cumberland State Forest;
- 1 site (and 1 individual) in the retained bushland where one empty shell was found previously;
- 1 site to the south of the works area in the retained bushland that is to be transferred to Forestry Corporation; and
- 2 sites in Cumberland State Forest beyond the subject lot to the south.

The habitats across the subject lot were classified in terms of their suitability for this species and potential habitat was mapped in consultation with Dr Clark (see Figure 15 in Appendix 1).

A total of 12.81 hectares of potential habitat for this species was identified across the subject lot, of which 0.68 hectares (6,756.50 square metres) occurs in landscaped garden in the demolition footprint (see Figure 15 in Appendix 1). Of the 4.3 hectares surveyed specifically for this species in December, 1.86 hectares occurred within the areas subsequently classified as potential habitat for this species, giving a density of 8 snails per hectare of suitable habitat.

However, survey conditions were not optimal as the rain that fell before and during survey was insufficient to moisten the leaf litter (personal communication Dr Stephanie Clark). The size of the population in the area surveyed is therefore considered to be larger than the 18 live animals observed.

6 PRESCRIBED IMPACTS

Impacts not requiring offset are "prescribed impacts" as per Part 6 Division 6.1 of the *BCR 2017*. The relevant impacts not requiring offset are detailed below.

Prescribed impacts are detailed in Chapter 6 of the BAM and include:

- Karst, caves, crevices, cliffs, rocks and other geological features of significance
- Human-made structures and non-native vegetation
- Habitat connectivity
- Water bodies, water quality and hydrological processes
- Wind farm developments
- Vehicle strikes

Of these, a number of prescribed impacts were identified within the demolition footprint and are detailed and assessed below.

6.1 Removal of man-made structures

The proposal is for the demolition of existing man-made structures, including the office buildings, carpark, and associated infrastructure. Approximately 3.3 hectares of the demolition footprint (53%) is man-made and will be removed.

These structures are not considered to provide good potential habitat for any fauna species of concern.

6.2 Removal of non-native vegetation

A total area of 2.9 hectares of planted native vegetation will be removed by the proposed demolition works, including planted garden beds and landscaped areas around existing buildings that contain patches of exotic non-native vegetation.

6.3 Edge effects

The proposal has the potential to marginally reduce the viability of adjacent habitat through edge effects.

6.4 Reduced viability of Powerful Owl Habitat

Chapter 5 of this BDAR assesses Powerful Owl breeding habitats and their viability in relation to the proposed demolition works.

The proposed demolition works have the potential to reduce viability of adjacent habitat for Powerful Owl breeding through noise and light spill.

6.5 Spread of Weeds and Pathogens

Although the demolition footprint has few weed infestations there is still potential to spread weeds and pathogens across the site and further to offsite lands

6.6 Reduced Connectivity

The loss of 2.9 hectares of planted native vegetation within the demolition footprint will have some impact on connectivity across the site.

6.7 Water bodies, water quality and hydrological processes

An identified first order stream occurs on site running north to south from an existing detention basin north of the existing carpark (see Figure 5 in Appendix 1) with the southern boundary of the subject lot delineated by a second order stream. Therefore works adjacent to these streams, dams, and detention basins have the potential to impact on riparian features such as bank stability and water quality.

7 AVOID AND MINIMISE IMPACTS

The *Biodiversity Conservation Act 2016* requires as a legislative imperative that impacts are to be avoided, then minimised by implementation of ameliorative measures, with offsetting only of unavoidable impacts. Prior to the commencement of this Act, this cascade of principles was only good practice and not enforceable.

7.1 Impacts Avoided and Minimised

The BAM details a number of ways in which a development proposal can demonstrate avoidance and minimisation of impact. Relevant clauses are paraphrased and addressed below.

- **Project footprint located according to biodiversity values and may be iterative, depending on findings.**

The proposal is for the demolition of existing development. The proposed demolition footprint has been located wholly within areas of existing development and landscaped gardens that have occupied the subject lot since development of the original IBM campus in the 1980s.

The proposed works are located in an area that is mapped as containing areas of high biodiversity value (see Figure 1 in Appendix 1), with that mapping being driven by entities whose loss has the potential to bring about a Serious and Irreversible Impact (SAII). However, this mapping is demonstrably in error, being a reflection of vegetation mapping that mistakenly identified a mix of native trees planted in the 1980s as a natural occurrence of Blue Gum High Forest (see Figure 9 in Appendix 1).

Therefore, the proposed demolition works have not been designed to avoid the areas of mapped high biodiversity value, as this entity does not occur in the developed part of the subject lot.

Nevertheless, the planted gardens do have some intrinsic habitat value, and so the vegetated parts within the demolition footprint have been minimised. However, the area of landscaped gardens to be impacted within the demolition footprint is the minimum area required in order to demolish the buildings in a safe and efficient manner.

- **Direct impacts avoided and minimised by locating the project in areas where there are no biodiversity values.**

The 6.2 hectares of the demolition footprint is made up of approximately 3.3 hectares of existing development (53% of the demolition footprint) and 2.9 hectares (47% of the demolition footprint) of planted landscape gardens. Thus the majority of the area directly impacted by the works have no biodiversity values.

- **Direct impacts avoided and minimised by locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition.**

The vegetation in the demolition footprint is entirely composed of planted native vegetation, but

nonetheless provides some habitat for threatened species. The location and extent of the impact footprint in the gardens is the minimum area required to demolish the buildings in a safe and efficient manner. Nevertheless, the planted gardens around the buildings and in the narrow garden beds of the open-air car parks are of significantly lesser value than other patches of vegetation on the subject lot:

- The planted landscaped gardens are relatively young, being planted in the early 1980s. As a consequence, although the trees may be tall, they do not possess the additional habitat values that old forests provide such as hollow-bearing trees. Hollows are an important habitat feature for many species of fauna, but particularly threatened species known from the local area;
- The floristic composition and the pattern of planting reflects the design of the landscape plan, and is not a reflection of a natural system. The combination of species is not equivalent to any known plant community and therefore provides an unexpected mix of resources that may not provide sufficient resources through all seasons of the year for local threatened species. Notably, the planting mix is dominated by trees that flower in the spring-summer period, when winter blossom is critical for the persistence of many threatened fauna species;
- The planted areas in the demolition footprint are dominated by *Casuarina glauca* Swamp Oak, being 22% of the planted trees. This species is native low-lying habitats on saline soils. They do not produce blossom, rarely produce hollows, and generally provide poor habitat for fauna.
- The planted *Corymbia citriodora* Lemon-scented Gum is one of the dominant planted species, being 7% of the trees planted in the gardens in the demolition footprint, and 16% of the planted trees overall. This species is native to Queensland and known to to readily hybridise with *Eucalyptus saligna* Sydney Blue Gum, a locally native species. This is an integral element of the significant patches of Blue Gum High Forest growing on and around the subject lot. Thus, the continued presence of *Corymbia citriodora* Lemon-scented Gum in such large numbers is a continued threat to the genetic integrity of the local critically endangered ecological community;
- The trees – particularly in the car parks - have reached a growth limit imposed by the shallow excavated troughs into which they have been planted. During survey, they were observed to suffer regular heat stress and water stress, no doubt a result of the planting medium now being hydrophobic. Leaves and blossom of stressed trees provide forage of a lesser nutritional value to fauna species feeding on them; and
- Many parts of the garden areas support significant weed loads. Some of the weed species present are serious environmental weeds or transformer weeds recognised as Weeds of National Significance.

- **Direct impacts avoided and minimised by locating the project in areas that avoid habitat for species that have a high biodiversity risk weighting or native vegetation that is a critically endangered ecological community or an endangered ecological community.**

The demolition footprint has been developed in order to avoid all patches of critically endangered ecological communities within the subject lot.

However, it cannot avoid some areas of landscaped gardens directly around the buildings to be demolished that provide potential or realised habitat for 2 species with high Biodiversity Risk Weightings - *Syzygium paniculatum* Magenta Lilly Pilly and *Pommerhelix duralensis* Dural Land Snail.

One of the garden beds has been planted with ***Syzygium paniculatum* Magenta Lilly Pilly**. There are 18 individuals within a constructed gully that forms part of the stormwater management system of the site - see Figure 12 in Appendix 1. These 18 individuals are a combination of adults (probably as part of the original planting palette) and juveniles (at least some probably self-sown).

The areas of habitat across the subject lot suitable for ***Pommerhelix duralensis* Dural Land Snail** have been identified by Dr Stephanie Clark – see Figure 15 in Appendix 1. A total of 0.68 hectares of garden deemed suitable falls within the demolition footprint. No snails were found in these areas, but given the density observed during survey (approximately 8 snails per hectare, then the impact area can be expected to support approximately 5 individuals.

- **Direct impacts avoided and minimised by locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained.**

The demolition of the existing buildings, some car parks, and immediately surrounding vegetation will not significantly alter connectivity across the site or with adjacent habitats. The demolition footprint is only a small part of the entire subject lot, much of which is occupied by continuous forest.

- **Detail other constraints to the footprint location.**

Important features that have constrained the footprint include:

  - A patch of the Critically Endangered Ecological Community Sydney Turpentine Ironbark Forest that occurs between the ring road and the existing buildings (see Figure 11 in Appendix 1). The footprint has been designed in order to avoid this patch;
  - The riparian corridor that occurs between the multi-storey car park on the eastern boundary and the central demolition footprint. This gully supports a patch of Critically Endangered Ecological Community Blue Gum High Forest, none of which will be directly impacted by the works; and
  - The dense gully vegetation described above is also known to be used as roosting habitat by the resident pair of Powerful Owls. The works area is located entirely outside of this habitat.

The development footprint has been constrained to the minimal area required to undertake demolition works safely while observing appropriate buffers from existing habitat values.

- **Detail how prescribed impacts *sensu* the *Biodiversity Conservation Regulation 2017* are avoided and minimised.**

    - The removal of the **human-made structures** on site is the objective of the project and are therefore unavoidable. These structures are unlikely to provide potential habitat for threatened species. Nevertheless, mitigation measures have been included in Table 6 in Appendix 3 that assist in minimising impacts to flora and fauna as a result of the proposed demolition works.
    - The **non-locally-native vegetation to be removed** is of little value to local threatened species:
        - Being planted in accordance with a landscape plan, it is an artificial construct dominated by species outside of their ecological niche (*Casuarina glauca* Swamp Oak) or geographical distribution;
        - Another dominant species *Corymbia citriodora* Lemon-scented Gum is a Queensland species that threatens the genetic integrity of *Eucalyptus saligna* Sydney Blue Gum, the major component of the Critically Endangered Ecological Community Blue Gum High Forest;
        - The trees do not contain hollows and are unlikely to mature further due to the constraints imposed by the growing conditions. This explains the absence of threatened and common species that rely on the presence of hollows (such as many arboreal mammals, birds, and microbats);
        - Understorey is generally absent and so the majority of the area of planted gardens cannot support a diverse mix of fauna species. This explains the absence of microbats in the car park areas as habitats for insect are depauperate. Also, the absence of understorey in the planted garden areas make them unsuitable as habitat for *Pseudocheirus peregrinus* Common Ringtail Possum, the preferred prey species of the Powerful Owl.
        - The areas within the demolition footprint deemed suitable for Dural Land Snail are addressed below in Section 7.2.
    - No **dams** or other water features will be impacted by the works. Impacts to the first order stream and its existing hydrological processes have been avoided and minimised by the proposed works with the first order stream located outside of the proposed demolition footprint and 'soft' segmented removal of the existing multi-storey carpark to minimise potential impacts to the stream and existing processes.
    - **Edge effects** are already in place, as the demolition footprint is currently occupied by built form. The proposed works are unlikely to introduce additional impacts, but any such impacts can be controlled by standard erosion and sediment controls, stormwater control, and appropriate management of litter and rubbish. In order to minimise impacts to adjacent vegetation, a demolition footprint has been delineated for the extent of works to be undertaken, which will be fenced during demolition works. mitigation measures have been included in Table 6 in Appendix 3.
    - The bushland at the edge of the demolition area has the potential to be impacted by **noise** emanating from the works. The most important potential indirect impact is on breeding habitat of the resident pair of Powerful Owls. This is further

discussed below in Section 5.2

- **Weeds and pathogens** have the potential to impact adjacent habitats. Appropriate mitigation measures have been included in Table 6 in Appendix 3.
  - Propagules of weed species present in the garden areas for demolition may be mobilised during works. Weed control is to be incorporated into the Construction Environmental Management Plan (CEMP). Appropriate controls include immediate removal of weedy material to a green waste facility, no stockpiling of weed material, covering of loads, maintenance of sedimentation fences, and general good site hygiene. As the weed species present and their capacity to spread changes through time, the Project Ecologist or bush regeneration contractor is to advise on the appropriate actions immediately prior to demolition works; and
  - The control of the potential movement of pathogens is to be incorporated into the CEMP. The risk of Myrtle Rust spread will principally be controlled by the erection of temporary protection fencing around the demolition works area to prevent movement from the works site into adjacent vegetation. The potential for the movement of soil-borne fungi will principally be controlled by the maintenance of sedimentation fences and good site hygiene.
- An increase in **predators and pest species** is not considered likely to occur as a result of the demolition works.

7.2 Unavoidable Impacts and their Control

- **Removal of non-locally-native vegetation.** The proposed demolition works will unavoidably remove 2.9 hectares of planted garden that provides some habitat values for local biodiversity. However, these habitats are highly simplified and support a narrow range of common urban species in a matrix of a larger area of equivalent habitat and a much larger area of natural bushland. The potential impacts to resident fauna will be ameliorated by the ecological supervision of clearing works. Animals in danger of harm may be relocated into adjacent bushland in enriched habitat (e.g. nest boxes, terrestrial hollow logs) and any injured fauna given veterinary care.
- **Reduced connectivity.** The removal of 2.9 hectares of landscaped gardens will reduce connectivity of habitat to some degree. However, given the extensive areas of native vegetation on site to be retained, including connecting riparian corridors and the adjoining vegetation of Cumberland State Forest, it is unlikely that connectivity features on site and in the local area will be significantly impacted by the proposed demolition works. The surrounding landscaped lands and natural bushland are well-connected across the subject lot and with adjacent habitat off-site. This general configuration will remain more or less intact.
- **Removal of 18 individuals of the threatened *Syzygium paniculatum* Magenta Lilly Pilly**. These horticultural specimens are of unknown provenance, and as such do not contribute to the conservation of the species (OEH 2012). Also, as this species is not known to occur naturally in the habitat provided by the site or in surrounding natural vegetation, replacement plantings are not recommended.
- **Indirect impacts on Powerful Owl.** The Powerful Owl is known to potentially abandon

early breeding activities (such as courting, mating, preparing the nest hollow, incubation of eggs, caring for new hatchlings) if sufficiently disturbed in those critical times.

Bain (2014) developed a set of guidelines specifically aimed at avoiding and mitigating development impacts on the Powerful Owl, the most important of which is the observation of a minimum distance of 100 metres from the development footprint to a nest site and 50 metres to roosting habitat during the breeding season. Recommendations were also made about the quantum and pattern of foraging habitat in a developed landscape.

The currently used **nesting habitat** in Cumberland State Forest is outside of this buffer distance from the demolition footprint and so the works are unlikely to impact on the nesting behaviour of the resident pair.

It is also noted that the continued successful breeding of this pair indicates that they are already habituated to significant noise, lights, and disturbances arising from the occupation of the subject lot by the current key tenant NorthConnex and / or other workers previously using the site 24 hours a day, and by the use of Cumberland State Forest by large numbers of visitors, including school groups.

This pair is known to have cycled through at least five nest trees over the past 20 years, including two on the subject lot (trees number 1 and 2 – see Figure 14 in Appendix 1). Therefore, there is the potential for them to use the nest trees again that occur on the subject lot in future breeding seasons.

As tree number 1 is 310 metres from the demolition footprint, a sufficient buffer is in place if they were to re-occupy this tree. Similarly, roosting habitat is available that is sufficiently distant from the demolition footprint.

However, tree number 2 is closer to the demolition area, with a buffer of only 66 metres. Therefore, continued monitoring of tree number 2 is recommended to ensure that if demolition works continue into another breeding season and the pair return to this tree, then the following noise controls can be imposed:

- Demolition activity should be restricted in areas that are within 100 metres of the active nest tree during the breeding season from March to September. In such circumstances, work is not to start until 1 hour after sunrise and must finish by 4 p.m.
- There is the potential for noisy works to interrupt the movement of fledglings between September and February (Dr Stephen Ambrose, personal communication). Therefore, noisy works should not begin until at least 30 minutes after dawn and be completed at least 60 minutes before dusk during that period.

Available **foraging habitat** will remain virtually the same. While the demolition will remove 2.9 hectares of planted gardens, this is mostly made up of very poor foraging habitat, being principally strips of planted trees in a car park that probably only provide occasional perching habitat for birds and foraging habitat for birds and flying-foxes. The

areas to be removed provides almost no potential habitat for their favoured prey, Ringtail Possums. Also, it is noted that the foraging habitat available to the resident breeding pair also includes the far superior natural habitats in the adjacent territories in the Eric Mobbs Reserve / Bidjigal Reserve to the south west and in Berowra Valley National Park to the north east. These additionally available areas in large reserves comprising natural bushland are likely to provide sufficient area of foraging habitat to account for the loss of the sub-optimal foraging habitats in the development footprint.

- **Indirect impacts to Dural Land Snail:** the proposal will require the removal of 0.68 hectares of suitable habitat identified for this species.

  It is considered the loss and modification to 5% of the total identified extent of suitable habitat on site is unlikely to significant impact on this species. However, to avoid potential impacts to this species and their habitats, a number of mitigation measures have been recommended and are detailed in Sections 8 and 9 of this BDAR.

8 ASSESSMENT OF IMPACTS

8.1 Vegetation

A total of 2.9 hectares of planted native vegetation identified as Vegetation Zone 4a will be removed by the proposal.

The extent of VZ4a was identified as planted native vegetation and has been assessed in accordance with Appendix D of the BAM. The application of the new streamlined module results in zero ecosystem credit and zero species credit obligations for Vegetation Zone VZ4a – Landscaped Gardens.

The decision-making key is shown in Chapter 2 of this BDAR.

8.2 Threatened Species Habitats

8.2.1 Magenta Lilly Pilly

Eighteen individuals of this species will be removed for the demolition works.

This species is very popular in horticulture, but many of the plantings in horticulture are hybrids or of unknown genetic origin. The plants on site are a case in point, being of unknown provenance. Although *ex situ* populations of this species may be important for the conservation of this species (particularly in regards to protection from Myrtle Rust), the recovery plan recommends that horticultural plantings be excluded from all actions related to the conservation of the species in the wild (OEH 2012).

Thus, the individuals in the demolition footprint are of no conservation value for the species and the direct impacts can be disregarded.[17]

8.2.2 Powerful Owl

The proposed demolition works will require the removal of 2.9 hectares of open, planted native vegetation that provides only marginal foraging habitat for this species. The home range occupied by this species is dependent on habitat quality, and can be anything from 400 hectares to 4,000 hectares.

The subject lot and the adjacent habitats are known to support a breeding pair of Powerful Owls, and disturbances close to their breeding habitat in the breeding season can interfere with the breeding success of that pair. Such impacts may arise from ill-placed lighting or demolition and construction noise during sensitive parts of the breeding cycle.

These potential impacts have been avoided as this pair is known to be concentrating their

[17] Although not required by the BDAR process, an impact assessment pursuant to the *EPBC Act 1999* is provided at Appendix 4 for Matters of National Environmental Significance recorded on site.

breeding activities in Cumberland State Forest, sufficiently distant from the works area.

However, it is acknowledged that 0.31 hectares of the 100 metre radius buffer circle from a known past nest tree (tree number 2) occurs within the demolition footprint. This part of their breeding habitat already comprises existing development, and the rest of their home range contains a matrix of forest and urban development; so this pair (and the urban Sydney population in general) is habituated to some human-generated disturbances.

Nevertheless, if this nest tree was to be used again in the future during the demolition stage of the project, conflict can be avoided by the imposition of controls on the timing of noisy works within the buffer area. Monitoring of the Powerful Owl is therefore essential in order to implement the owl protection protocols.

Potential impacts to this species have therefore been avoided, minimised, and mitigated. It is unlikely that the proposed demolition will have a significant adverse impact such that it would place the local population at risk of extinction.

8.2.3 Dural Land Snail

The demolition footprint contains 0.68 hectares of suitable habitat to be removed, while 12.81 hectares of potential and realised habitat will be retained (see Figure 15 in Appendix 1).

Although the actual density of snails is likely to be higher, the observed density of 8 snails per hectare gives a likely total population size of 102 across the 12.81 hectares of suitable habitat identified and mapped. Applying the same density measure to the 0.68 hectares of suitable habitat within the demolition footprint means that 5 individuals could be expected to be impacted, or 4.9% of the population on the subject lot.

Although the population may be able to withstand a loss of 4.9%, it is proposed to avoid and ameliorate such impacts by:

- Installation of temporary protective fencing between the carpark and habitat external to the demolition footprint;
- Prior to scheduled demolition works, intensive pre-clearing survey for Dural Land Snails by Dural Land Snail specialist in suitable snail habitat in the works area;
- Relocation of all Dural Land Snails found in the works area in accordance with an approved relocation protocol;
- Retention and protection from damage of the retaining wall around the multi-storey carpark; and
- Disassembly of the carpark in a methodical manner with an ecologist present for advice and snail rescue.

9 MITIGATION AND MANAGEMENT OF IMPACTS

To mitigate potential impacts to native vegetation and threatened species and their habitats, a number of ameliorative measures are to be implemented as part of the proposed demolition. These are detailed in Table 6 in Appendix 3.

These include:

- Protective fencing;
- Installation and maintenance of erosion and sedimentation controls;
- Implementation of hygiene protocols (see Appendix 5);
- Careful piecemeal disassembly of man-made structures where fauna habitat is present;
- Control of weeds;
- Pre-clearing and monitoring surveys for targeted fauna;
- Implementation of additional controls on works if Powerful Owl breeding occurs within a pre-set distance of works;
- Removal of habitats under ecological supervision; and
- Tree removal to be supervised by a Project Arborist.

10 IMPACT SUMMARY

The proposal will result in the following:

- Clearing of 2.9 hectares of planted native vegetation for the demolition footprint, including:
    - The removal of 18 individuals of *Syzygium paniculatum* Magenta Lily Pilly, arising from landscaped plantings;
    - The removal of 0.68 hectares of suitable habitat for the Dural Land Snail;
    - The modification of 0.31 hectares of buffer lands for the Powerful Owl within the 100 metre buffer area of a tree last used for breeding in 2015 (tree number 2);
    - Removal of 2.9 hectares of marginal potential foraging habitat for Powerful Owl.

The application of the new streamlined module in accordance with Appendix D of the BAM results in zero ecosystem credit and zero species credit obligations for the loss of planted native vegetation, in this instance the loss of 2.9 hectares of Vegetation Zone 4a – Landscaped Gardens.

The decision-making key in support of that judgment is shown in Chapter 2 of this BDAR.

The potential for Serious and Irreversible Impacts (SAIIs) to arise from the proposed demolition works has been considered. No threatened entities listed as SAII entities or candidate SAII entities occur in the demolition footprint or are likely to be impacted by the proposed works.

Furthermore, no threatened species identified during surveys is considered to meet any of the four principles of an SAII entity:

- Principle 1 – Species or ecological community currently in a rapid rate of decline;
- Principle 2 – Species or ecological communities with very small population size;
- Principle 3 – Species or area of ecological community with very limited geographic distribution; and
- Principle 4 - Species or ecological community that is unlikely to respond to management and is therefore irreplaceable.

Therefore, SAII requires no further consideration.

11 CONCLUSIONS

The proposed demolition works at 55 Coonara Avenue, West Pennant Hills have been assessed by way of a streamlined BDAR.

Vegetation within the demolition footprint is planted native vegetation. The proposal will remove 2.9 hectares of planted native vegetation identified as Vegetation Zone 4a – Landscaped Gardens.

Threatened species habitat occurs in the demolition area for three species:

- *Syzygium paniculatum* Magenta Lilly Pilly – all of the individuals within the footprint are planted or offspring of planted specimens of unknown provenance. Therefore their loss need not be considered further;
- *Ninox strenua* Powerful Owl – habitat associated with a tree last used for nesting in 2015 occurs near the demolition footprint. If the pair of Powerful Owls was to use this tree again during the works period, then additional controls are to be implemented to avoid disturbance impacts. To that end, monitoring of the owls (currently using Cumberland State Forest for breeding) is to continue; and
- *Pommerhelix duralensis* Dural Land Snail – suitable habitat for this species in the demolition footprint may impact in the order of 5 individuals, which is estimated to represent approximately 5% of the population on the subject lot. In order to avoid this loss, intensive expert pre-clearing survey and relocation in accordance with an approved protocol is to occur.

Although the surrounding lands on the development site contain important ecological features, including Critically Endangered Ecological Communities, riparian habitats, and threatened species habitats, the proposed works will not significantly impact on these values.

It is concluded that impacts to the development site have been appropriately avoided and minimised based on the proposed works and the site's ecological constraints.

In accordance with Appendix D of BAM 2020, no offset obligations arise from this proposal.

12 REFERENCES

Bain, D. (2014) Land Manager Guidelines for Powerful Owl Conservation in Urban Sydney. Birdlife Australia

Benson, D.H. and Howell, J. (1990) *Taken for Granted: The Bushland of Sydney and Its Suburbs*. Kangaroo Press, Sydney

Chapman and Murphy (1989) Soil landscapes of the Sydney 1:100,000 sheet. Soil Conservation Service of NSW

Clark, S.A. (2009) A review of the land snail genus *Meridolum* (Gastropoda: Camaenidae) from central New South Wales, Australia. *Molluscan Research* 29:61–120

Commonwealth of Australia (2014) *EPBC Act Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory*

Couston, M. (2013) Species Impact Statement for proposed Treetop Adventure Trail, Cumberland State Forest, West Pennant Hills. Unpublished report, Footprint Green

Department of Environment and Climate Change NSW (2002) Descriptions for NSW (Mitchell) landscapes, version 2, based on descriptions compiled by Dr. Peter Mitchell.

Hornsby Shire Council (no date) Historical photographs, available at https://hornsbyshire.recollect.net.au/nodes/view/1967 viewed 27 June 2020

NSW National Parks and Wildlife Service (2001) Environmental Impact Assessment Guidelines – *Syzygium paniculatum*

NSW Office of Environment and Heritage (2012) National Recovery Plan Magenta Lilly Pilly *Syzygium paniculatum.* NSW Office of Environment and Heritage, Goulburn Street Sydney

NSW Office of Environment and Heritage (2017) Guidance to assist a decision-maker to determine a serious and irreversible impact. NSW Government, Sydney

NSW Scientific Committee (2016) Final Determination Threatened species *Pommerhelix duralensis* Dural Woodland Snail

Office of Environment and Heritage (2012) National Recovery Plan: Magenta Lilly Pilly Syzygium paniculatum, Office of Environment and Heritage, NSW Government, Sydney.

Office of Environment and Heritage (2013) The Native Vegetation of the Sydney Metropolitan Area. Volumes 1 and 2 and maps. Digital Version 2.0 NSW Office of Environment and Heritage, Sydney

Office of Environment and Heritage (2016) Digital maps Version 3.1 NSW Office of Environment and Heritage, Sydney

Office of Environment and Heritage (2016) eSpade soil landscape mapping. NSW Government, Sydney. Accessed 12th June 2020 (http://www.environment.nsw.gov.au/eSpade2Webapp#)

Office of Environment and Heritage (2021) Dural Land Snail – profile. Available at https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20283

Pennay, M., B. Law, and L. Reinhold (2004.)Bat calls of New South Wales: region based guide to the echolocation calls of Microchiropteran bats. NSW Department of Environment and Conservation, Hurstville

Phillips, S. and Callaghan, J. (2011) The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*. *Australian Zoologist* 35(3): 774-780

Phillips, S. and Callaghan, J. (2011) The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*. *Australian Zoologist* 35(3):774-780

Ridgeway, P.A., Lindsay, K., Pou, D. and Visintin, A. (2014) Indications of diverse behavioural ecologies in the morphologically conservative Australian land snails *Pommerhelix* and *Meridolum* (Stylommatophora: Camaenidae). *Molluscan Research* DOI: 10.1080/13235818.2013.866179

Rowland, J. (2008) Pennant Hills. Dictionary of Sydney. http://dictionaryofsydney.org/entry/pennant_hills, viewed 27 Jun 2020

Stone, C. and Simpson, J.A. (2006) Leaf, tree and soil properties in a *Eucalyptus saligna* forest exhibiting canopy decline. *Cunninghamia* 9:507–520

The Hills Shire Council (2008) Vegetation map. The Hills Shire Council. Available at http://mapping.thehills.nsw.gov.au/IntraMaps90/

Tozer, M. (2003) The native vegetation of the Cumberland Plan, Western Sydney: systematic classification and field identification of communities, NSW National Parks and Wildlife Service, *Cunninghamia* 8(1):1-75

APPENDIX 1

FIGURES

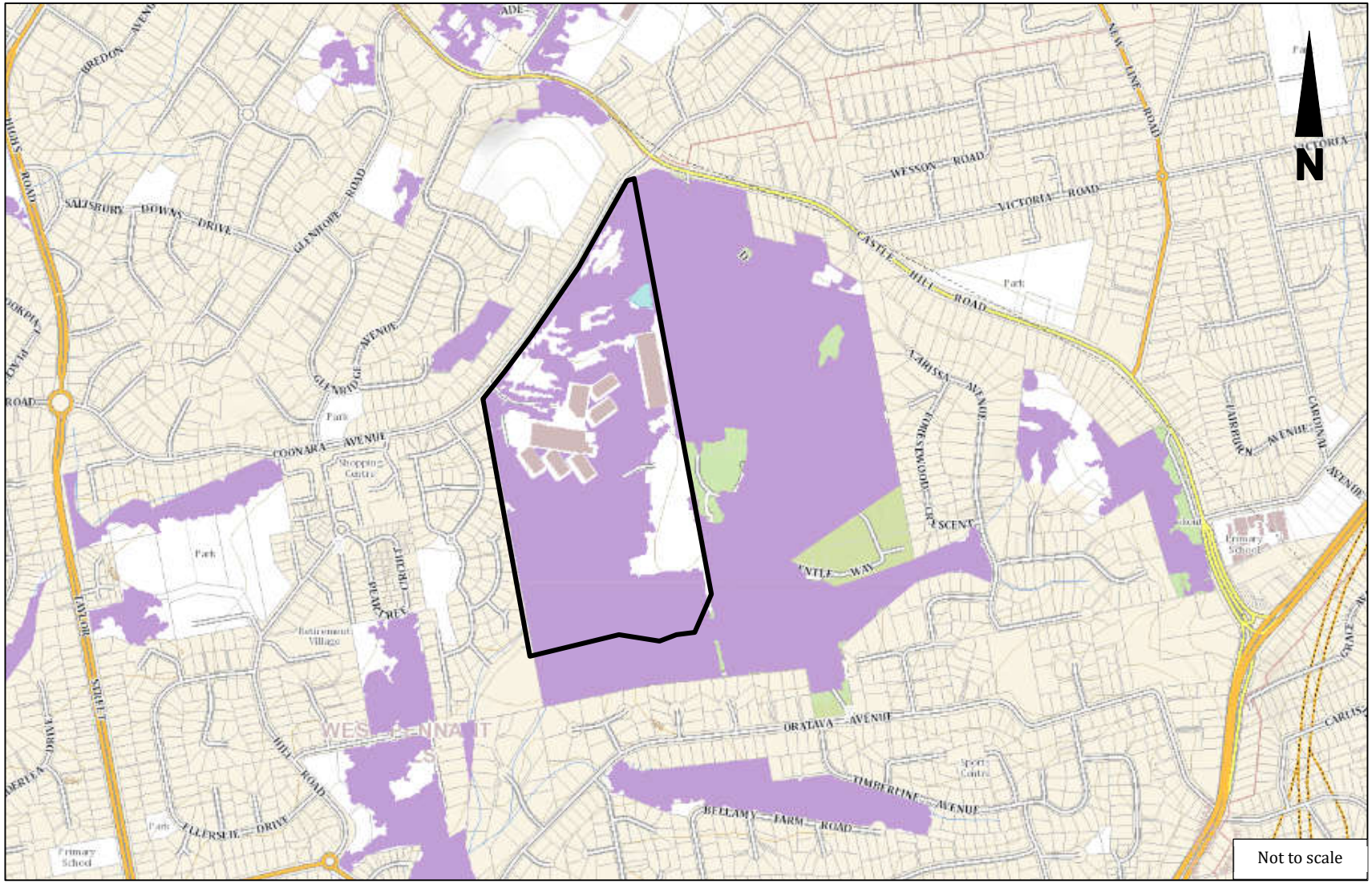


Figure 1: Biodiversity Values Map and Threshold Tool showing the subject lot (black outline).

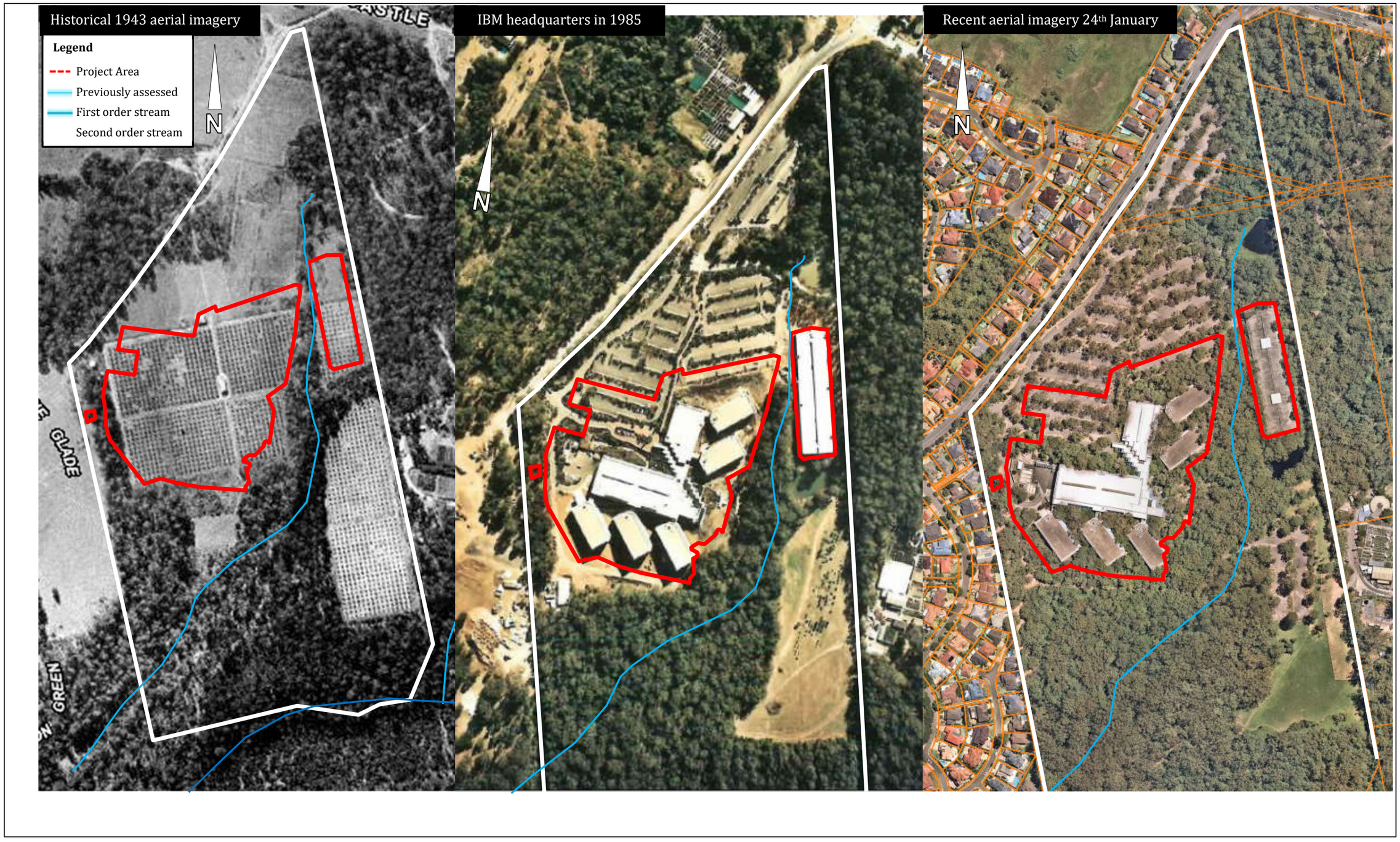


Figure 2: Historical aerial imagery of the subject lot.

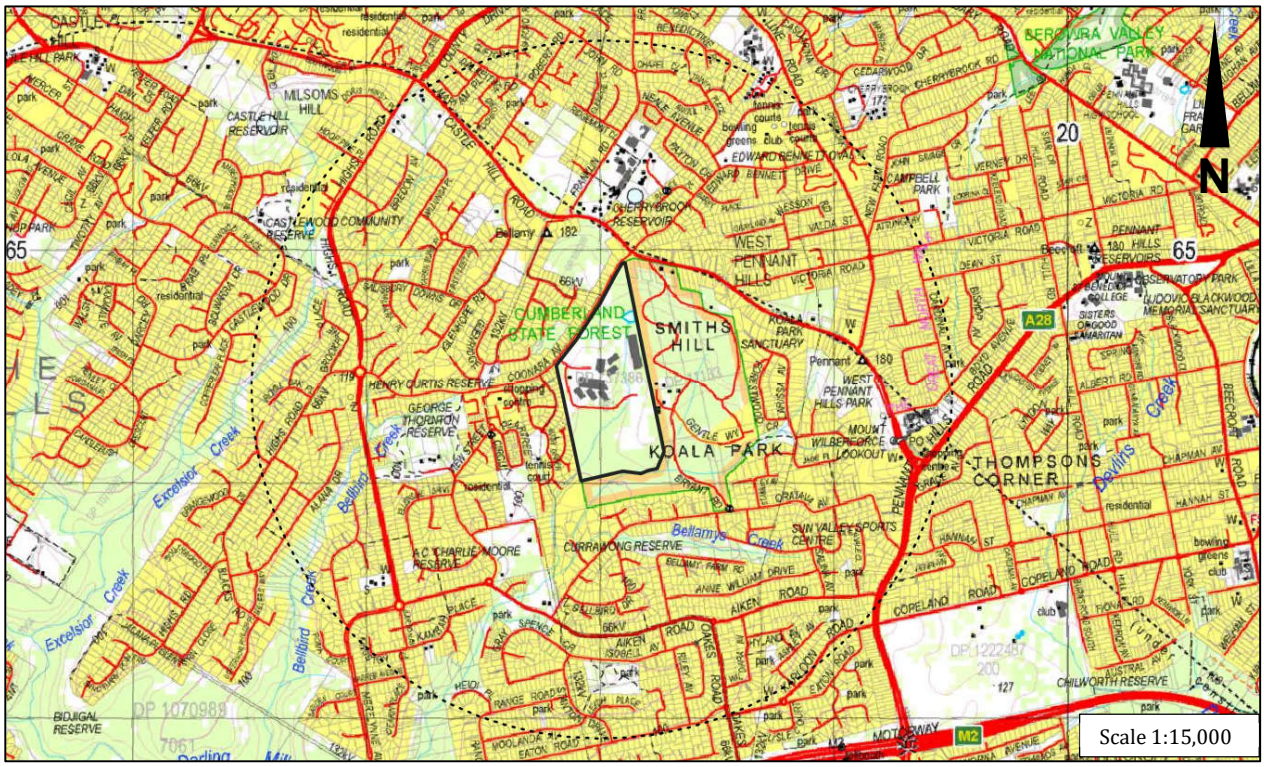
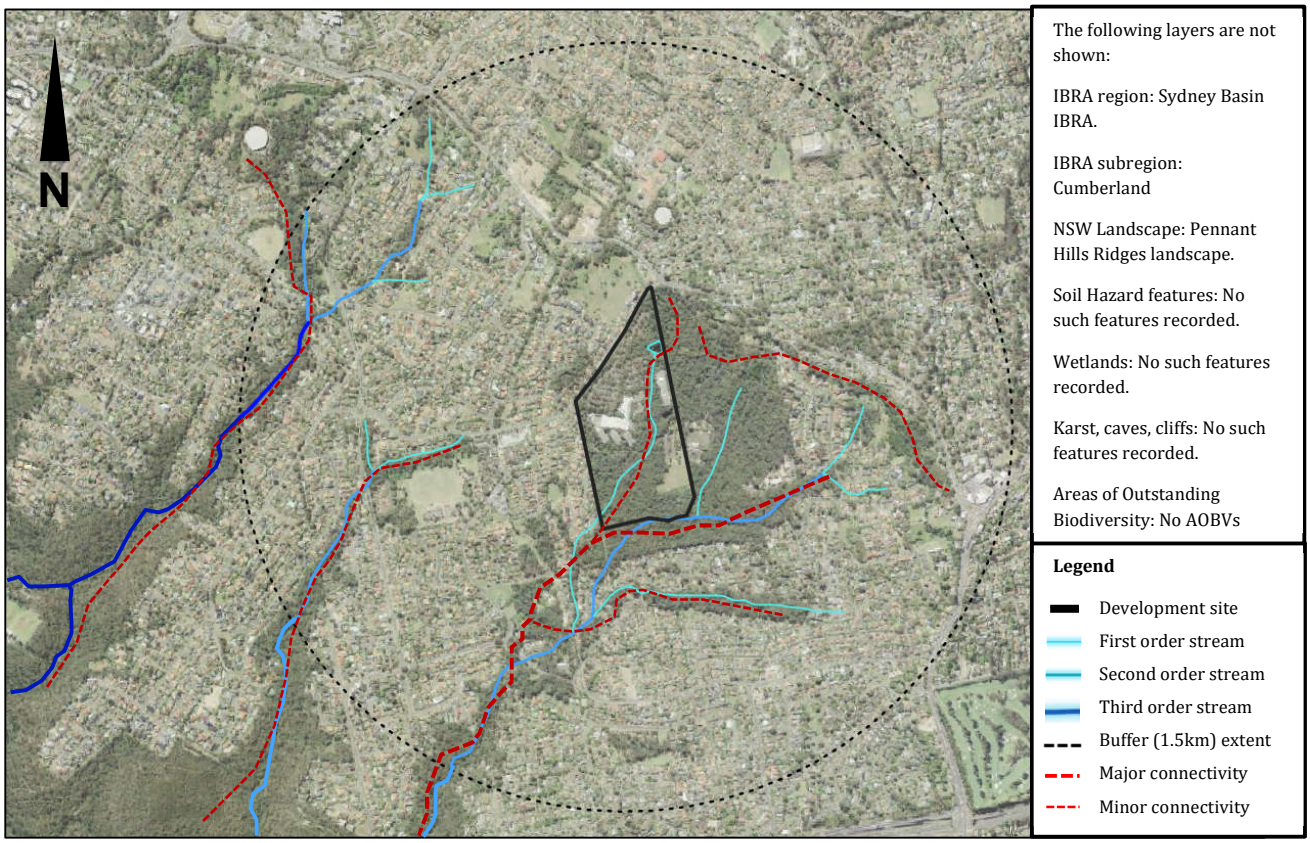


Figure 3 : Topographic map of the subject land. Black outline = development site boundary; black dash line = 1.5km buffer.



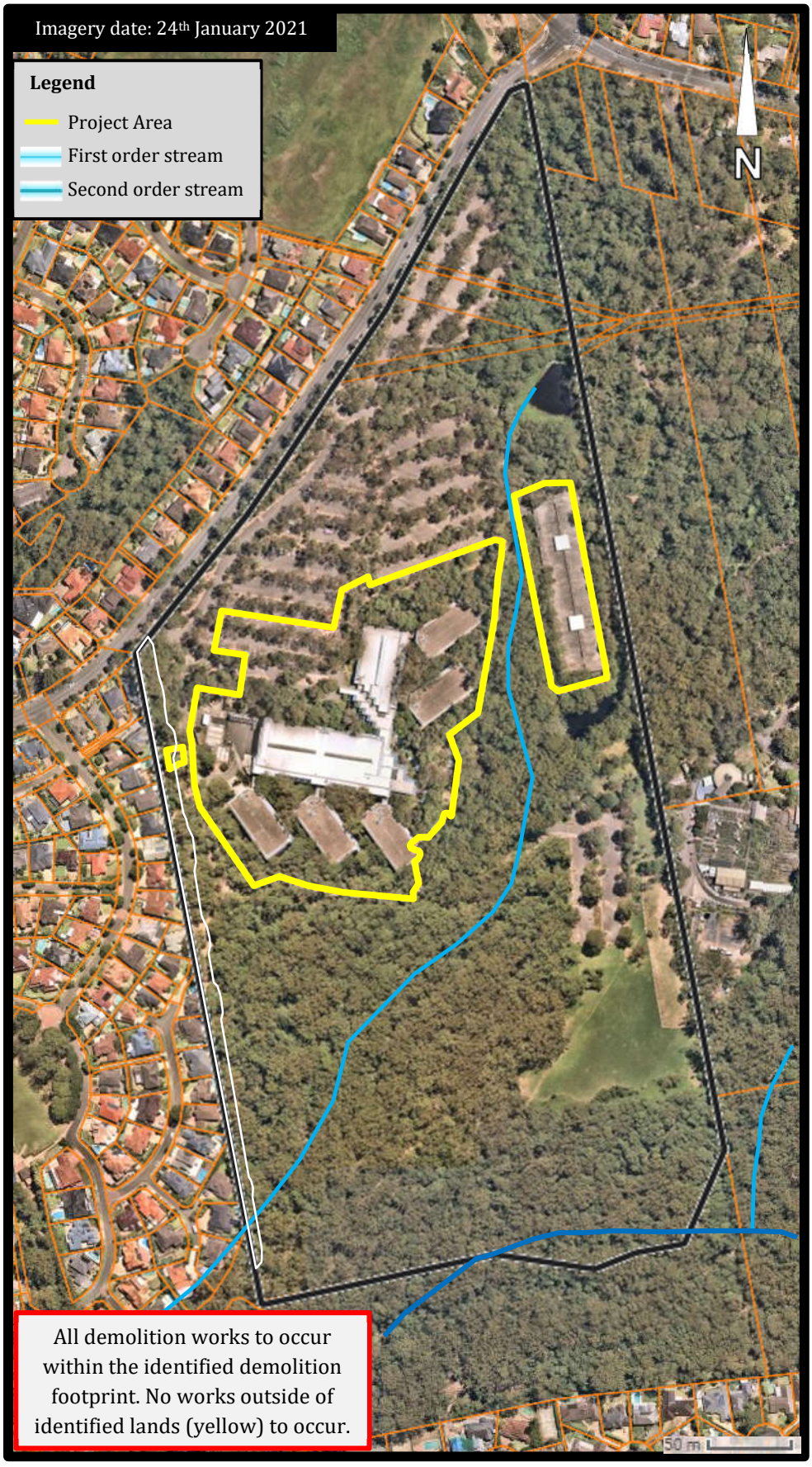


Figure 5 (F_SIT): Site Map. Orange = Cadastre boundaries; Black outline = Boundary of the subject land; yellow outline = proposed demolition footprint; white outline = HRC lands.

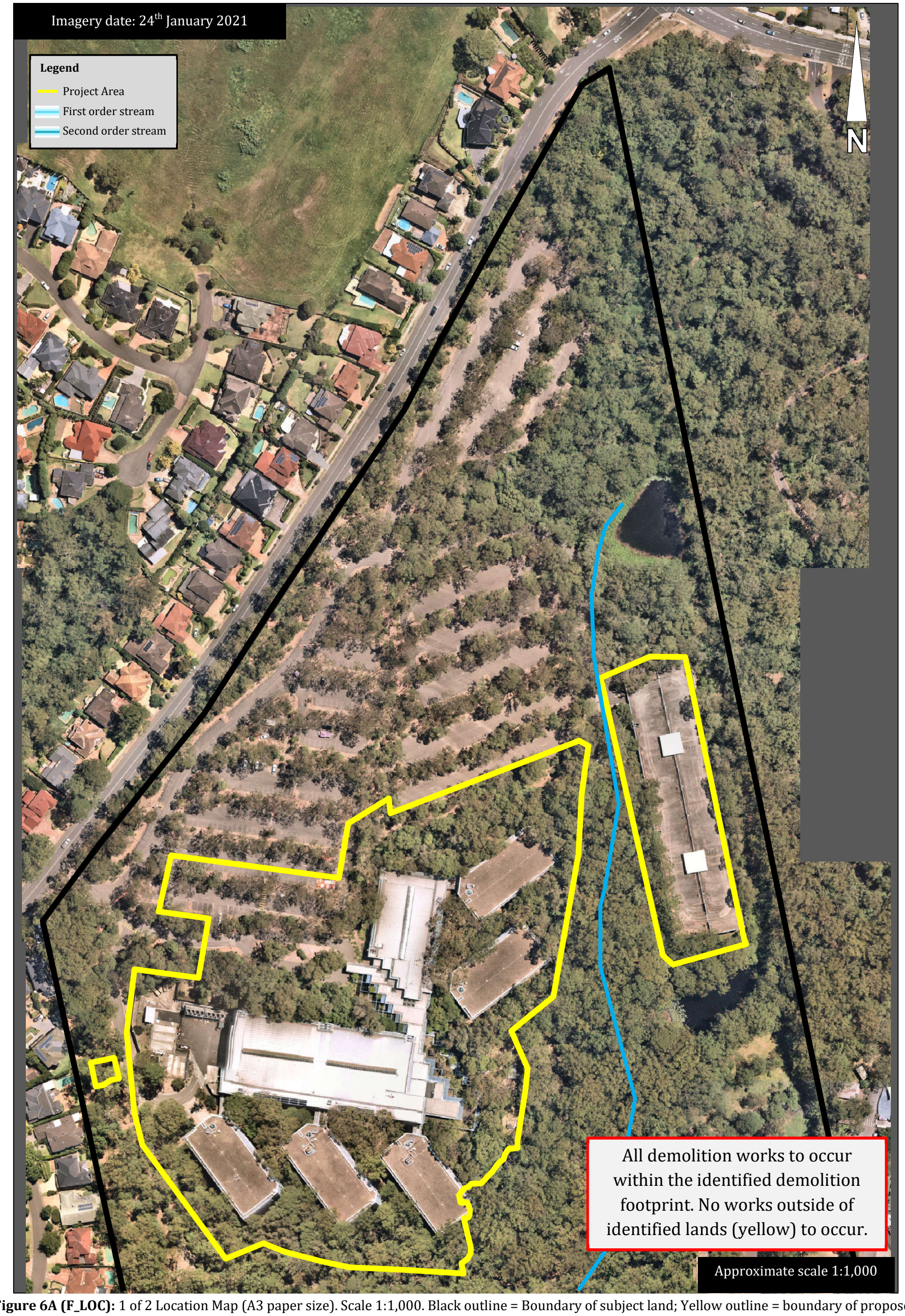


Figure 6A (F_LOC): 1 of 2 Location Map (A3 paper size). Scale 1:1,000. Black outline = Boundary of subject land; Yellow outline = boundary of proposed demolition footprint.

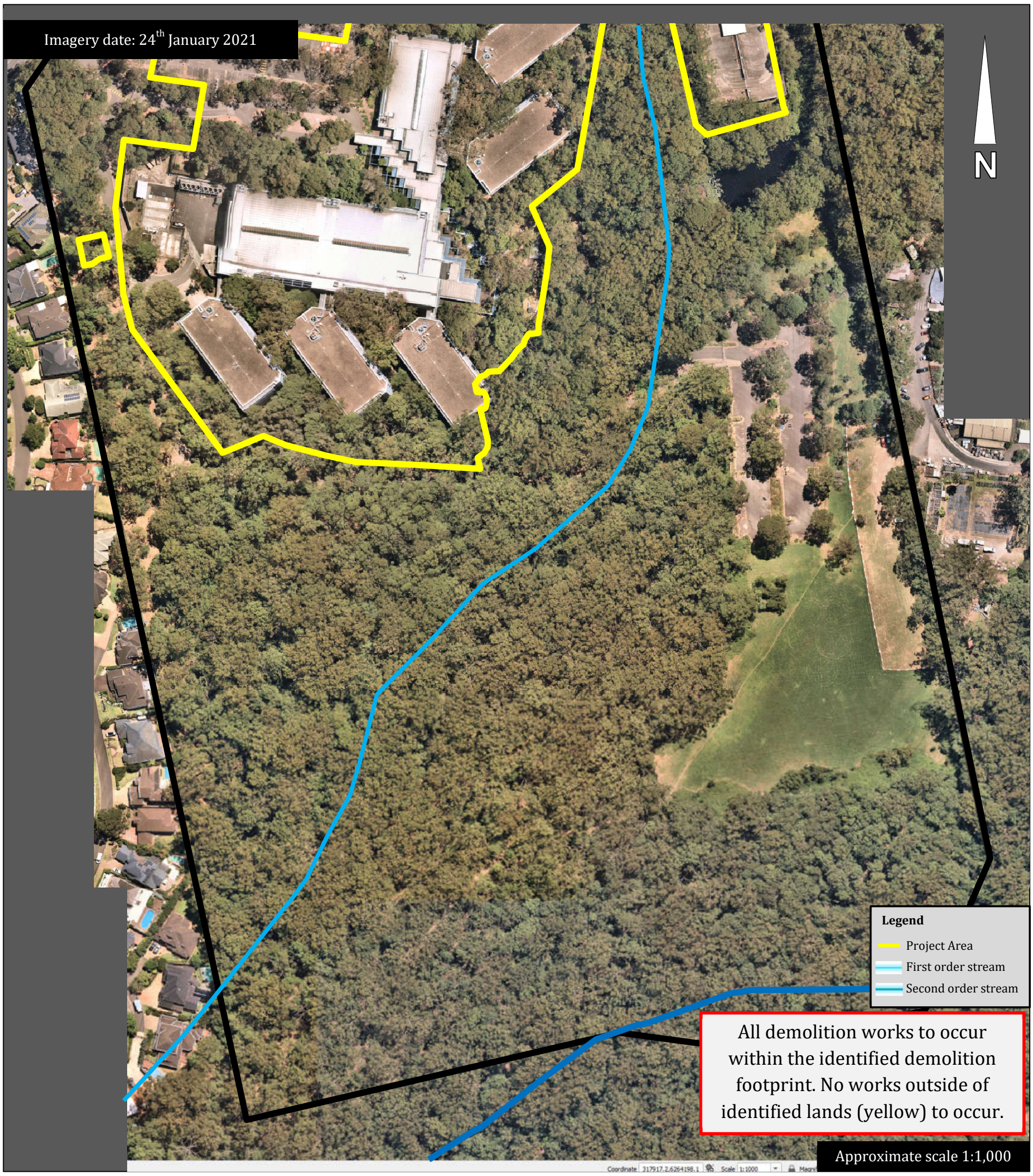


Figure 6B (F_LOC): 2 of 2 Location Map (A3 paper size). Scale 1:1,000. Black outline = Boundary of subject land; Yellow outline = boundary of proposed demolition footprint.

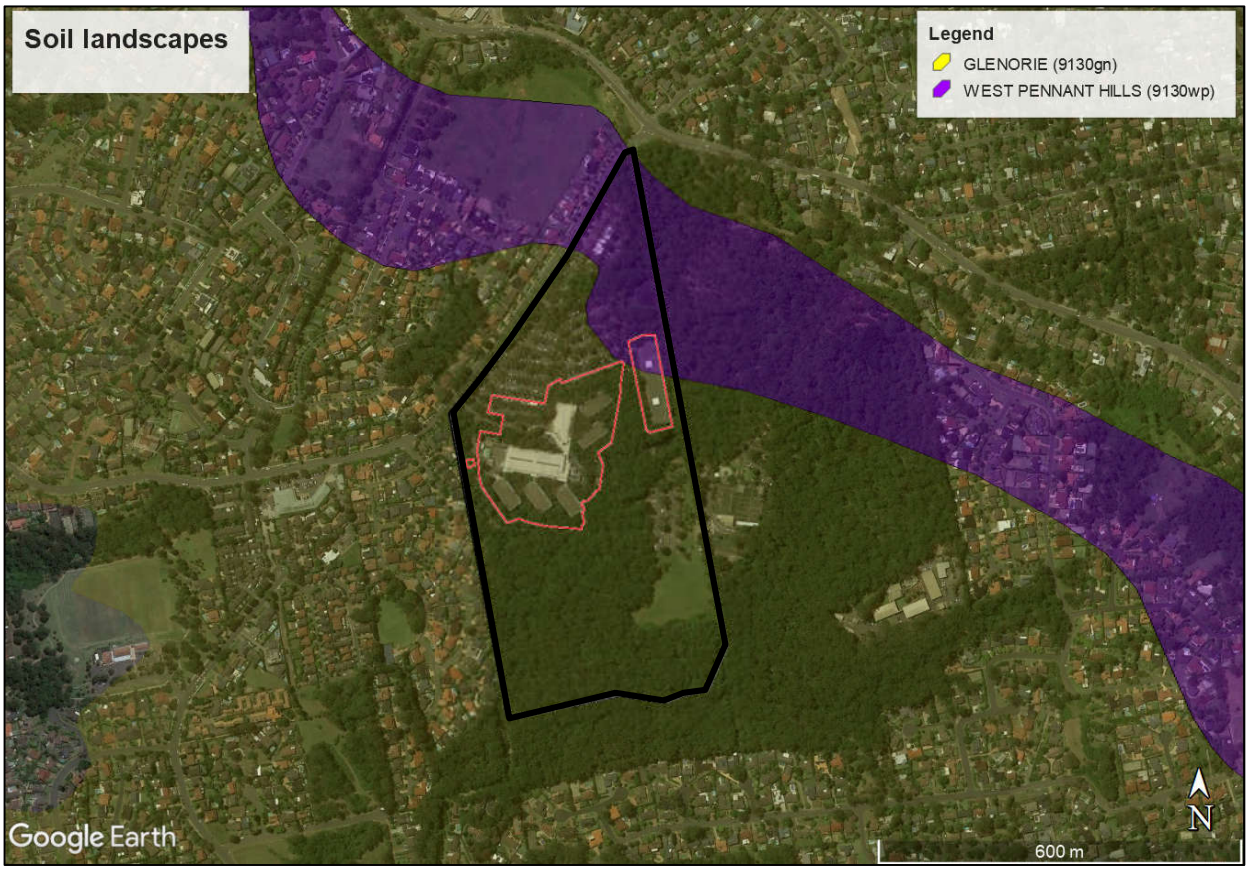


Figure 7: Soil landscape mapping of the subject lot and the proposed demolition footprint.

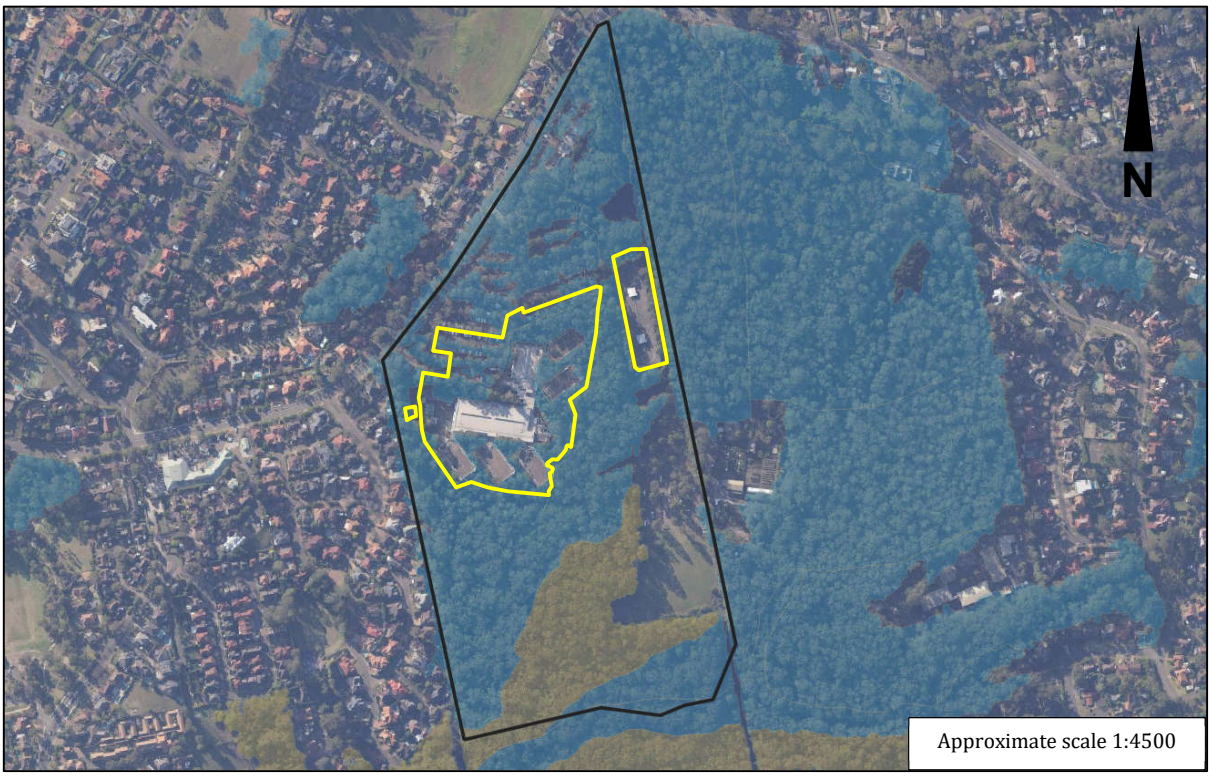


Figure 8: Sydney Metropolitan vegetation mapping. Black outline = Subject lot; yellow outline = demolition footprint; Blue = mapped Blue Gum High Forest (CEEC); orange = mapped Sydney Turpentine ironbark Forest CEEC).

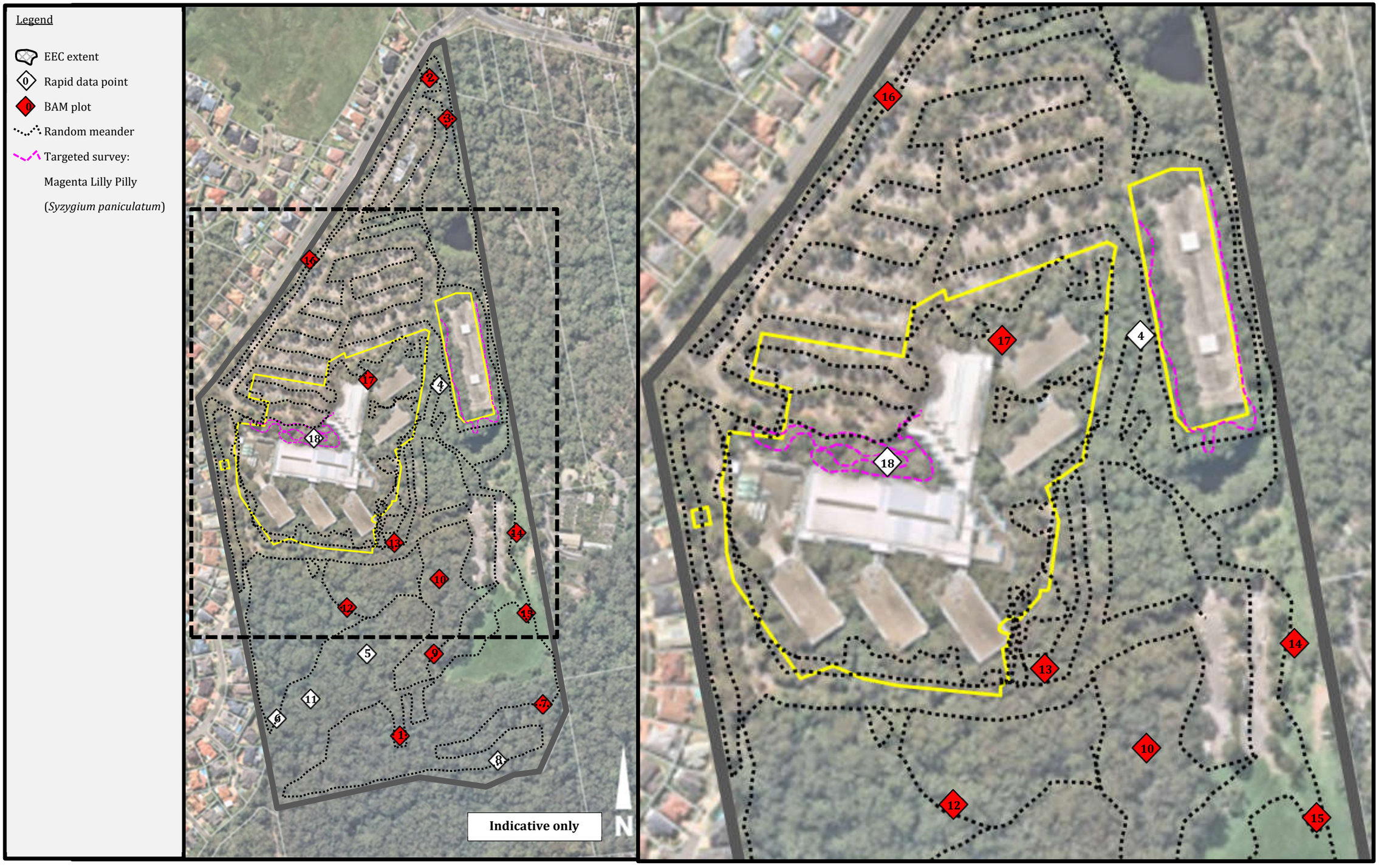


Figure 9: Floristic surveys undertaken across the subject lot and within the demolition footprint.

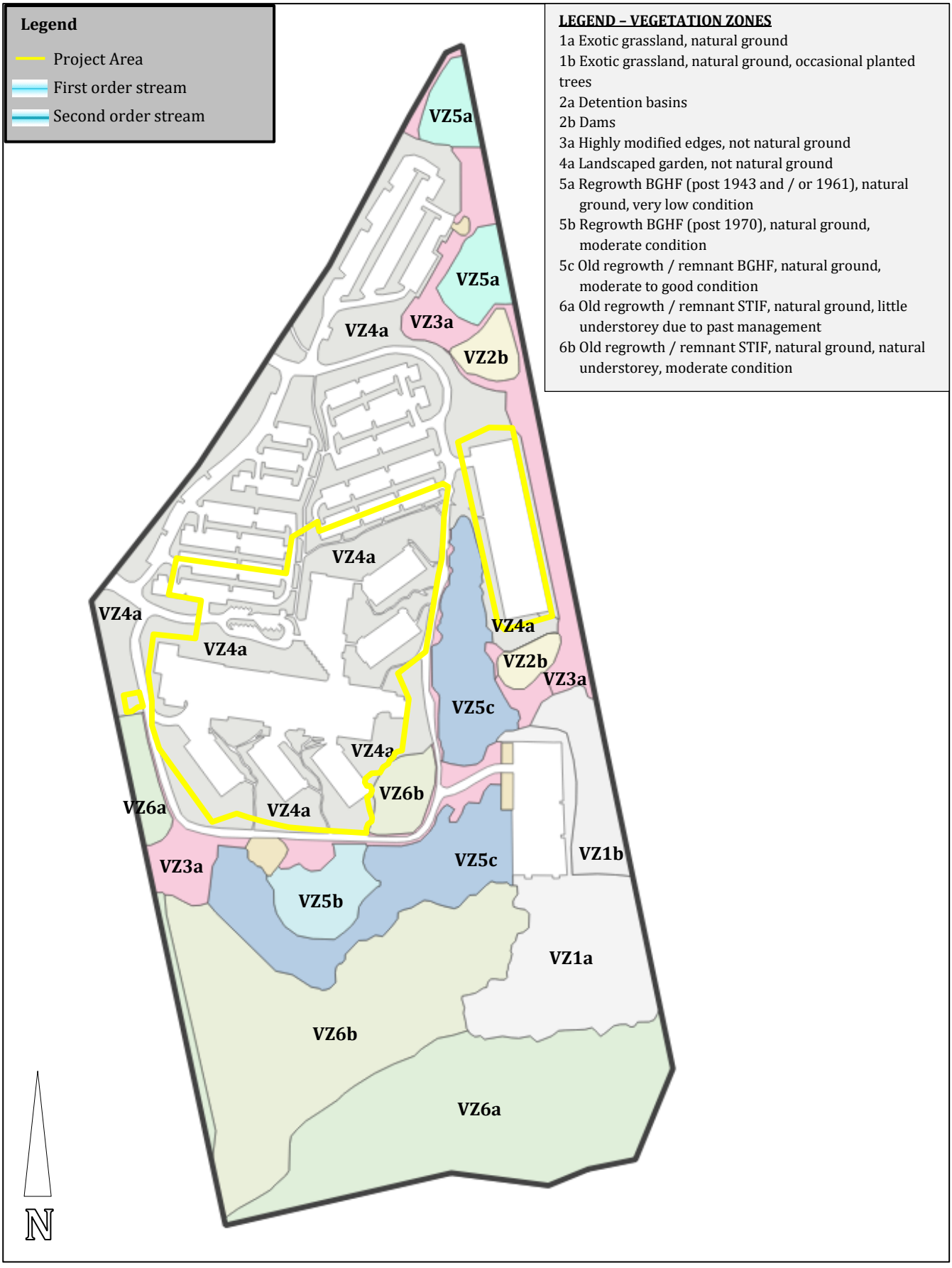


Figure 10: Map of vegetation zones identified across the subject lot during surveys. Proposed demolition footprint (yellow outline) in relation to identified vegetation zones across the subject site.

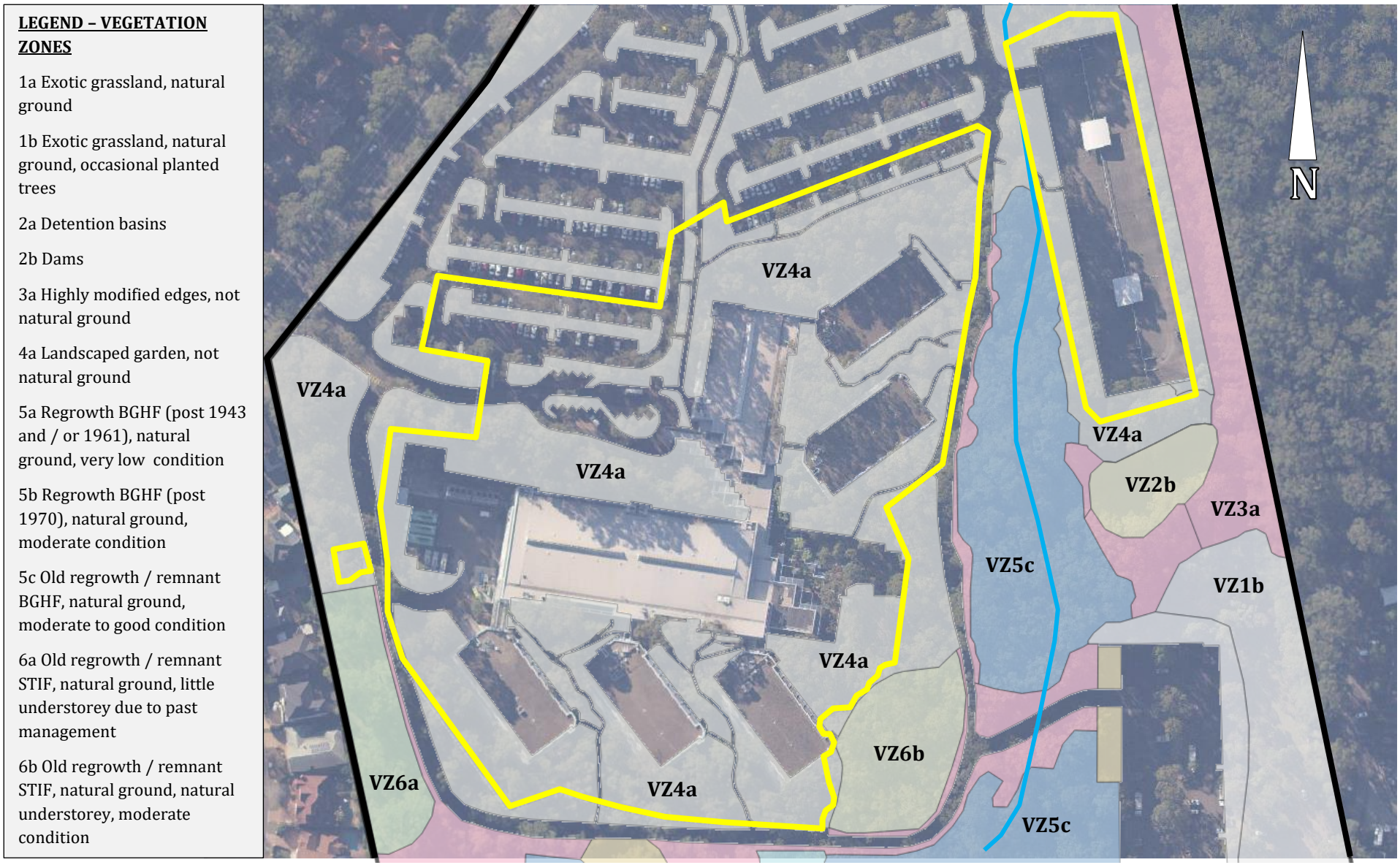


Figure 11: Close up of proposed demolition footprint (yellow outline) in relation to the vegetation zones in the demolition footprint and adjoining lands.

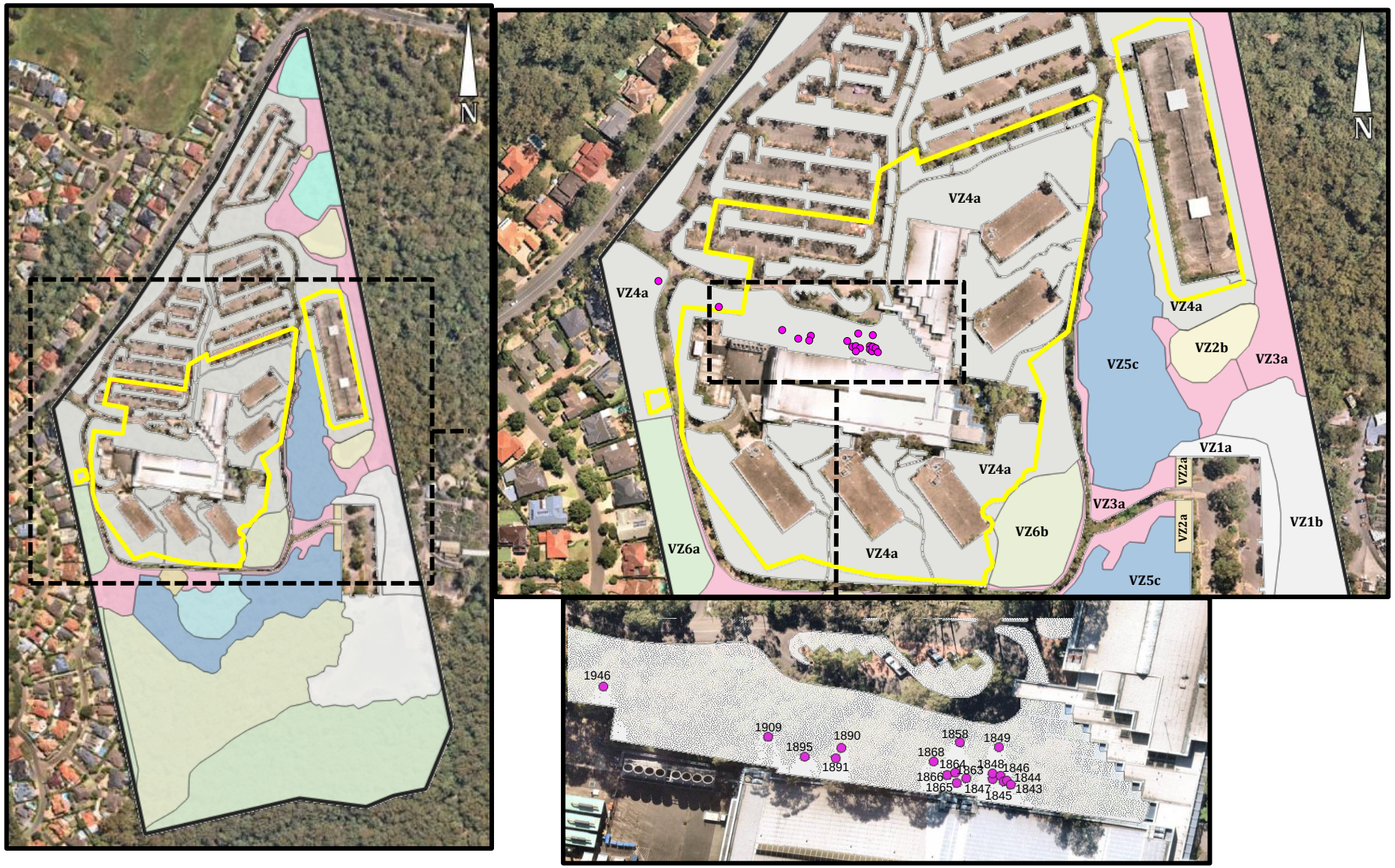


Figure 12 (F_TST): Planted *Syzygium paniculatum* locations. Tree numbers reflect those in the arborist report. As species records were planted during landscaping efforts in 1983 no further assessment of this species is required. All of the demolition project area was actively searched for this species; search paths are not shown for reasons of clarity.

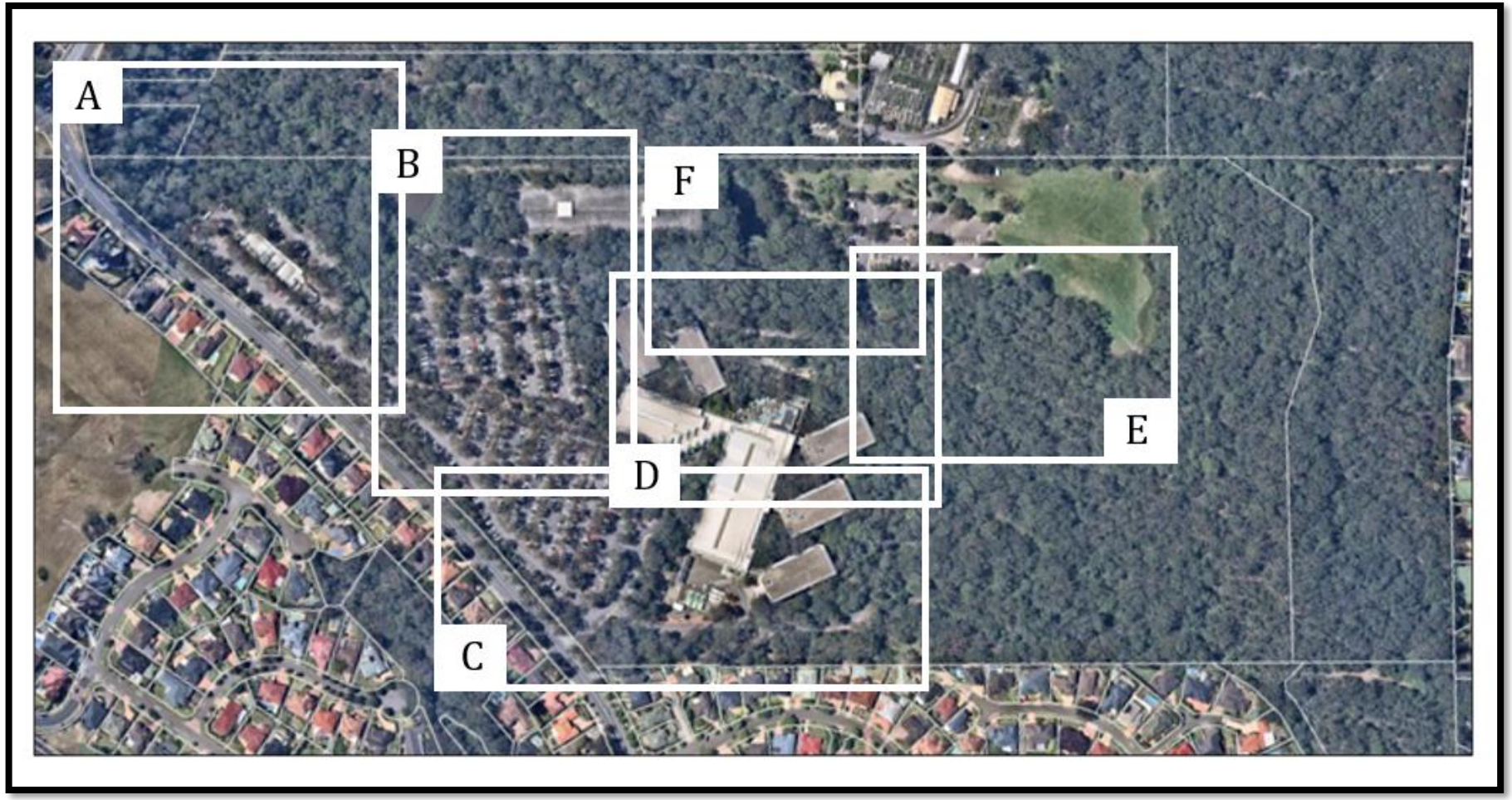


Figure 13 (F_TST): Fauna survey effort across the entire subject site detailed in Figures 13A to 13F.

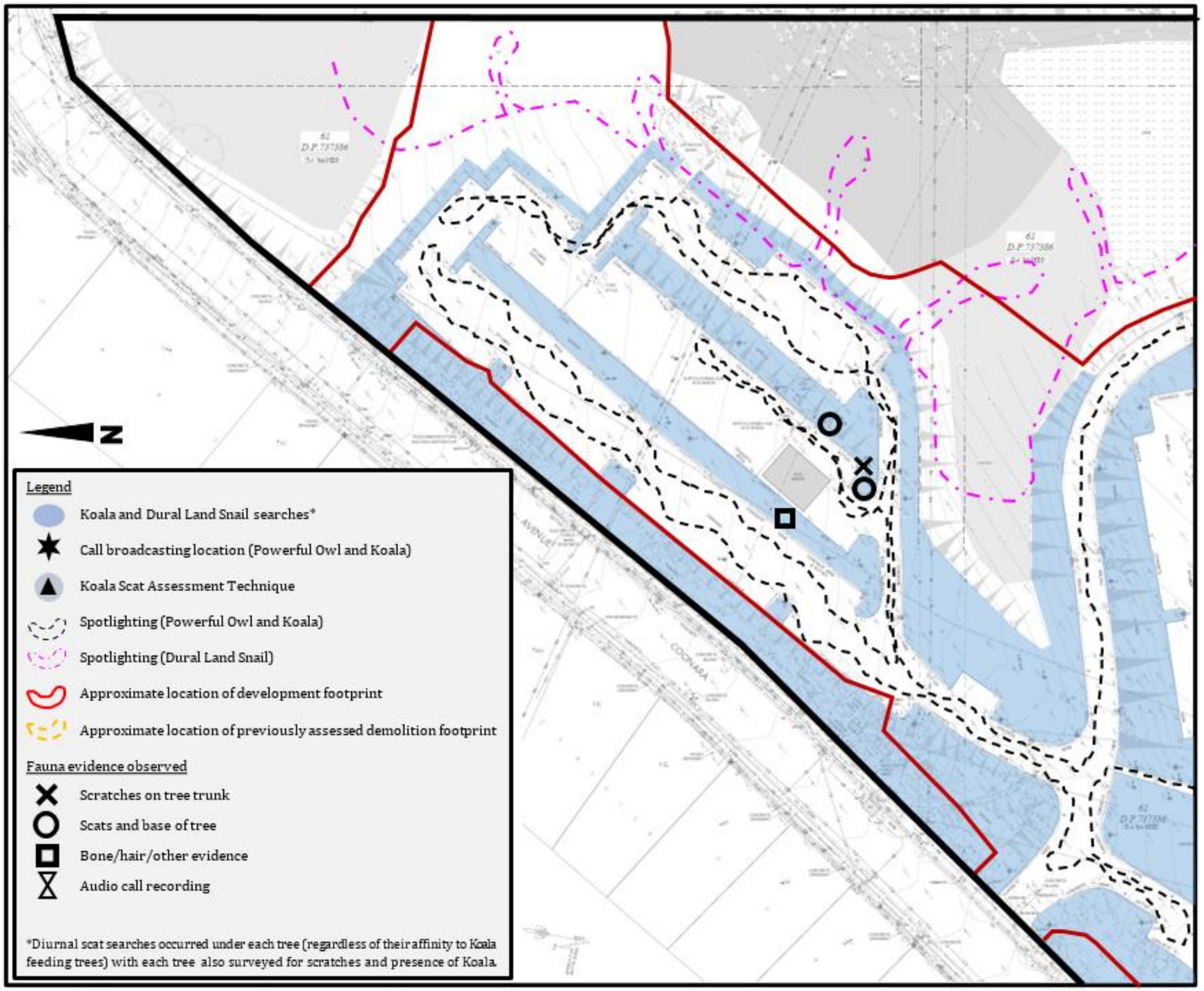


Figure 13A (F_TST): Fauna Survey effort and general fauna evidence observed- section A.

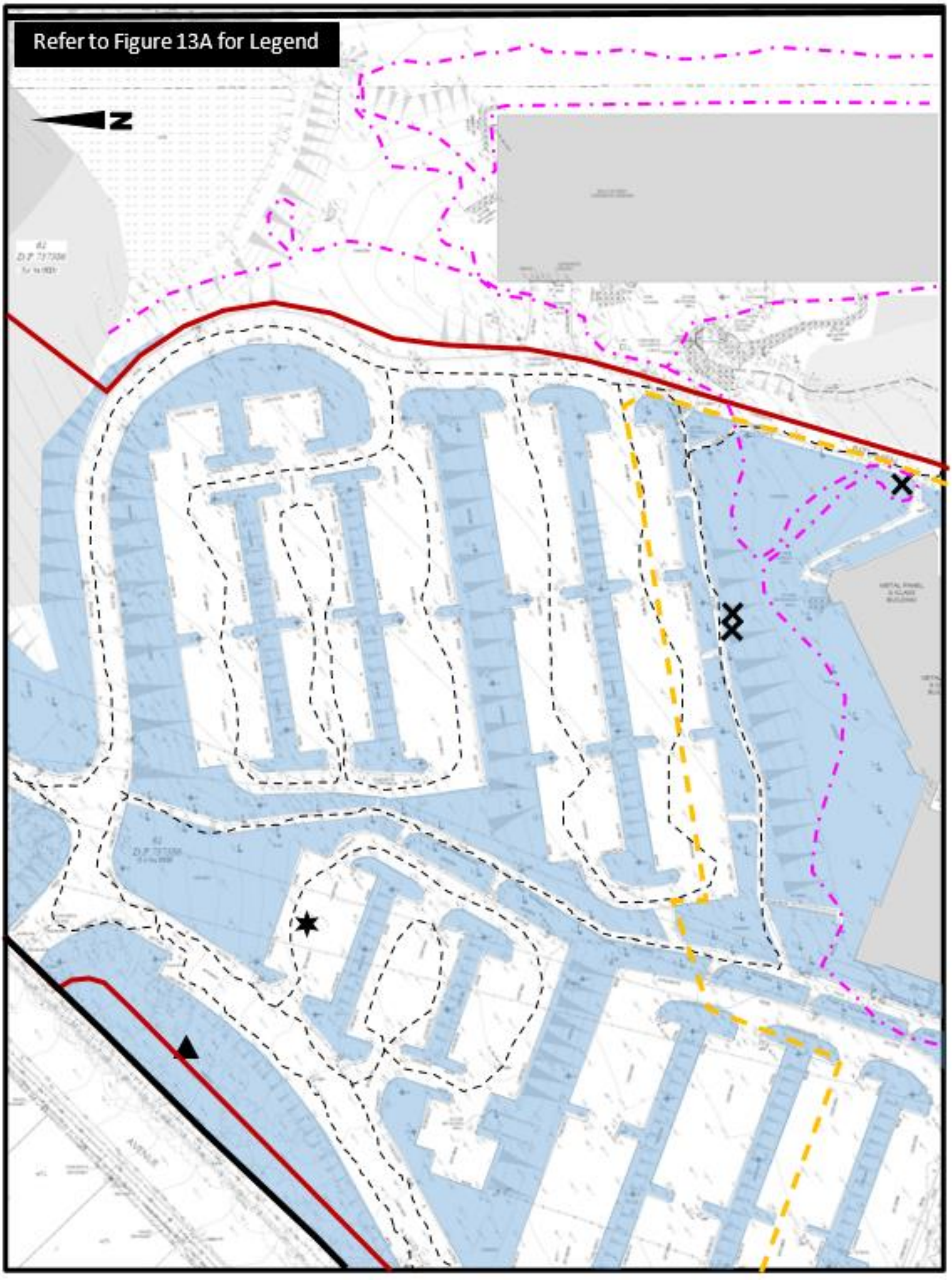


Figure 13B (F_TST): Fauna Survey effort and general fauna evidence observed - section B.

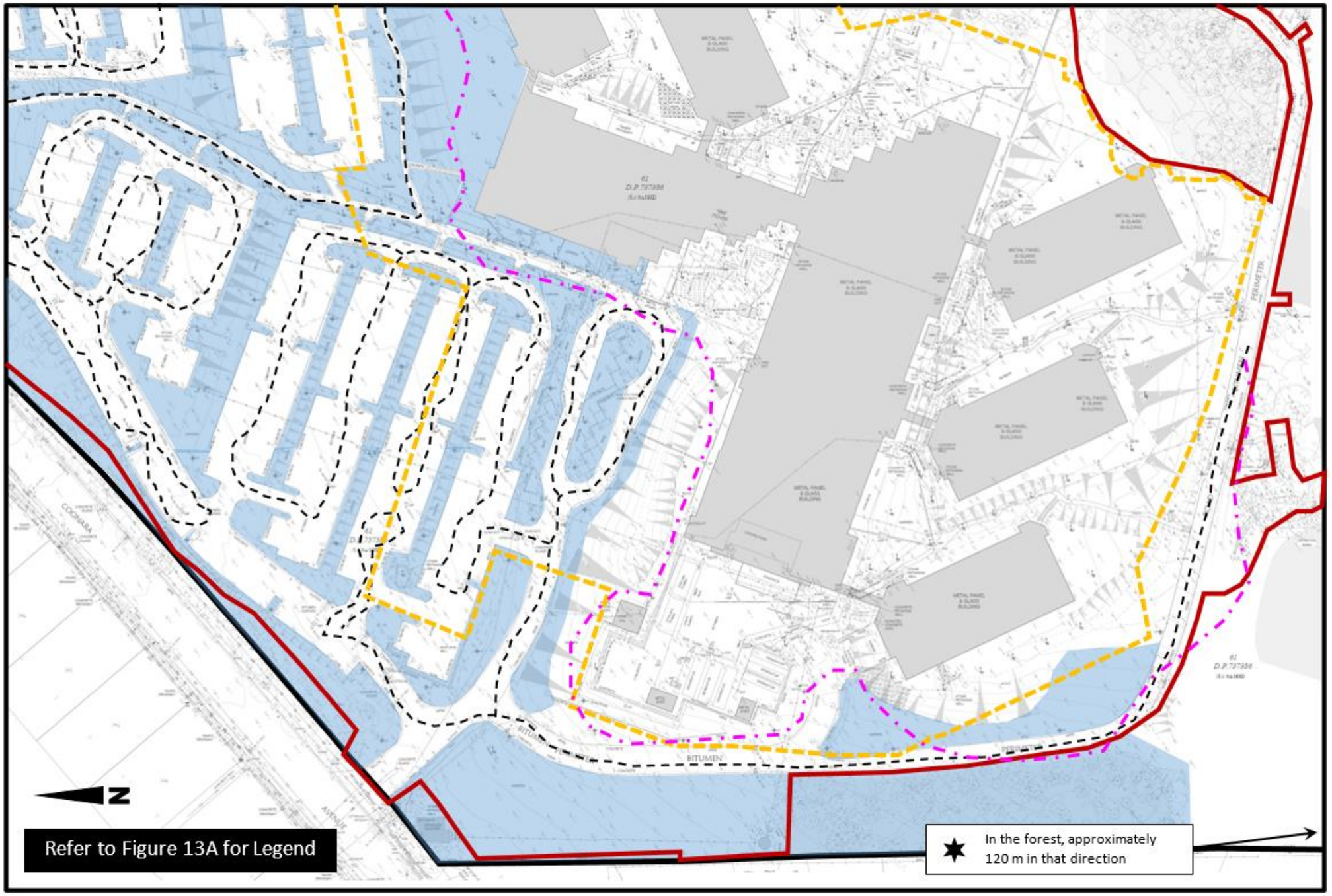


Figure 13C (F_TST): Fauna Survey effort and general fauna evidence observed - section C.

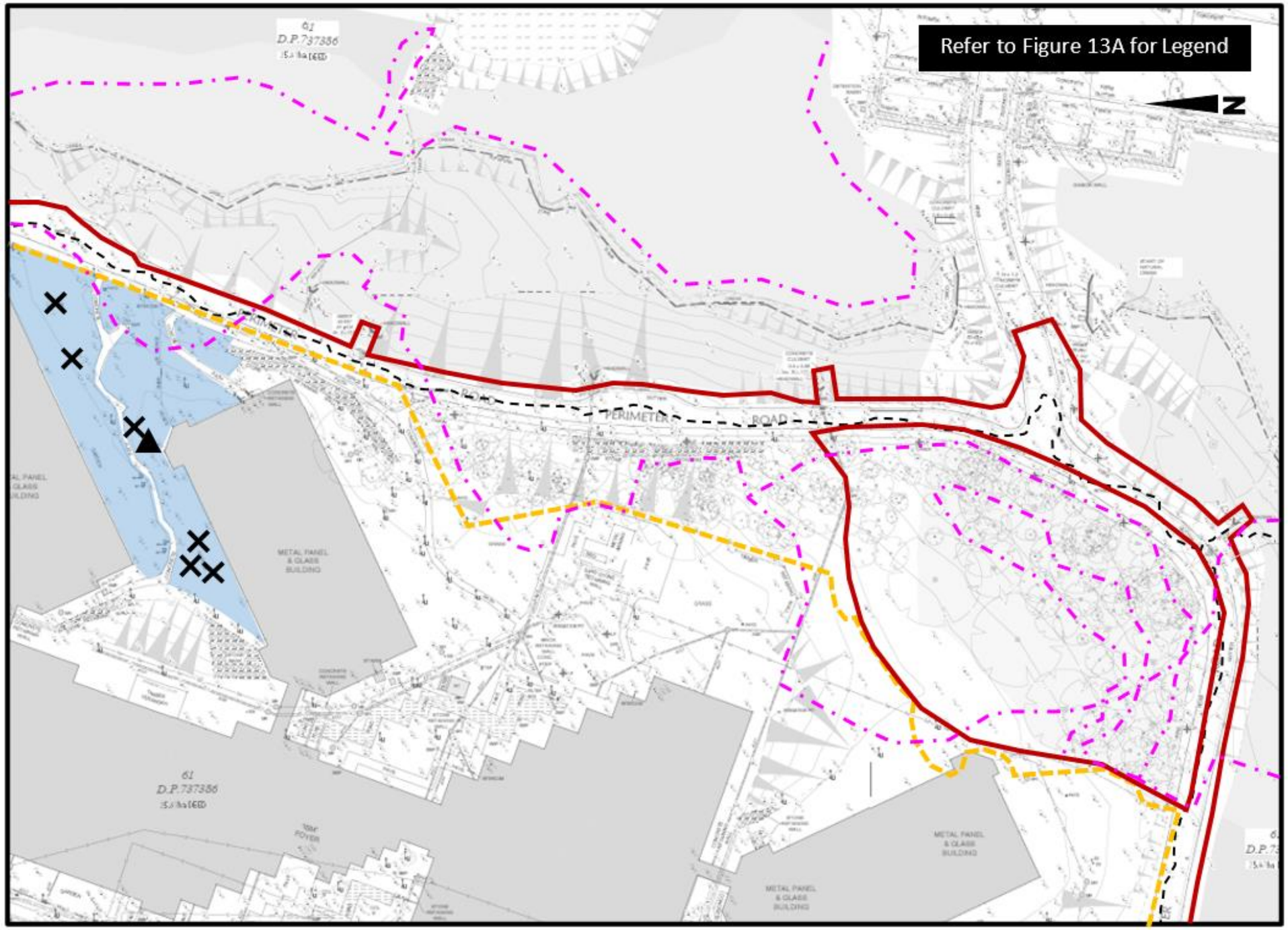


Figure 13D (F_TST): Fauna Survey effort and general fauna evidence observed - section D.

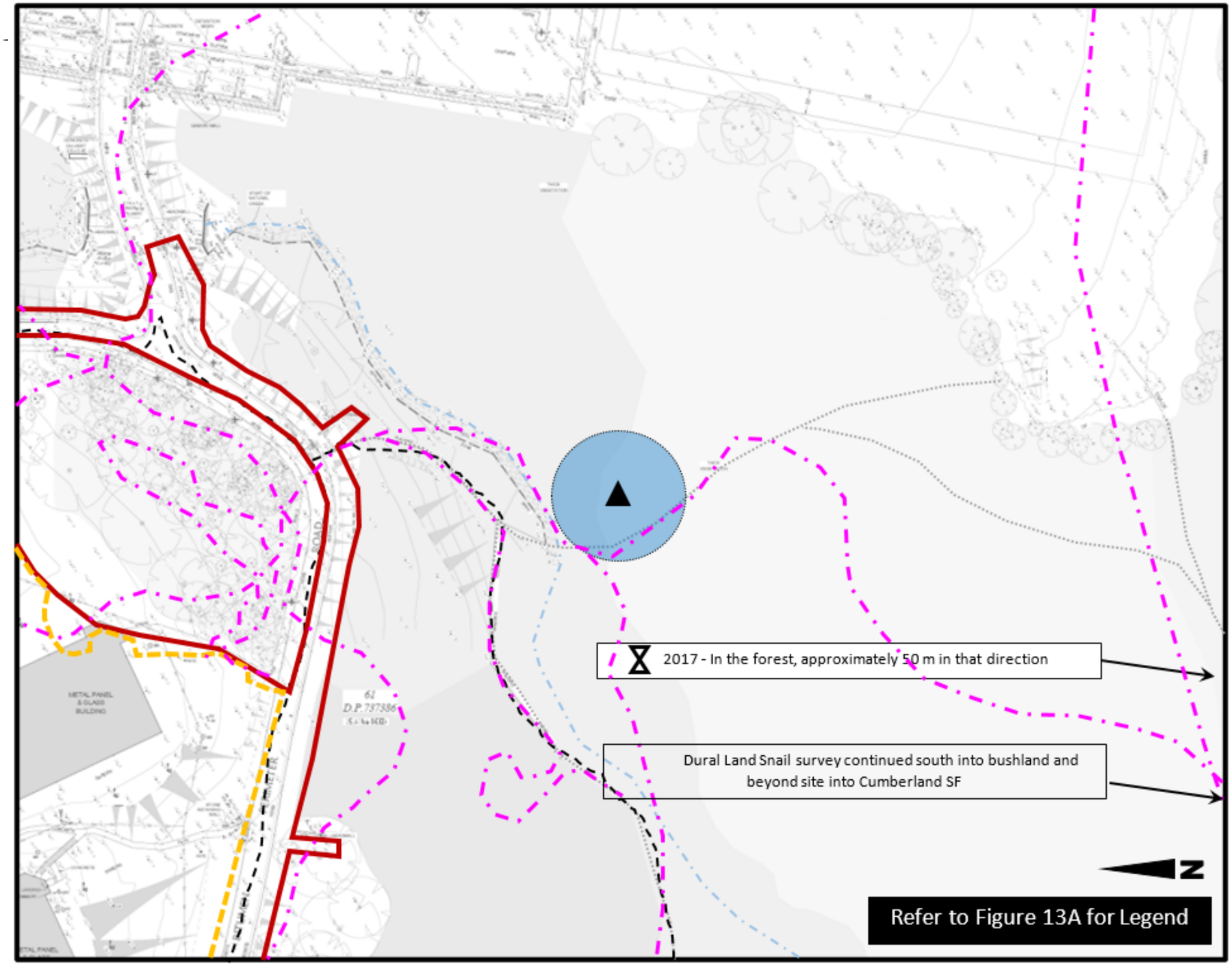


Figure 13E (F_TST): Fauna Survey effort and general fauna evidence observed - section E.

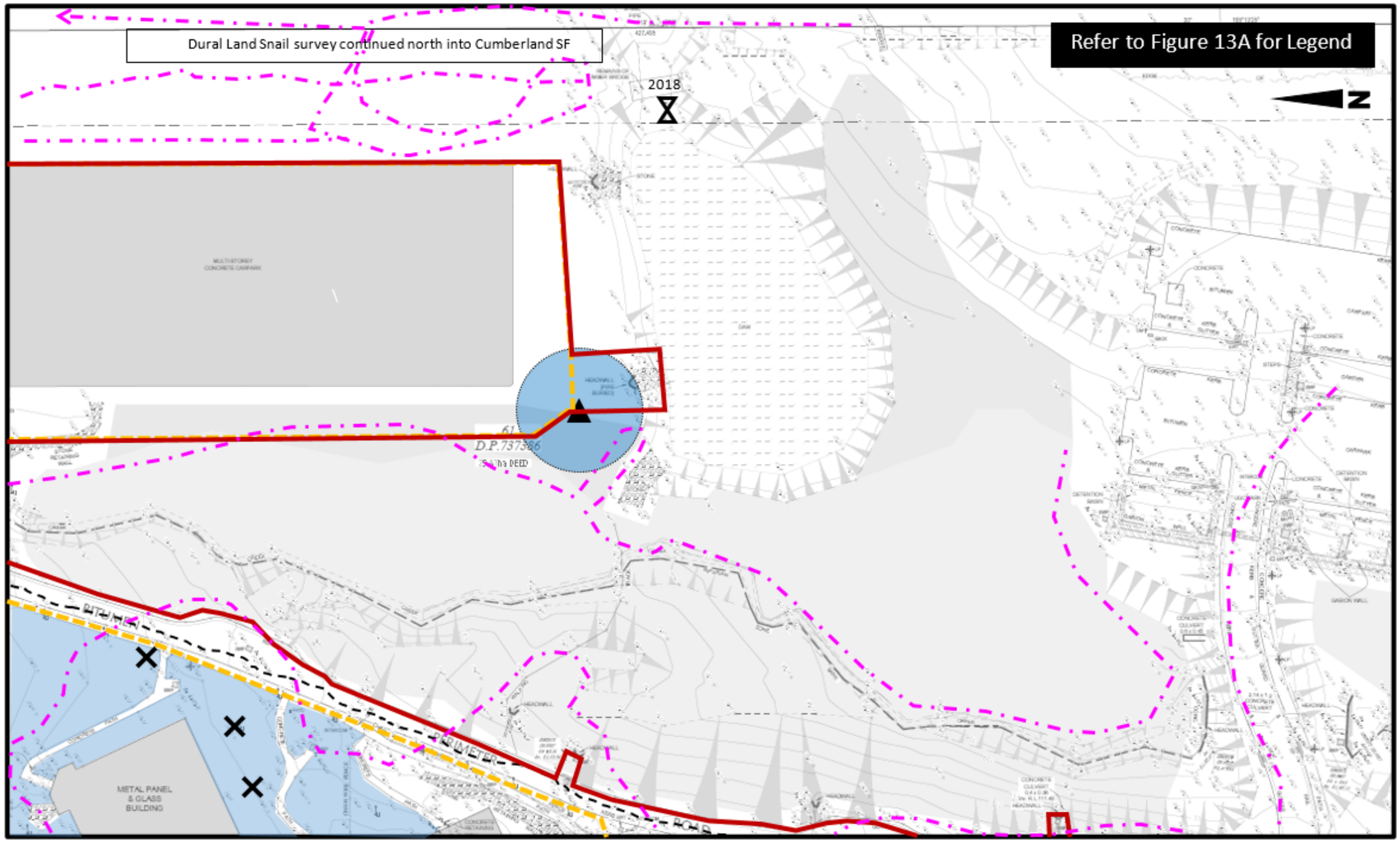


Figure 13F (F_TST): Fauna Survey effort and general fauna evidence observed – section F.

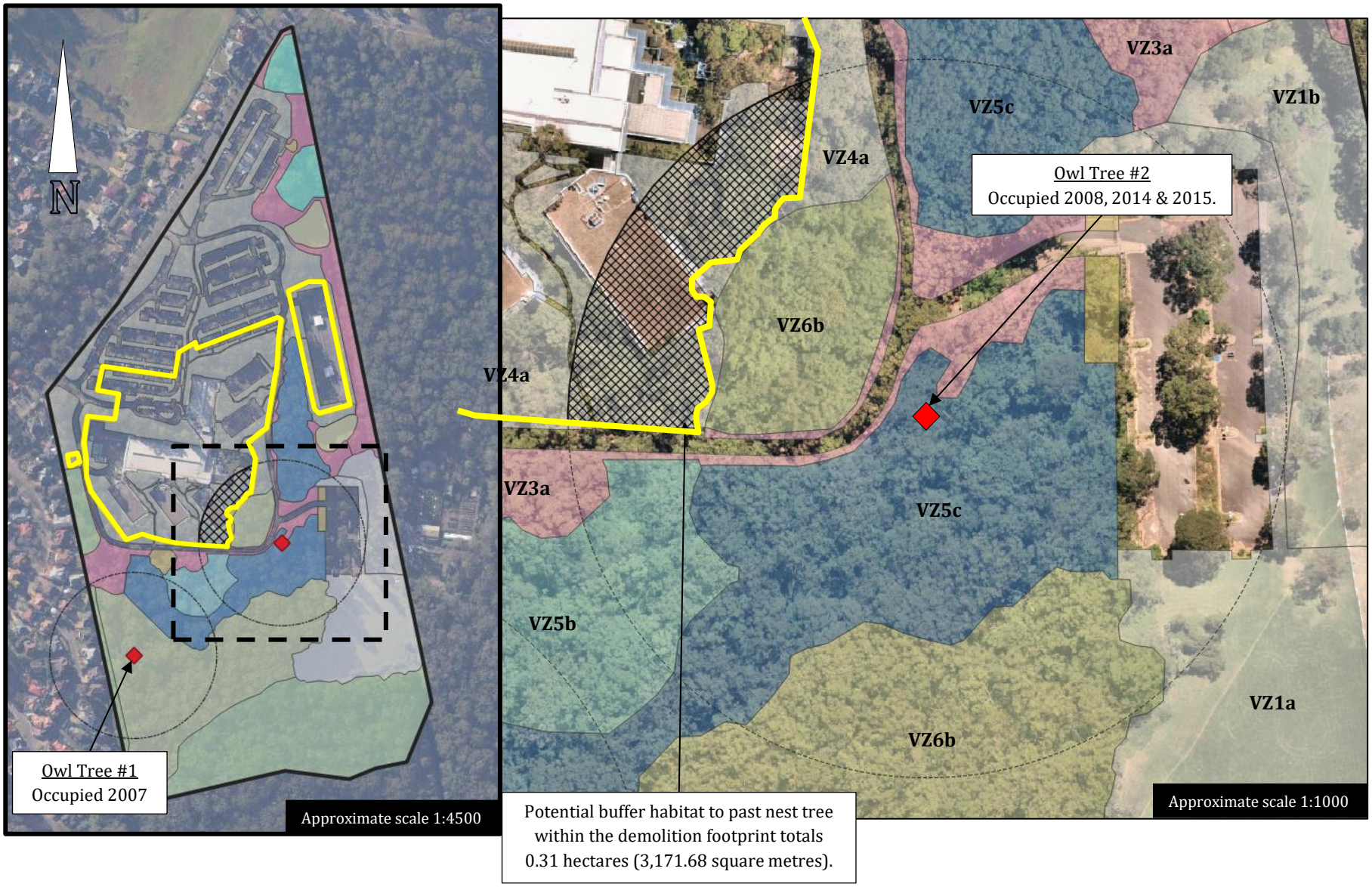


Figure 14 (F_TST): Powerful Owl nest tree buffer within proposed demolition footprint.

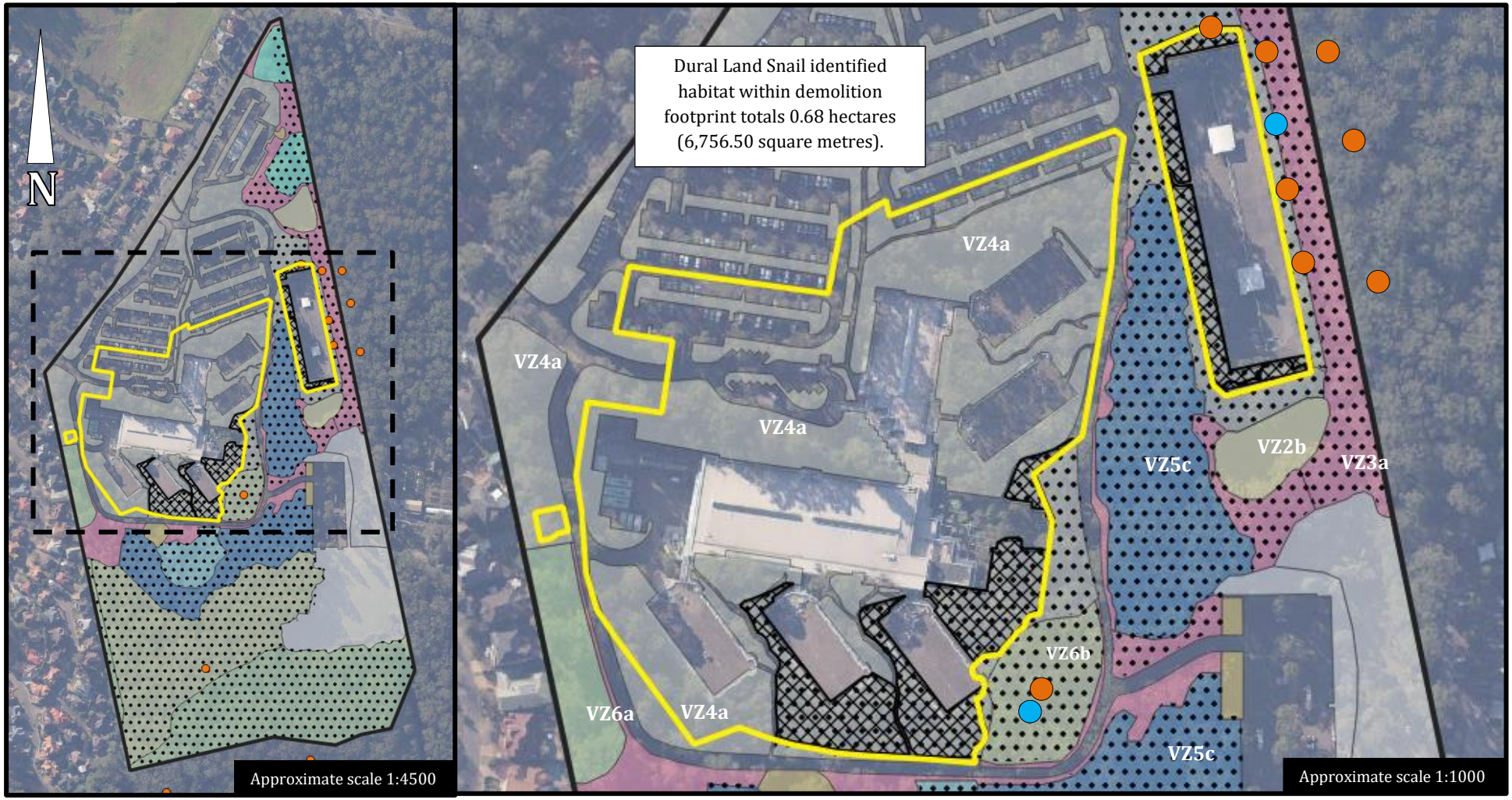
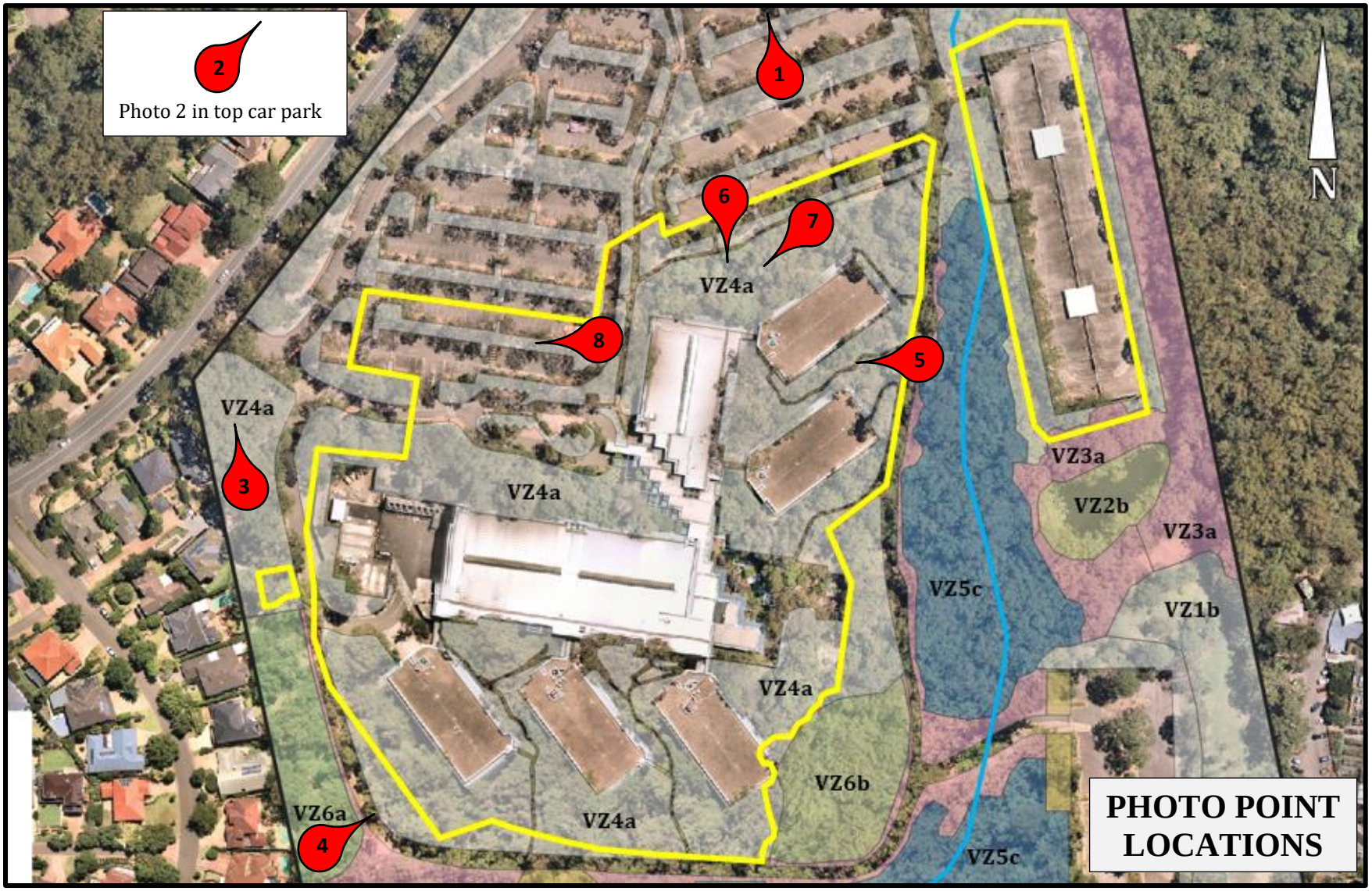


Figure 15 (F_TST): Fauna species survey results: **Dural Land Snail.** Demolition footprint (yellow outline) in relation to live individuals observed (orange dot); empty shells observed (blue dot) and identified suitable species habitat on the subject lot (black dotted areas). The total area of suitable habitat across the subject lot totals 12.81 hectares, while the extent of suitable habitat within the demolition footprint (black hatching) totals 0.68 hectares.

APPENDIX 2

PHOTOGRAPHS


2
Photo 2 in top car park
1
6
7
8
5
3
4
N
VZ4a
VZ4a
VZ4a
VZ4a
VZ4a
VZ6a
VZ6b
VZ5c
VZ5c
VZ3a
VZ2b
VZ3a
VZ1b
PHOTO POINT LOCATIONS

Photograph 1: Open-air car park in the demolition project area with trees planted in narrow beds.

Photograph 2: Open-air car park in the northern part of the development lot.

Photograph 3 Bushland along the site's western boundary, currently managed for bushfire mitigation, mainly through removal of Lantana and other weeds in the understorey.

Photograph 4: Landscaped vegetation alongside the edge of the ring road with a dense understorey due to regular pruning for safe vehicle passage.

Photograph 5: Landscaped area at the north eastern corner of the existing buildings.

Photograph 6: Landscaped area on the northern side of the existing buildings.

Photograph 7: Grove of Swamp Oak in VZ 4a.

Photograph 8: Planted trees in poor condition in VZ 4a.

APPENDIX 3

TABLES

Table 1(T_PTP): Floristic plot survey data within Planted Native Vegetation.

KEYSTONE ECOLOGICAL	**Date:** 22.04.2020 **Recorders:** E.Ashby, A.McTackett	**Survey Name** Lot 61 DP 737386, 55 Coonara Ave, West Pennant Hills	**Plot Identifier** RDP16_VZ4a	**Site sheet no.** 2 of 2

#	(native only. Leave blank for weeds)		***Top 3 native species in each growth form group: Full species name mandatory.*** ***All other native and exotic species: Full species name where practicable. Circle top 3 species in each layer.***	N, E or HTW	Cover (%)	Abund (stem count)	Stratum	Sample collect
	GF Code	BAM GF code						
1		Shrub	*Pittosporum undulatum* Sweet Pittosporum	N	0.5			
2		Other	*Hardenbergia violacea* Coral pea	N	0.5			
3		Other	*Clematis* sp.	N	10			
4		Tree	*Eucalyptus pilularis* Blackbutt	N	1			
5		Tree	*Corymbia citriodora* Lemon-scented Gum	N	5			
6		Tree	*Eucalyptus paniculata* Grey Ironbark	N	1			
7		-	*Ligustrum lucidum* Large-leaved Privet	HTE	0.5			
8		Other	*Glycine clandestina*	N	0.1			
9		Tree	*Syncarpia glomulifera* Turpentine	N	12			
10		Other	*Eustrephus latifolius* Wombat Berry	N	0.5			
11		Forb	*Brunoniella australis* Blue Trumpet	N	0.1			
12		Forb	*Lobelia pedunculata*	N	0.1			
13		Grasses	*Lomandra longifolia* Mat Rush	N	0.1			
14		Other	*Cayratia clematidea* Native Grape	N	0.1			
15		Forb	*Pseuderanthemum variabile* Pastel Flower	N	0.1			
16		Grasses	*Entolasia marginata*	N	0.2			
17		-	*Phytolacca octandra* Inkweed*	E	0.1			
18		-	*Ehrharta erecta**	HTE	0.1			
19		-	*Thunbergia alata* Black-eyed Susan*	E	0.1			
20		-	*Ligustrum sinense* Small-leaved Privet*	HTE	10			
21		Tree	*Alphitonia excelsa*	N	2			
22		Grasses	*Oplismenus aemulus*	N	0.1			
23		Shrub	*Acacia elata*	N	0.1			
24		-	*Sonchus oleraceus* Common Sowthistle*	E	0.1			
25		-	*Celtis sinensis* Japanese Hackberry*	E	0.1			
26		Forb	*Dianella caerulea* Flax Lilly	N	0.1			
27		-	*Bidens pilosa* Cobbler's Pegs*	HTE	0.5			
28		-	*Bromeliad* sp.*	E	0.1			
29		Tree	*Eucalyptus punctata* Grey Gum	N	1			
30		Shrub	*Bursaria spinosa*	N	0.5			
31		Tree	*Allocasuarina littoralis*	N	0.2			
32		-	*Ochna serrulata* Mickey Mouse Plant*	HTE	0.1			
33		Other	*Doryanthes excelsa* Gymea Lilly	N	0.5			
34		Tree	*Callistemon viminalis* Bottlebrush	N	0.2			
35		Forb	*Solanum prinophyllum*	N	0.1			
36		-	*Syagrus romanzoffiana* Cocos Palm*	E	0.1			
37		-	*Solanum nigrum* Nightshade*	E	0.1			
38		Tree	*Brachychiton acerifolius* Illawarra Flame Tree	N	0.1			
39		Shrub	*Polyscias sambucifolia* Elderberry Ash	N	0.1			
40		Tree	*Eucalyptus tereticornis* Forest Red Gum	N	10			
41		-	*Cordyline* sp*	E	0.1			
42		Other	*Glycine tabacina*	N	0.1			
43		Shrub	*Acacia* sp.	N	1			
44								
45								

GF Codes: *First letter represents GF code; code in bracket (e.g. (SG)) represents the BAM code for the calculator.* ***Circle if in Top 3 of layer.***

A: Cycad (OG); **C:** Chenopod (SG); **D:** Other Grass (GG); **E:** Ferns (EG); **F:** Forb (FG); **G:** Tussock Grass (GG); **H:** Hummock Grass (GG); **K:** Epiphyte (OG); **L:** Vine (OG); **M:** Mallee Tree (TG); **P:** Palm (OG); **Q:** Tree Fern (OG); **R:** Rush (GG): **S:** Shrub (SG); **T:** Tree (TG); **V:** Sedge (GG); **X:** Xanthorrhoea (OG); **Y:** Mallee Shrub (SG); **Z:** Heath Shrub (SG)
N, E, HTW: N: native; **E:** exotic; **HTW:** high threat weed.
Cover: 0.1, 0.2, 0.3…1, 2, 3,…10, 15, 20, 25,….100% (foliage cover); **Note:** 0.1% cover represents approximately 63cm x 63cm or a circle about 71cm diameter. 0.1% cover is the lowest allowed – this may be an over estimate of the actual cover. 0.5% cover represents an area of approximately 1.4m x 1.4m, and 1% cover = 2m x 2m, 5% = 4m x 5x, 25% = 10m x 10m.
Abundance: 1, 2, 3,….10, 20, 30,….100, 200,….1000, … **grass abundance**: count fractional unit, i.e. runner = one plant. Abundance of 200 – 1000 has no effect in BAM calculator.
Stratum: T1: Upper (20m+); **T2:** Upper (15-20m); **T3**: Trees (10-15m); **S1**: Small trees (5-10m); **S2:** Shrubs (≤5m); **L1**: ground (≤1m); **L2:** Lower ground (≤0.5m)

KEYSTONE ECOLOGICAL	**Date** 22.04.2020 **Recorders:** E.Ashby A.McTackett	**Survey Name** 55 Coonara Ave, West Pennant Hills	**Plot Identifier** RDP17_VZ4a	**Site sheet no.** 2 of 2

#	(native only. Leave blank for weeds)		***Top 3 native species in each growth form group: Full species name mandatory.*** ***All other native and exotic species: Full species name where practicable. Circle top 3 species in each layer.***	N, E or HTW	Cover (%)	Abund (stem count)	Stratum	Sample collect
	GF Code	BAM GF code						
1		Tree	*Corymbia citriodora* Lemon-scented Gum	N	12			
2		Tree	*Casuarina glauca* Swamp Oak	N	40			
3		-	*Sonchus oleraceus* Common Sowthistle*	E	25			
4		Forb	*Oxalis perennans*	N	5			
5		-	*Conyza* sp.*	E	0.2			
6		Other	*Cayratia clematidea* Native Grape	N	0.2			
7		-	*Ehrharta erecta**	HTE	50			
8		-	*Cordyline* sp*	E	10			
9		Shrub	*Pittosporum undulatum* Sweet Pittosporum	N	5			
10		Other	*Doryanthes excelsa* Gymea Lilly	N	25			
11		Forb	*Geranium homeanum*	N	0.1			
12		Grasses	*Lomandra longifolia* Mat Rush	N	5			
13		Tree	*Syncarpia glomulifera* Turpentine	N	1			
14		Other	*Clematis* sp.	N	0.2			
15		-	*Solanum nigrum* Nightshade*	E	0.2			
16		Shrub	*Homalanthus populifolius* Bleeding Heart	N	0.1			
17		-	*Sigesbeckia orientalis* Indian Weed*	E	0.1			
18		-	*Phytolacca octandra* Inkweed*	E	0.1			
19		-	*Stellaria media* Chickweed*	E	0.1			
20		Other	*Stephania japonica* Snake Vine	N	0.1			
21		-	*Sida rhombifolia* Paddy's Lucerne*	E	0.2			
22		Other	*Livistona australis* Cabbage Fan Palm	N	25			
23		Forb	*Dichondra repens* Kidney Weed	N	0.1			
24		-	*Dietes bicolor**	E	0.2			
25		-	*Ochna serrulata* Mickey Mouse Plant*	HTE	2			
26		Other	*Morinda jasminoides* Sweet Morinda	N	0.1			
27		-	*Ligustrum sinense* Small-leaved Privet*	THE	1			
28		Shrub	*Acacia* sp.	N	1			
29		-	*Asparagus aethiopicus**	HTE	0.1			
30		-	*Cyperus eragrostis**	HTE	0.1			
31		Tree	*Glochidion ferdinandi* Cheese Tree	N	0.1			
32		Forb	*Solanum prinophyllum*	N	0.1			
33		-	*Hypochaeris radicata* Flatweed*	E	0.1			
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								

GF Codes: *First letter represents GF code; code in bracket (e.g. (SG)) represents the BAM code for the calculator.* ***Circle if in Top 3 of layer.***

A: Cycad (OG); **C:** Chenopod (SG); **D:** Other Grass (GG); **E:** Ferns (EG); **F:** Forb (FG); **G:** Tussock Grass (GG); **H:** Hummock Grass (GG); **K:** Epiphyte (OG); **L:** Vine (OG); **M:** Mallee Tree (TG); **P:** Palm (OG); **Q:** Tree Fern (OG); **R:** Rush (GG): **S:** Shrub (SG); **T:** Tree (TG); **V:** Sedge (GG); **X:** Xanthorrhoea (OG); **Y:** Mallee Shrub (SG); **Z:** Heath Shrub (SG)
N, E, HTW: N: native; **E:** exotic; **HTW:** high threat weed.
Cover: 0.1, 0.2, 0.3…1, 2, 3,…10, 15, 20, 25,….100% (foliage cover); **Note:** 0.1% cover represents approximately 63cm x 63cm or a circle about 71cm diameter. 0.1% cover is the lowest allowed – this may be an over estimate of the actual cover. 0.5% cover represents an area of approximately 1.4m x 1.4m, and 1% cover = 2m x 2m, 5% = 4m x 5x, 25% = 10m x 10m.
Abundance: 1, 2, 3,….10, 20, 30,….100, 200,….1000, … **grass abundance**: count fractional unit, i.e. runner = one plant. Abundance of 200 – 1000 has no effect in BAM calculator.

Stratum: T1: Upper (20m+); **T2:** Upper (15-20m); **T3**: Trees (10-15m); **S1**: Small trees (5-10m); **S2:** Shrubs (≤5m); **L1**: ground (≤1m); **L2:** Lower ground (≤0.5m)

Table 2: All flora species recorded during plot surveys (RDP), random meander (RM) across the subject lot, and tree survey by the Project Arborist Footprint Green (FG) in the demolition area.
Note that RDP 16 and RDP 17 are within VZ4a, but RDP 16 is outside the demolition project area. BGHF = Species characteristic of Blue Gum High Forest, STIF = Species characteristic of Sydney Turpentine Ironbark Forest, * = exotic; HTW = High Threat Weed; WONS = Weed of National Significance.

Family	Scientific Name	Common Name	FG	RM	RDP 1	RDP 2	RDP 3	RDP 4	RDP 5	RDP 6	RDP 7	RDP 8	RDP 9	RDP 10	RDP 11	RDP 12	RDP 13	RDP16	RDP17
Acanthaceae	*Brunoniella australis*	Blue Trumpet																x	
Acanthaceae	*Pseuderanthemum variabile* BGHF, STIF	Pastel Flower											x				x	x	
Acanthaceae	*Thunbergia alata**	Black-eyed Susan																x	
Adiantaceae	*Adiantum aethiopicum* BGHF	Common Maidenhair			x				x	x	x	x							
Apocynaceae	*Parsonsia straminea*	Common Silkpod			x					x	x	x	x	x			x		
Araliaceae	*Hedera helix**	English Ivy						x							x				
Araliaceae	*Polyscias sambucifolia* subsp. long leaflets STIF	Elderberry Panax			x		x		x				x					x	
Araliaceae	*Schefflera actinophylla*	Umbrella Tree	x																
Arecaceae	*Archontophoenix cunninghamiana*	Bangalow Palm	x																
Arecaceae	*Livistona australis*	Cabbage Tree Palm		x							x								x
Arecaceae	*Syagrus romanzoffiana*	Cocos Palm																x	
Asparagaceae	*Asparagus aethiopicus**	Ground Asparagus				x					x						x		x
Asparagaceae	*Asparagus scandens**	Asparagus															x		
Aspleniaceae	*Asplenium australasicum*	Birds Nest Fern						x											
Asteliaceae	*Cordyline* species complex[1]	Palm Lilies						x	x		x	x	x		x		x	x	x
Asteraceae	*Bidens pilosa**	Cobbler's Pegs																x	
Asteraceae	*Conyza* sp.*	-																	x
Asteraceae	*Hypochaeris radicata*	Flatweed																	x
Asteraceae	*Ozothamnus diosmifolius*	Rice Flower		x									x						
Asteraceae	*Sigesbeckia orientalis*	Indian Weed																	x
Asteraceae	*Sonchus oleraceus**	Common Sowthistle																x	x
Bignoniaceae	*Jacaranda mimosifolia**	Jacaranda	x																
Bignoniaceae	*Pandorea jasminoides*	Bower Vine		x															
Bignoniaceae	*Pandorea pandorana* BGHF, STIF	Wonga Vine			x				x	x	x	x	x	x	x		x		
Blechnaceae	*Blechnum cartilagineum* BGHF	Gristle Fern		x															
Blechnaceae	*Blechnum neohollandicum* BGHF											x			x				
Bromeliaceae	*Bromeliad* sp.*																	x	
Campanulaceae	*Lobelia purpurascens*	Whiteroot																x	
Cannabacceae	*Celtis australis**	Nettle Tree	x																
Cannabacceae	*Celtis sinensis* *	Japanese Hackberry																x	
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle				x													
Caryophyllaceae	*Stellaria media**	Chickweed																	x
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak											x					x	
Casuarinaceae	*Allocasuarina torulosa* BGHF, STIF	Forest Oak			x														
Casuarinaceae	*Casuarina glauca*	Swamp Oak	x																x
Celastraceae	*Denhamia silvestris* BGHF	-							x		x			x					

[1] Cordylines were planted extensively during the IBM development in the landscaped gardens and in the adjacent bushland. The seeds within the shiny soft fruits are spread by birds and the seeds germinate readily. The leaf shapes and widths observed are highly variable, indicating the presence of more than one species. These may include the locally native *Cordyline stricta*, but may also include species from the north coast, and exotics. This group hybridises easily and needs further study (personal communication Dr Karen Wilson, Royal Botanic Gardens).

Family	Scientific Name	Common Name	FG	RM	RDP 1	RDP 2	RDP 3	RDP 4	RDP 5	RDP 6	RDP 7	RDP 8	RDP 9	RDP 10	RDP 11	RDP 12	RDP 13	RDP16	RDP17
Convolvulaceae	*Dichondra repens*	Kidney Weed																	x
Cunoniaceae	*Ceratopetalum gummiferum*	Christmas Bush		x															
Cyatheaceae	*Cyathea australis*	Rough Tree-fern	x	x															
Cyperaceae	*Cyperus eragrostis**	-																	x
Cyperaceae	*Lepidosperma laterale* STIF	Variable Sword-sedge									x	x	x	x					
Dilleniaceae	*Hibbertia dentata*	Trailing Guinea Flower										x							
Doryanthaceae	*Doryanthes excelsa*	Gymea Lilly																x	x
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash	x																
Ericaceae	*Leucopogon juniperinus* BGHF, STIF	Prickly Beard-heath			x					x	x		x	x					
Euphorbiaceae	*Breynia oblongifolia* BGHF, STIF	Coffee Bush		x	x						x		x	x			x		
Euphorbiaceae	*Glochidion ferdinandi* var. *ferdinandi* BGHF	Cheese Tree				x			x	x	x		x	x	x	x			x
Euphorbiaceae	*Homalanthus populifolius*	Bleeding Heart																	x
Euphorbiaceae	*Poranthera microphylla* STIF			x															
Euphorbiaceae	*Triadica sebifera**	Chinese Tallowwood	x																
Fabaceae	*Glycine clandestina*																	x	
Fabaceae	*Glycine tabacina*																	x	
Fabaceae	*Hardenbergia violacea*	Coral Pea																x	
Geraniaceae	*Geranium homeanum*	-																	x
Iridaceae	*Dietes bicolor**	Spanish Iris		x															x
Lamiaceae	*Clerodendrum tomentosum* BGHF, STIF	Hairy Clerodendrum								x	x								
Lauraceae	*Cinnamomum camphora**	Camphor Laurel	x																
Lauraceae	*Cryptocarya glaucescens*	Jackwood									x								
Lindsaeaceae	*Lindsaea linearis*	Screw Fern										x							
Lomandraceae	*Lomandra filiformis*											x	x						
Lomandraceae	*Lomandra longifolia* BGHF, STIF	Spiky-headed Mat-rush						x	x		x	x		x	x	x		x	x
Lomariopsidaceae	*Nephrolepis cordifolia*	Fish-bone Fern						x											
Luzuriagaceae	*Eustrephus latifolius* BGHF	Wombat Berry		x	x						x		x	x	x		x	x	
Malvaceae	*Brachychiton acerifolius*	Illawarra Flame Tree	x															x	
Malvaceae	*Brachychiton populneus*	Kurrajong															x		
Malvaceae	*Sida rhombifolia* *	Paddy's Lucerne																	x
Meliaceae	*Melia azedarach*	White Cedar	x																
Menispermiaceae	*Sarcopetalum harveyanum*	Pearl Vine							x			x					x		
Menispermiaceae	*Stephania japonica* var. *discolor*	Snake Vine					x							x			x		x
Mimosaceae	*Acacia binervia*	Coast Myall Wattle																	
Mimosaceae	*Acacia decurrens*	-	x																
Mimosaceae	*Acacia elata*	Cedar Wattle	x			x												x	
Mimosaceae	*Acacia floribunda*	Sally Wattle		x															
Mimosaceae	*Acacia implexa* STIF	Hickory Wattle	x																
Mimosaceae	*Acacia longissima*	Long-leaf Wattle			x							x							
Mimosaceae	*Acacia parramattensis*	-	x																
Mimosaceae	*Acacia* sp.	-																x	x
Moraceae	*Ficus coronata* BGHF	Sandpaper Fig	x	x											x				
Moraceae	*Ficus rubiginosa*	Port Jackson Fig	x																

Family	Scientific Name	Common Name	FG	RM	RDP 1	RDP 2	RDP 3	RDP 4	RDP 5	RDP 6	RDP 7	RDP 8	RDP 9	RDP 10	RDP 11	RDP 12	RDP 13	RDP16	RDP17
Musaceae	*Musa* sp.*	Banana															x		
Myrsinaceae	*Myrsine variabilis* BGHF	Muttonwood	x		x														
Myrtaceae	*Acmena smithii* BGHF	Lilly Pilly	x																
Myrtaceae	*Angophora costata* BGHF, STIF	Smooth-barked Apple	x		x			x	x	x	x	x	x				x		
Myrtaceae	*Angophora floribunda*	Rough-barked Apple	x																
Myrtaceae	*Callistemon viminalis* 'Captain Cook'	Bottlebrush	x															x	
Myrtaceae	*Callistemon viminalis*	Bottlebrush	x																
Myrtaceae	*Corymbia citriodora**	Lemon-scented Gum	x	x														x	x
Myrtaceae	*Corymbia gummifera*	Red Bloodwood	x																
Myrtaceae	*Corymbia maculata*	Spotted Gum	x																
Myrtaceae	*Eucalyptus microcorys*	Tallowwood																	
Myrtaceae	*Eucalyptus paniculata* subsp. *paniculata* BGHF, STIF	Grey Ironbark				x												x	
Myrtaceae	*Eucalyptus pilularis* BGHF	Blackbutt			x			x	x	x	x	x	x	x	x		x	x	
Myrtaceae	*Eucalyptus punctata*	Grey Gum	x	x														x	
Myrtaceae	*Eucalyptus resinifera* subsp. *resinifera*	Red Mahogany									x								
Myrtaceae	*Eucalyptus saligna* BGHF	Sydney Blue Gum	x			x	x	x	nearby					x	x	x	x		
Myrtaceae	*Eucalyptus saligna x botryoides* STIF	Blue Gum / Bangalay	x																
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	x	x														x	
Myrtaceae	*Leptospermum* sp.	-	x																
Myrtaceae	*Melaleuca armillaris*	-	x																
Myrtaceae	*Syncarpia glomulifera* STIF	Turpentine	x		x				x	x	x	x		x	x		x	x	x
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	x																
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant			x	x												x	x
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet	x			x	x	x			x				x	x	x	x	
Oleaceae	*Ligustrum sinense**	Small-leaved Privet				x			x	x	x			x	x	x		x	x
Oleaceae	*Notelaea longifolia* BGHF, STIF	Mock Olive			x					x	x		x						
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive	x	x													x		
Orchidaceae	*Acianthus* sp.	Orchid		x															
Orchidaceae	*Cryptostylis subulata*	Large Tongue Orchid								x									
Orchidaceae	*Dipodium variegatum*	-		x															
Passifloraceae	*Passiflora herbertiana*	Native Passionfruit											x				x		
Passifloraceae	*Passiflora subpeltata**	White Passionflower																	
Passifloraceae	*Passiflora tarminiana**	Banana Passionfruit					x												
Phormiaceae	*Dianella caerulea* BGHF, STIF	Flax Lily			x				x	x							x	x	
Phormiaceae	*Dianella prunina*	-									x	x	x						
Phytolaccaceae	*Phytolacca octandra**	Inkweed																x	x
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry																	
Pittosporaceae	*Bursaria spinosa* var. *spinosa* STIF	Blackthorn			x					x								x	
Pittosporaceae	*Pittosporum revolutum*	Yellow Pittosporum										x	x	x			x		
Pittosporaceae	*Pittosporum undulatum* BGHF, STIF	Sweet Pittosporum	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x
Plantaginaceae	*Plantago lanceolata**	Ribwort		x															
Plantaginaceae	*Veronica plebeia*	Creeping Speedwell		x															
Poaceae	*Andropogon virginicus**	Whisky Grass		x															

Family	Scientific Name	Common Name	FG	RM	RDP 1	RDP 2	RDP 3	RDP 4	RDP 5	RDP 6	RDP 7	RDP 8	RDP 9	RDP 10	RDP 11	RDP 12	RDP 13	RDP16	RDP17
Poaceae	*Briza maxima**	Quaking Grass		x															
Poaceae	*Briza minor**	Shivery Grass		x															
Poaceae	*Echinopogon caespitosus* var. *caespitosus*	Tufted Hedgehog Grass		x															
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass		x															
Poaceae	*Ehrharta erecta**	Panic Veldtgrass					x											x	x
Poaceae	*Entolasia marginata* BGHF, STIF	Bordered Panic			x			x			x	x		x		x	x	x	
Poaceae	*Entolasia stricta*	Wiry Panic											x						
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass		x															
Poaceae	*Microlaena stipoides* var. *stipoides* STIF	Weeping Rice Grass		x															
Poaceae	*Oplismenus aemulus* BGHF, STIF	Basket Grass		x										x				x	
Poaceae	*Sporobolus africanus**	Parramatta Grass																	
Poaceae	*Themeda triandra* STIF	Kangaroo Grass		x								x	x						
Polypodiaceae	*Platycerium superbum*	Staghorn									x								
Proteaceae	*Grevillea robusta*	Silky Oak	x																
Proteaceae	*Hakea salicifolia*	-	x																
Proteaceae	*Lomatia silaifolia*	Crinkle Bush			x							x	x						
Proteaceae	*Persoonia levis*	Broad-leaved Geebung		?															
Proteaceae	*Persoonia linearis* STIF	Narrow-leaved Geebung		x															
Pteridaceae	*Pteris tremula*	Tender Brake		?															
Ranunculaceae	*Clematis aristata* BGHF, STIF	Old Man's Beard			x		x			x	x			x					
Ranunculaceae	*Clematis glycinoides* var. *glycinoides*	Clematis									x						x	x	x
Rhamnaceae	*Alphitonia excelsa* BGHF	Red Ash	x		x									x			x	x	
Rhamnaceae	*Pomaderris intermedia*										x						x		
Rosaceae	*Rubus fruticosis* sp. agg.*	Blackberry									x								
Rubiaceae	*Morinda jasminoides* BGHF	-			x		x	x	x	x	x	x		x	x	x	x		x
Rutaceae	*Zieria smithii* STIF	Sandfly Zieria		x									x	x					
Sapindaceae	*Dodonaea triquetra*	Hop Bush											x						
Smilacaceae	*Smilax australis*	Lawyer Vine									x	x							
Smilacaceae	*Smilax glyciphylla* BGHF, STIF	Sarsparilla							x										
Solanaceae	*Duboisia myoporoides*	Corkwood		x															
Solanaceae	*Solanum mauritianum**	Wild Tobacco Bush		x													x		
Solanaceae	*Solanum nigrum **	Nightshade																x	x
Solanaceae	*Solanum prinophyllum*	Forest Nightshade																x	x
Solanaceae	*Solanum seaforthianum**	Brazilian Nightshade					x												
Thelypteridaceae	*Christella dentata*	-		x											x				
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower		x															
Verbenaceae	*Lantana camara**	Lantana				x	x		x	x	x		x						
Vitaceae	*Cayratia clematidea*	Slender Grape				x											x	x	x
Xanthorrhoeaceae	*Xanthorrhoea media*	-			x														

Table 3: Survey activities for the Powerful Owl on and near the site from 2015 to 2020. Unless otherwise stated, all activities are on the subject lot.

Life Cycle Stage	Date	Survey method	Survey method suitable to detect:			
			Male in day roost	Male night activity	Female in nest / day roost	Juvenile in nest / day roost
Incubation	20 June 2014	• Direct observation of roosting habitat	✓			
Nestlings	8 September 2015	• Direct observation of roosting habitat	✓		✓	✓
Nestlings	September 2017	• Direct observation of roosting habitat	✓		✓	
Fledglings	12 December 2017	• Direct observation of roosting habitat • Passive audio recording • Call broadcast • Spotlighting	✓	✓	✓	✓
Fledglings	29 December 2017		✓	✓	✓	✓
Fledglings	30 December 2017		✓	✓	✓	✓
Fledglings	31 December 2017		✓	✓	✓	✓
Fledglings	2 February 2018	• Direct observation of roosting habitat	✓		✓	✓
Fledglings	21 February 2018	• Direct observation of roosting habitat	✓		✓	✓
Courting and mating	14 March 2018	• Direct observation of roosting habitat	✓		✓	✓
Incubation	8 June 2018	• Direct observation of roosting habitat	✓			
Incubation	10 July 2018	• Direct observation of roosting habitat	✓			
Incubation	18 July 2018	• Direct observation of roosting habitat	✓			
Incubation	8 August 2018	• Direct observation of roosting habitat	✓			
Fledglings	4 December 2018	• Direct observation of roosting habitat	✓	✓	✓	✓

Life Cycle Stage	Date	Survey method	Survey method suitable to detect:			
			Male in day roost	Male night activity	Female in nest / day roost	Juvenile in nest / day roost
Fledglings	5 December 2018	• Passive audio recording • Call broadcast • Spotlighting	✓	✓	✓	✓
Fledglings	31 January 2019	• Direct observation of roosting habitat	✓		✓	✓
Courting and mating	9 May 2019	• Direct observation of roosting habitat	✓			
Courting and mating	28 May 2019	• Direct observation of roosting habitat	✓			
Incubation	12 June 2019	• Direct observation of roosting habitat • Passive audio recording	✓			
Incubation	2 - 9 July 2019	• Passive audio recording	✓	✓		
Incubation	2 July 2019	• Direct observation of roosting habitat • Nest tree watch • Spotlighting	✓	✓		
Incubation	9 July 2019	• Direct observation of roosting habitat • Nest tree watch • Spotlighting	✓	✓		
Incubation	18 -23 July 2019	• Passive audio recording	✓	✓		
Incubation	18 July 2019	• Direct observation of roosting habitat • Nest tree watch • Spotlighting	✓	✓		
Incubation	23 July 2019	• Direct observation of roosting habitat • Nest tree watch • Spotlighting	✓	✓		

Life Cycle Stage	Date	Survey method	Survey method suitable to detect:			
			Male in day roost	Male night activity	Female in nest / day roost	Juvenile in nest / day roost
Incubation	23 July 2019	In Cumberland State Forest and the subject site: • Direct observation of roosting habitat • Passive audio recording • Nest tree watch • Spotlighting		✓	✓	
Nestlings	6 September 2019	In Cumberland State Forest: • Direct observation of roosting habitat • Passive audio recording • Nest tree watch • Spotlighting		✓	✓	✓
Nestlings	8 September 2019	In Cumberland State Forest: • Direct observation of roosting habitat • Passive audio recording • Nest tree watch • Spotlighting		✓	✓	✓
Nestlings	9 September 2019	In Cumberland State Forest: • Direct observation of roosting habitat • Passive audio recording • Nest tree watch • Spotlighting		✓	✓	✓
Courting and mating	23-28 April 2020	• Passive audio recording		✓		
Courting and mating	23 April 2020	• Direct observation of roosting habitat	✓			

Life Cycle Stage	Date	Survey method	Survey method suitable to detect:			
			Male in day roost	Male night activity	Female in nest / day roost	Juvenile in nest / day roost
		• Nest tree watch • Spotlighting				
Courting and mating	23 April 2020	In Cumberland State Forest: • Direct observation of roosting habitat • Nest tree watch • Spotlighting	✓			
Incubation	End June 2020	In Cumberland State Forest: • Direct observation of roosting habitat • Nest tree watch • Spotlighting	✓	✓	✓	

Table 4: Dural Land Snail surveys. All surveys were undertaken on the subject site unless otherwise stated.

Survey Dates	Survey effort	Survey hours	Number of people surveying	Total person survey hours	Comments
February 2018	• Incidental surveys: o Random meander o Opportunistic diurnal habitat searches	2 hours	1	2 survey hours	Diurnal survey
4th December 2018 5th December 2018	• Targeted searches throughout carpark and existing development areas.	8 hours	4	32 survey hours	Diurnal survey
9th May 2019	• Follow up targeted searches throughout carpark and existing development areas.	4 hours	2	8 survey hours	Diurnal survey
November 2020	• Incidental surveys o Random meander o Opportunistic diurnal habitat searches o spotlighting	4 hours	2	8 survey hours	Diurnal survey
3rd December 2020 14th December 2020	• Diurnal habitat searches (searching logs, rocks debris and leaf litter) • Raking of leaf litter • Nocturnal survey: spotlighting for individuals. • Nocturnal habitat searches (searching logs, rocks debris and leaf litter by torch light)	14 hours	2	28 survey hours	• Conditions during survey: o Light rain prior to survey o Mild to warm temperatures o Humidity relatively high o Leaf litter: not very moist

Table 5: Fauna recorded on and near the subject lot, detailing the type of observation; and the numbers of all species reported as occurring in Cumberland State Forest as detailed in OEH BioNet Atlas 2021 (http://www.bionet.nsw.gov.au/). Listed species of conservation significance are shown in bold type, * = exotic species.

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
Invertebrates	*Allopeas clavulinum**	-	Observed			
	Triboniophorus graeffei	-	Observed			
	Pommerhelix duralensis	**Dural Land Snail**	**Observed**	**0 (BioNet) (5 recorded during 2020 survey)**	**Endangered**	**Endangered**
	Cralopa stroudensis	-	Observed			
	Decoriropa lirata	-	Observed			
	Diphyoropa saturni	-	Observed			
	Macrophallikoropa belli	-	Observed			
	Wilhelminaia mathildae	-	Observed			
	Stanisicarion freycineti	-	Observed			
	*Cornu aspersum**	-	Observed			
	Iotula microcosmos	-	Observed			
	Pseudiotula eurysiana	-	Observed			
	*Testacella haliotidea**	-	Observed			
	Pupisoma porti	-	Observed			
Amphibians	*Crinia signifera*	Common Eastern Froglet	Call recorded	3		

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
	Limnodynastes peronii	Brown-striped Frog		8		
	Litoria dentata	Bleating Tree Frog		2		
	Litoria peronii	Peron's Tree Frog	Call recorded	2		
Reptiles	*Phyllurus platurus*	Broad-tailed Gecko		2		
	Pygopus lepidopodus	Common Scaly-foot		1		
	Eulamprus quoyii	Eastern Water-skink		3		
	Lampropholis guichenoti	Pale-flecked Garden Sunskink	Observed	1		
	Tiliqua scincoides	Eastern Blue-tongue		1		
	Cacophis squamulosus	Golden-crowned Snake		1		
	Pseudechis porphyriacus	Red-bellied Black Snake		1		
Birds	*Alectura lathami*	Australian Brush-turkey	Observed	1		
	Anas superciliosa	Pacific Black Duck	Observed	1		
	Columba leucomela	White-headed Pigeon		1		
	Macropygia amboinensis	Brown Cuckoo-Dove		1		
	Ocyphaps lophotes	Crested Pigeon		1		
	*Streptopelia chinensis**	Spotted Turtle-Dove		3		
	Podargus strigoides	Tawny Frogmouth	Call recorded	6		

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
	Hirundapus caudacutus	**White-throated Needletail**		**1**		**Migratory**
	Phalacrocorax varius	Pied Cormorant		1		
	Egretta novaehollandiae	White-faced Heron		1		
	Accipiter cirrocephalus	Collared Sparrowhawk		1		
	Accipiter fasciatus	Brown Goshawk	Observed	1		
Birds	*Accipiter novaehollandiae*	Grey Goshawk		5		
	Aviceda subcristata	Pacific Baza		1		
	Elanus axillaris	Black-shouldered Kite		1		
	Lophoictinia isura	**Square-tailed Kite**		**1**	**Vulnerable**	
	Gallinula tenebrosa	Dusky Moorhen	Observed	1		
	Vanellus miles	Masked Lapwing	Call recorded	1		
	Cacatua galerita	Sulphur-crested Cockatoo	Observed	14		
	Cacatua sanguinea	Little Corella	Observed	4		
	Cacatua tenuirostris	Long-billed Corella		1		
	Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo		1		
	Eolophus roseicapillus	Galah	Observed	2		
	Eolophus roseicapillus albiceps			1		

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
	Alisterus scapularis	Australian King-Parrot	Observed	7		
	Barnardius zonarius	Australian Ringneck		1		
	Barnardius zonarius barnardi	[Mallee Ringneck]		1		
	Glossopsitta concinna	Musk Lorikeet	Observed	6		
	Glossopsitta pusilla	**Little Lorikeet**		**1**	**Vulnerable**	
	Lathamus discolor	**Swift Parrot**		**1**	**Endangered**	**Critically Endangered**
	Platycercus elegans	Crimson Rosella	Observed	25		
	Platycercus eximius	Eastern Rosella	Observed	7		
	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet		1		
	Trichoglossus haematodus	Rainbow Lorikeet	Observed	11		
	Cacomantis flabelliformis	Fan-tailed Cuckoo		9		
	Cacomantis pallidus	Pallid Cuckoo		1		
	Chalcites basalis	Horsfield's Bronze-Cuckoo		1		
	Chalcites lucidus	Shining Bronze-Cuckoo		1		
Birds	*Eudynamys orientalis*	Eastern Koel	Call recorded	3		
	Scythrops novaehollandiae	Channel-billed Cuckoo		1		
	Ninox novaeseelandiae	Southern Boobook	Call recorded	3		

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
	Ninox strenua	**Powerful Owl**	**Call recorded and heard in CSF Pair observed in CSF**	**2**	**Vulnerable**	
	Tyto javanica	Eastern Barn Owl		1		
	Dacelo novaeguineae	Laughing Kookaburra	Observed	21		
	Todiramphus sanctus	Sacred Kingfisher		8		
	Eurystomus orientalis	Dollarbird		3		
	Cormobates leucophaea	White-throated Treecreeper	Call recorded	40		
	Ptilonorhynchus violaceus	Satin Bowerbird		48		
	Malurus cyaneus	Superb Fairy-wren	Observed	111		
	Malurus lamberti	Variegated Fairy-wren		37		
	Malurus lamberti lamberti			1		
	Acanthiza lineata	Striated Thornbill		11		
	Acanthiza nana	Yellow Thornbill		2		
	Acanthiza pusilla	Brown Thornbill	Call recorded	24		
	Acanthiza pusilla pusilla			1		
	Gerygone mouki	Brown Gerygone	Observed	37		
	Sericornis frontalis	White-browed Scrubwren	Observed	231		
	Pardalotus punctatus	Spotted Pardalote	Call recorded	28		

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
	Pardalotus striatus	Striated Pardalote		1		
	Acanthorhynchus tenuirostris	Eastern Spinebill		120		
	Anthochaera carunculata	Red Wattlebird	Call recorded	7		
	Anthochaera chrysoptera	Little Wattlebird		7		
	Caligavis chrysops	Yellow-faced Honeyeater		46		
	Lichenostomus melanops	Yellow-tufted Honeyeater		186		
Birds	*Manorina melanocephala*	Noisy Miner	Observed	14		
	Manorina melanophrys	Bell Miner	Observed	314		
	Meliphaga lewinii	Lewin's Honeyeater	Call recorded	60		
	Melithreptus lunatus	White-naped Honeyeater		36		
	Myzomela sanguinolenta	Scarlet Honeyeater	Observed	1		
	Nesoptilotis leucotis	White-eared Honeyeater		1		
	Phylidonyris niger	White-cheeked Honeyeater		20		
	Phylidonyris novaehollandiae	New Holland Honeyeater		14		
	Ptilotula fuscus	Fuscous Honeyeater		5		
	Psophodes olivaceus	Eastern Whipbird	Observed	39		
	Coracina novaehollandiae	Black-faced Cuckoo-shrike	Heard	3		

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
	Coracina papuensis	White-bellied Cuckoo-shrike		1		
	Colluricincla harmonica	Grey Shrike-thrush		43		
	Falcunculus frontatus frontatus	Eastern Shrike-tit		4		
	Pachycephala pectoralis	Golden Whistler	Observed	80		
	Pachycephala rufiventris	Rufous Whistler		5		
	Oriolus sagittatus	Olive-backed Oriole	Call recorded	11		
	Artamus cyanopterus cyanopterus	**Dusky Woodswallow**		**14**	**Vulnerable**	
	Artamus superciliosus	White-browed Woodswallow		1		
	Cracticus tibicen	Australian Magpie	Call recorded	11		
	Cracticus torquatus	Grey Butcherbird	Observed	15		
	Cracticus nigrogularis	Pied Butcherbird	Call recorded			
	Strepera graculina	Pied Currawong	Observed	18		
	Rhipidura albiscapa	Grey Fantail		29		
	Rhipidura leucophrys	Willie Wagtail		14		
	Rhipidura rufifrons	Rufous Fantail		15		
Birds	*Corvus coronoides*	Australian Raven	Observed	10		
	Grallina cyanoleuca	Magpie-lark		2		

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
	Monarcha melanopsis	Black-faced Monarch		1		
	Myiagra alecto	Shining Flycatcher		1		
	Myiagra inquieta	Restless Flycatcher		1		
	Myiagra rubecula	Leaden Flycatcher		2		
	Symposiachrus trivirgatus	Spectacled Monarch		1		
	Eopsaltria australis	Eastern Yellow Robin	Observed	334		
	Petroica goodenovii	Red-capped Robin		1		
	Petroica phoenicea	**Flame Robin**		**1**	**Vulnerable**	
	Petroica rosea	Rose Robin		4		
	Zosterops lateralis	Silvereye		213		
	Hirundo neoxena	Welcome Swallow		22		
	*Pycnonotus jocosus**	Red-whiskered Bulbul		48		
	*Turdus merula**	Eurasian Blackbird		18		
	Zoothera sp.	unidentified ground thrush		1		
	*Sturnus tristis**	Common Myna	Call recorded	2		
	*Sturnus vulgaris**	Common Starling		1		
	Dicaeum hirundinaceum	Mistletoebird		1		

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
	Neochmia temporalis	Red-browed Finch		278		
	*Passer domesticus**	House Sparrow		26		
	*Carduelis carduelis**	European Goldfinch		1		
Mammals	*Tachyglossus aculeatus*	Short-beaked Echidna	Observed	1		
	Perameles nasuta	Long-nosed Bandicoot		1		
	Petaurus breviceps	Sugar Glider	Call recorded	4		
	Pseudocheirus peregrinus	Common Ringtail Possum	Observed Call recorded	12		
Mammals	*Acrobates pygmaeus*	Feathertail Glider		1		
	Trichosurus vulpecula	Common Brushtail Possum	Scats	8		
	Pteropus poliocephalus	**Grey-headed Flying-fox**	**Heard foraging**	**2**	**Vulnerable**	**Vulnerable**
	Saccolaimus flaviventris	**Yellow-bellied Sheathtail-bat**	**Call recorded - probable**	**2**	**Vulnerable**	
	Austronomus australis	White-striped Freetail-bat	Call recorded - definite	4		
	Mormopterus norfolkensis	**Eastern Freetail-bat**	**Call recorded - possible**	**2**	**Vulnerable**	
	Mormopterus ridei	Eastern Free-tailed Bat		4		
	Mormopterus sp.	Freetail-bat	Call recorded - probable	1		
	Chalinolobus gouldii	Gould's Wattled Bat	Call recorded - probable	8		
	Falsistrellus tasmaniensis	**Eastern False Pipistrelle**	**Call recorded - possible**	**1**	**Vulnerable**	

Group	Scientific Name	Common Name	Subject lot (record type)	Cumberland SF (number)	Status	
					BC Act 2016	*EPBC Act 1999*
	Nyctophilus geoffroyi	Lesser Long-eared Bat		4		
	Nyctophilus gouldi	Gould's Long-eared Bat		9		
	Nyctophilus sp.	long-eared bat	Call recorded - probable	2		
	Scotorepens orion	Eastern Broad-nosed Bat	Call recorded - possible	3		
	Scoteanax rueppellii	**Greater Broad-nosed Bat**	**Call recorded - possible**		**Vulnerable**	
	Vespadelus vulturnus	Little Forest Bat	Call recorded - possible	8		
	*Mus musculus**	House Mouse		1		
	*Rattus rattus**	Black Rat		1		
	*Canis lupus familiaris**	Dog		1		
	*Vulpes vulpes**	Fox		1		

Table 6: Measures to be implemented before, during and after construction to avoid and minimise the impacts of the project, including action, outcome, timing and responsibility.

MEASURES TO AVOID AND MINIMISE IMPACTS							
Area	**Management activity**	**Action**	**Outcome**	**Sequencing and Timing of Actions**			**Responsibility**
				Before Construction	**During Construction**	**After Construction**	
All Areas	Fencing	• Erect exclusion fencing and gates.	Prevent accidental incursion into protected vegetation.	✓	✓		Civil Contractor
	Erosion and sedimentation controls	• Install erosion and sedimentation controls on the development site.	Prevent downslope sedimentation	✓	✓		Civil Contractor
Weed infested patches	Weed control	• Appropriate action in accordance with weed species present.	Weeds not spread during clearing works.	✓	✓		Project Ecologist / Bush Regeneration Contractor Civil Contractor
Gardens	Removal of sandstone blocks	• Removal under direct ecological supervision to protect resident fauna.	Blocks removed without injury to fauna; injured fauna receives veterinary care, rehabilitated and released	✓	✓		Project Ecologist Civil Contractor
	Fencing	• Erect protective fencing around trees to be retained under Arborist supervision.	Trees and vegetation protected from construction activities.	✓	✓		Civil Contractor
	Tree removal - general	• General tree removal under arborist supervision.	Trees felled without damage to retained vegetation.	✓	✓		Arborist Civil Contractor
	Tree removal – fauna habitat	• Tree and vegetation removal from areas identified as having specific fauna habitat (e.g. hollow-bearing trees, dense undergrowth) to be conducted under ecological supervision.	Trees felled without injury to fauna; injured fauna receives veterinary care, rehabilitated and released.	✓	✓		Project Ecologist Civil Contractor

MEASURES TO AVOID AND MINIMISE IMPACTS							
Area	**Management activity**	**Action**	**Outcome**	**Sequencing and Timing of Actions**			**Responsibility**
				Before Construction	**During Construction**	**After Construction**	
Snail habitat	Dural Land Snail Protection	• Targeted pre-clearing surveys undertaken and individuals relocated to closest, most suitable and secure habitat within the subject lot and / or Cumberland State Forest.	Snails safely relocated into suitable retained habitats	✓			Project Ecologist
		• Impose conservation zones ('no go' zones) within areas of suitable habitat, outside of the demolition footprint.	Impacts to habitats are avoided and minimised during demolition.	✓	✓		Project Ecologist Civil Contractor
		• Monitor known locations and habitats as part of a long term management plan for the entire site.	Monitor the viability of the species and their habitats.			✓	Project Ecologist
	Demolition of existing multi-storey carpark	• The retaining wall to the east of the carpark will be kept in place. • Fencing around the carpark is to be 1 metre off the existing structure on the eastern side (between the carpark and the inner surface of the retaining wall) and 2 metres along the northern side of the carpark. • The carpark is to be disassembled slowly in slabs / pieces in direction away from habitat to avoid disturbance. • Slow disassembling within specific fauna habitat areas to be conducted under ecological supervision.	Habitats retained and minimally disturbed.	✓	✓		Project Ecologist Civil Contractor
All areas	Myrtle Rust and Phytophthora Control	• Ensure hygiene protocols are in place to minimise the potential spread of Myrtle Rust or Phytophthora across the site and off site.	Minimise potential spread of Myrtle Rust on and off site.	✓	✓	✓	Project Ecologist Civil Contractor Bush Regeneration Contractor
		• Wash down stations to be installed at entry / exit points to demolition footprint.					Civil Contractor
	Powerful Owl protection	• Monitor resident Powerful Owls with particular attention to potential nest	Breeding owls not disturbed.	✓	✓	✓	Project Ecologist Civil Contractor

MEASURES TO AVOID AND MINIMISE IMPACTS							
		trees near the development area during the breeding season.					

		• Impose the following controls to construction if works are too close to Powerful Owl breeding habitat.
		  • Demolition activity should be restricted in areas that are within 100 metres of the active nest tree during the breeding season from March to September. In such circumstances, work is not to start until 1 hour after sunrise and must finish by 4 p.m.
		  • There is the potential for noisy works to interrupt the movement of fledglings between September and February (Dr Stephen Ambrose, personal communication). Therefore, noisy works should not begin until at least 30 minutes after dawn and be completed at least 60 minutes before dusk during that period.
			Breeding owls not disturbed.	✓	✓		

	Fauna welfare	• Clearing of vegetation to be undertaken with the supervision of the Project Ecologist to minimise impacts to potential resident fauna. • Vegetation clearing to be staged to allow fauna 'escape' paths.	Impacts to fauna and animal welfare avoided.	✓	✓		Project Ecologist Civil Contractor

Table 7: Raw tree data from Footprint Green's 3 forest quadrats.

- Project - Coonara RD, Pennant Hills - quadrat data 22-09-20							
Tree No	Genus Species	Height (m)	Canopy Spread (m)	DBH (mm)	SULE	Landscape Significance	Other text
1	Eucalyptus pilularis	35	10	590	1	High L/scape Sig.	Plot 1
2	Eucalyptus pilularis	35	12	500	1	High L/scape Sig.	Plot 1
3	Glochidion ferdinandi	10	3	120	1	Low L/scape Sig.	Plot 1
4	Alphitonia excelsa	9	3	20	1	Low L/scape Sig.	Plot 1
5	Alphitonia excelsa	10	2	800	1	Low L/scape Sig.	Plot 1
6	Glochidion ferdinandi	14	7	180	1	Moderate L/scape Sig.	Plot 1
7	Glochidion ferdinandi	10	5	180	1	Moderate L/scape Sig.	Plot 1
8	Glochidion ferdinandi	7	2	80	2	Low L/scape Sig.	Plot 1
9	Glochidion ferdinandi	12	6	180	1	Low L/scape Sig.	Plot 1
10	Glochidion ferdinandi	10	4	100	1	Low L/scape Sig.	Plot 1
11	Glochidion ferdinandi	12	5	150	1	Moderate L/scape Sig.	Plot 1
12	Allocasuarina torulosa	9	2	100	2	Low L/scape Sig.	Plot 1
13	Glochidion ferdinandi	10	3	80	1	Low L/scape Sig.	Plot 1
14	Allocasuarina torulosa	12	4	120	2	Low L/scape Sig.	Plot 1
15	Eucalyptus pilularis	35	20	950	1	Very High L/scape Sig.	Plot 1
16	Alphitonia excelsa	9	3	60	1	Low L/scape Sig.	Plot 1
17	Alphitonia excelsa	12	4	120	1	Moderate L/scape Sig.	Plot 1
18	Eucalyptus pilularis	35	12	500	2	Very High L/scape Sig.	Plot 1
19	Olea europaea subsp cuspidata	5	3	60	2	Env. Pest Species - Exempt from Council DCP	Plot 1
20	Glochidion ferdinandi	10	4	80	1	Moderate L/scape Sig.	Plot 1
21	Eucalyptus pilularis	35	30	1050	1	Very High L/scape Sig.	Plot 1
22	Glochidion ferdinandi	9	3	80	1	Low L/scape Sig.	Plot 1
23	Alphitonia excelsa	5	2	40	2	Low L/scape Sig.	Plot 1
24	Alphitonia excelsa	6	3	70	1	Low L/scape Sig.	Plot 1
25	Glochidion ferdinandi	7	3	40	1	Low L/scape Sig.	Plot 1
26	Pittosporum undulatum	8	4	80	1	Low L/scape Sig.	Plot 1
27	Pittosporum undulatum	9	3	80	1	Low L/scape Sig.	Plot 1
28	Alphitonia excelsa	4	1	60	1	Low L/scape Sig.	Plot 1

- Project - Coonara RD, Pennant Hills - quadrat data 22-09-20							
Tree No	**Genus Species**	**Height (m)**	**Canopy Spread (m)**	**DBH (mm)**	**SULE**	**Landscape Significance**	**Other text**
29	Alphitonia excelsa	8	3	60	1	Low L/scape Sig.	Plot 1
30	Glochidion ferdinandi	10	3	120	1	Low L/scape Sig.	Plot 2
31	Pittosporum undulatum	7	5	100	1	Low L/scape Sig.	Plot 2
32	Glochidion ferdinandi	9	5	130	1	Moderate L/scape Sig.	Plot 2
33	Glochidion ferdinandi	10	5	120	1	Moderate L/scape Sig.	Plot 2
34	Pittosporum undulatum	6	3	40	2	Low L/scape Sig.	Plot 2
35	Pittosporum undulatum	10	3	80	1	Low L/scape Sig.	Plot 2
36	Pittosporum undulatum	4	2	60	2	Low L/scape Sig.	Plot 2
37	Eucalyptus saligna	14	8	230	1	Moderate L/scape Sig.	Plot 2
38	Glochidion ferdinandi	8	3	60	1	Low L/scape Sig.	Plot 2
39	Pittosporum undulatum	4	2	40	1	Low L/scape Sig.	Plot 2
40	Glochidion ferdinandi	9	3	50	1	Low L/scape Sig.	Plot 2
41	Syncarpia glomulifera	23	16	240	1	High L/scape Sig.	Plot 2
42	Syncarpia glomulifera	10	4	60	1	Low L/scape Sig.	Plot 2
43	Eucalyptus pilularis	38	28	960	1	Very High L/scape Sig.	Plot 2
44	Glochidion ferdinandi	12	3	110	1	Low L/scape Sig.	Plot 2
45	Eucalyptus pilularis	38	16	690	1	Very High L/scape Sig.	Plot 2
46	Eucalyptus pilularis	40	30	920	1	Very High L/scape Sig.	Plot 2
47	Glochidion ferdinandi	12	7	200	1	Moderate L/scape Sig.	Plot 2
48	Pittosporum undulatum	12	6	120	1	Moderate L/scape Sig.	Plot 2
49	Glochidion ferdinandi	5	4	50	1	Low L/scape Sig.	Plot 2
50	Glochidion ferdinandi	4	2	30	3	Low L/scape Sig.	Plot 2
51	Glochidion ferdinandi	8	4	60	1	Low L/scape Sig.	Plot 2
52	Glochidion ferdinandi	6	3	40	1	Low L/scape Sig.	Plot 2
53	Glochidion ferdinandi	4	2	30	1	Low L/scape Sig.	Plot 2
54	Glochidion ferdinandi	10	5	70	1	Moderate L/scape Sig.	Plot 2
55	Syncarpia glomulifera	11	6	290	1	Moderate L/scape Sig.	Plot 3
56	Eucalyptus resinifera	14	6	180	2	Moderate L/scape Sig.	Plot 3
57	Pittosporum undulatum	7	4	120	2	Low L/scape Sig.	Plot 3
58	Pittosporum undulatum	8	5	120	2	Low L/scape Sig.	Plot 3

- Project - Coonara RD, Pennant Hills - quadrat data 22-09-20							
Tree No	Genus Species	Height (m)	Canopy Spread (m)	DBH (mm)	SULE	Landscape Significance	Other text
59	Syncarpia glomulifera	15	11	460	1	High L/scape Sig.	Plot 3
60	Eucalyptus pilularis	25	15	720	3	High L/scape Sig.	Plot 3
61	Eucalyptus resinifera	16	3	260	4	Moderate L/scape Sig.	Plot 3
62	Glochidion ferdinandi	4	2	60	1	Low L/scape Sig.	Plot 3
63	Pittosporum undulatum	7	3	90	1	Low L/scape Sig.	Plot 3
64	Pittosporum undulatum	5	2	60	2	Low L/scape Sig.	Plot 3
65	Pittosporum undulatum	5	2	40	1	Low L/scape Sig.	Plot 3
66	Angophora costata	20	9	270	1	High L/scape Sig.	Plot 3
67	Glochidion ferdinandi	4	2	60	1	Low L/scape Sig.	Plot 3
68	Pittosporum undulatum	6	4	90	1	Low L/scape Sig.	Plot 3
69	Allocasuarina torulosa	8	3	140	4	Low L/scape Sig.	Plot 3
70	Allocasuarina torulosa	13	3	120	2	Moderate L/scape Sig.	Plot 3
71	Eucalyptus resinifera	22	8	470	2	High L/scape Sig.	Plot 3
72	Notelaea longifolia	3	2	30	1	Low L/scape Sig.	Plot 3
73	Pittosporum undulatum	3	2	30	4	Low L/scape Sig.	Plot 3
74	Allocasuarina torulosa	12	3	180	4	Low L/scape Sig.	Plot 3
75	Pittosporum undulatum	3	2	30	2	Low L/scape Sig.	Plot 3
76	Glochidion ferdinandi	3	2	30	1	Low L/scape Sig.	Plot 3
77	Alphitonia excelsa	6	3	30	1	Low L/scape Sig.	Plot 3
78	Pittosporum undulatum	4	2	50	1	Low L/scape Sig.	Plot 3
79	Pittosporum undulatum	3	2	30	2	Low L/scape Sig.	Plot 3
80	Pittosporum undulatum	3	2	40	2	Low L/scape Sig.	Plot 3
81	Pittosporum undulatum	9	2	60	2	Low L/scape Sig.	Plot 3
82	Pittosporum undulatum	7	3	80	2	Low L/scape Sig.	Plot 3
83	Eucalyptus pilularis	33	24	770	1	Very High L/scape Sig.	Plot 3
84	Eucalyptus pilularis	35	20	680	1	Very High L/scape Sig.	Plot 3
85	Syncarpia glomulifera	22	14	280	1	High L/scape Sig.	Plot 3
86	Pittosporum undulatum	4	3	80	1	Low L/scape Sig.	Plot 3
87	Brachychiton acerifolius	4	2	30	1	Low L/scape Sig.	Plot 3
88	Allocasuarina littoralis	3	2	30	1	Low L/scape Sig.	Plot 3

- Project - Coonara RD, Pennant Hills - quadrat data 22-09-20							
Tree No	**Genus Species**	**Height (m)**	**Canopy Spread (m)**	**DBH (mm)**	**SULE**	**Landscape Significance**	**Other text**
89	Angophora costata	17	3	200	4	Moderate L/scape Sig.	Plot 3
90	Pittosporum undulatum	4	2	30	2	Low L/scape Sig.	Plot 3
91	Pittosporum undulatum	3	1	20	1	Low L/scape Sig.	Plot 3
92	Angophora costata	24	14	440	1	High L/scape Sig.	Plot 3
93	Alphitonia excelsa	5	2	20	1	Low L/scape Sig.	Plot 3
94	Angophora costata	21	7	130	2	High L/scape Sig.	Plot 3
95	Eucalyptus pilularis	33	15	570	1	Very High L/scape Sig.	Plot 3
96	Glochidion ferdinandi	4	3	40	1	Low L/scape Sig.	Plot 3
97	Angophora costata	15	4	170	2	Moderate L/scape Sig.	Plot 3
98	Alphitonia excelsa	3	2	30	1	Low L/scape Sig.	Plot 3
99	Pittosporum undulatum	3	3	50	2	Low L/scape Sig.	Plot 3
100	Notelaea longifolia	3	2	30	1	Low L/scape Sig.	Plot 3

Table 8: Planting schedule extracted from historical IBM documents.

Source 1: Tech Specs for Landscape Works Phase 3 (1985 p1241-1267)

Source 2: Multi Deck Car Park landscape plan

Source 3: Extract from Landscape Plan in Council comments, 29 April 2021

Source 4: Letter to Baulkham Hills Shire Council from Landscan, 6 March 1984

Source	Planting code	Species	Natural provenance	Affiliation with EEC	
				BGHF	STIF
1, 2	Ae	*Acacia elata*	Locally native to Sydney area		
1, 2	Ah	*Acacia howittii*	Vic		
1, 3	Eus	*Acmena smithii*	Locally native to Sydney area	Characteristic	
1, 2, 3	Ac	*Angophora costata*	Locally native to Sydney area	Characteristic	Characteristic
1	Af	*Angophora floribunda*	Locally native to Sydney area	Characteristic	
1	Ag	*Anigozanthus* "Green Delight"	WA, cultivar		
1	Ar	*Anigozanthus* "Regal Claw"	WA, cultivar		
1, 4	Ab	*Asplenium bulbiferum*	Exotic		
1, 2	Be	*Banksia ericifolia*	Locally native to Sydney area		
3		*Banksia integrifolia*	Locally native to Sydney area		
3		*Banksia serrata*	Locally native to Sydney area		
1, 2	Br	*Bauera rubioides*	Locally native to Sydney area		
4	Blc	*Blechnum cartilagineum*	Locally native to Sydney area	Characteristic	
2	Bg	*Bougainvillea glabra*	Exotic		
3		*Callicoma serratifolia*	Locally native to Sydney area		
1, 2	Cca	*Callistemon* "Captain Cook"	Cultivar		
1, 2	Cc	*Callistemon citrinus*	Locally native to Sydney area		
1, 2	Cg	*Casuarina glauca*	Locally native to Sydney area		
1	Cgu	*Ceratopetalum gummiferum*	Locally native to Sydney area		
1	Ca	*Clematis aristata*	Locally native to Sydney area	Characteristic	Characteristic
1	Ck	*Coprosma kirkii*	Exotic		
1, 2	Ec	*Corymbia citriodora*	Qld		

Source	Planting code	Species	Natural provenance	Affiliation with EEC	
				BGHF	STIF
1, 2, 3	Em	*Corymbia maculata*	Locally native to Sydney area		
1, 4	Cd	*Culcita dubia*	Locally native to Sydney area		
1, 4	Cyc	*Cyathea cooperi*	Probably North Coast NSW and Qld		
1	Da	*Dicksonia antarctica*	Probably montane NSW		
1	Di	*Dietes iridoides*	Exotic		
1	Do	*Doodia aspera*	Locally native to Sydney area	Characteristic	Characteristic
3		*Elaeocarpus reticulatus*	Locally native to Sydney area	Characteristic	Characteristic
1, 2	Emy	*Eriostemon myoporoides*	Locally native to Sydney area		
3		*Eucalyptus pilularis*	Locally native to Sydney area	Characteristic	Characteristic
1, 2	Ep	*Eucalyptus saligna*	Locally native to Sydney area	Characteristic	
2	Fp	*Ficus pumila*	Exotic		
1	Bs	*Gastrolobium sericeum*	WA		
2	Gx	*Gelsemium sempevirens*	Exotic		
1, 2	Gc	*Grevillea* "Canberra Gem"	Cultivar		
1, 2	Gp	*Grevillea* "Poorinda elegans"	Cultivar		
1, 2	Gpr	*Grevillea* "Poorinda Royal Mantle"	Cultivar		
1, 2	Gs	*Grevillea* "Scarlet Sprite"	Cultivar		
1, 2	Gg	*Grevillea gaudichaudi*	Cultivar		
1, 2	Go	*Grevillea obtusifolia*	Cultivar		
1, 2	Gr	*Grevillea rosmarinifolia*	Central Tablelands NSW		
1, 2	Hs	*Hakea salicifolia*	Locally native to Sydney area		
1, 2	Hv	*Hardenbergia violaceae*	Locally native to Sydney area		
2	Hc	*Hedera canariensis*	Exotic		
1	Ix	*Iris* "Minnie Colquit"	Exotic, cultivar		
2	Jp	*Jasminum polyanthum*	Exotic		
1, 2	Kr	*Kennedia rubicunda*	Locally native to Sydney area		Characteristic
2	Ml	*Mandevilla laxa*	Exotic		
2	Ma	*Melaleuca armillaris*	Locally native to Sydney area		

Source	Planting code	Species	Natural provenance	Affiliation with EEC	
				BGHF	STIF
2	Pp	*Pandorea pandorana*	Locally native to Sydney area	Characteristic	Characteristic
2	Pt	*Parthenocissus tricuspidata* "Veitchii"	Exotic, cultivar		
1, 2, 3	Pu	*Pittosporum undulatum*	Locally native to Sydney area	Characteristic	Characteristic
1, 4	Ptu	*Pteris umbrosa*	Locally native to Sydney area		
2	Sm	*Solandra maxima*	Exotic, weed		
1, 2, 3	Sg	*Syncarpia glomulifera*	Locally native to Sydney area		Characteristic
1	Ths	*Thryptomene Saxicola*	WA		
4	Tb	*Todea barbara*	Locally native to Sydney area		
1, 2	Vh	*Viola hederaceae*	Locally native to Sydney area	Characteristic	

Table 9: Characteristic species of BGHF per the NSW Scientific Committee's Final Determination, their presence within the VZ4a areas around the buildings and likely provenance. Species also listed in the planting schedules are indicated by a superscript 'P'.

Form	BGHF species (per Final Determination)	Present in VZ4a in Areas E and F around buildings		Notes
		As trees in Project Arborist plan	Observed in vegetation plots	
TREE	*Acmena smithii* P	✓		Observed and planted
	Allocasuarina torulosa			
	Alphitonia excelsa		✓	Spread by birds, pioneer
	Angophora costata P	✓		Observed and planted
	Angophora floribunda P	✓		Observed and planted
	Backhousia myrtifolia			
	Clerodendrum tomentosum			
	Elaeocarpus reticulatus P	✓		Observed and planted
	Eucalyptus globoidea			
	Eucalyptus paniculata P	✓	✓	Observed and planted
	Eucalyptus pilularis P	✓	✓	Observed and planted
	Eucalyptus saligna P	✓		Observed and planted
	Ficus coronata	✓		Spread by birds and bats
	Glochidion ferdinandi	✓	✓	Spread by birds
	Pittosporum undulatum P	✓	✓	Observed and planted
	Rapanea variabilis			
SHRUB	*Breynia oblongifolia*			
	Leucopogon juniperinus			
	Denhamia silvestris			
	Notelaea longifolia forma *longifolia*			
	Persoonia linearis			
	Pittosporum revolutum			
	Polyscias sambucifolia subsp. A			
GRASS/ GRAMINOID	*Carex maculata*			
	Dianella caerulea		✓	
	Entolasia marginata		✓	
	Entolasia stricta			
	Lomandra longifolia		✓	Mass plantings observed
	Oplismenus aemulus		✓	
	Oplismenus imbecillis			
	Poa affinis			
HERB/FORB	*Hydrocotyle laxiflora*			
	Oxalis perennans			
	Pratia purpurascens			
	Pseuderanthemum variabile		✓	
	Viola hederacea P			
FERN	*Adiantum aethiopicum*			
	Asplenium flabellifolium			
	Blechnum cartilagineum P			
	Calochlaena dubia			
	Doodia aspera P			
	Platylobium formosum			
	Pteridium esculentum			
VINE	*Cissus hypoglauca*			
	Clematis aristata P			
	Eustrephus latifolius		✓	
	Glycine clandestina			
	Marsdenia rostrata			
	Morinda jasminoides		✓	
	Pandorea pandorana P			
	Smilax australis			
	Smilax glyciphylla			
	Tylophora barbata			

Table 10: Characteristic species of STIF per the NSW Scientific Committee's Final Determination, their presence within the VZ4a areas around the buildings and likely provenance. Species also listed in the planting schedules are indicated by a superscript 'P'.

Form	STIF species (per Final Determination)	Present in VZ4a in Areas E and F around buildings		Notes
		As trees in Project Arborist plan	Observed in vegetation plots	
TREE	*Acacia parramattensis*	✓		
	Allocasuarina torulosa			
	Angophora costata P	✓		Observed and planted
	Clerodendrum tomentosum			
	Elaeocarpus reticulatus P	✓		Observed and planted
	Eucalyptus acmenoides			
	Eucalyptus fibrosa			
	Eucalyptus globoidea			
	Eucalyptus notabilis			
	Eucalyptus paniculata P	✓	✓	Observed and planted
	Eucalyptus pilularis P	✓		Observed and planted
	Eucalyptus punctata			
	Eucalyptus resinifera			
	Eucalyptus saligna x botryoides			
	Exocarpos cupressiformis			
	Glochidion ferdinandi	✓		
	Myrsine variabilis			
	Notelaea longifolia			
	Pittosporum undulatum P	✓	✓	Observed and planted
	Syncarpia glomulifera P	✓	✓	Observed and planted
	Trema tomentosa var. *aspera*			
SHRUB	*Acacia falcata*			
	Acacia floribunda			
	Acacia implexa	✓		
	Acacia longifolia var. longifolia			
	Breynia oblongifolia			
	Bursaria spinosa var. spinosa		✓	
	Daviesia ulicifolia			
	Denhamia silvestris			
	Dodonaea triquetra			
	Gonocarpus tetragynus			
	Hibbertia aspera			
	Hibbertia diffusa			
	Indigofera australis			
	Kunzea ambigua			
	Leucopogon juniperinus			
	Ozothamnus diosmifolius			
	Persoonia linearis			
	Pittosporum revolutum			
	Polyscias sambucifolia		✓	
	Pomaderris intermedia			
SHRUB	*Pultenaea villosa*			
	Rubus parvifolius			
	Solanum prinophyllum			
	Zieria smithii			
HERB/FORB	*Arthropodium milleflorum*			
	Brunoniella australis			
	Brunoniella pumilio			
	Centella asiatica			
	Commelina cyanea			
	Dichondra repens			
	Einadia hastata			
	Geranium solanderi			

Form	STIF species (per Final Determination)	Present in VZ4a in Areas E and F around buildings		Notes
		As trees in Project Arborist plan	Observed in vegetation plots	
	Goodenia hederacea var. hederacea			
	Goodenia heterophylla			
	Hydrocotyle sibthorpioides			
	Lobelia purpurascens			
	Opercularia hispida			
	Opercularia varia			
	Oxalis exilis			
	Poranthera microphylla			
	Pseuderanthemum variabile		✓	
	Rumex brownii			
	Sigesbeckia orientalis			
	Veronica plebeia			
FERN	*Adiantum aethiopicum*			
	Cheilanthes sieberi subsp. *sieberi*			
	Doodia aspera P			
	Lindsaea microphylla			
GRASS/ GRAMINOID	*Anisopogon avenaceus*			
	Aristida vagans			
	Austrostipa pubescens			
	Austrostipa rudis subsp. rudis			
	Dianella caerulea		✓	
	Dianella longifolia var. longifolia			
	Dichelachne inaequiglumis			
	Dichelachne rara			
	Digitaria parviflora			
	Echinopogon caespitosus var. caespitosus			
	Echinopogon ovatus			
	Entolasia marginata		✓	
GRASS/ GRAMINOID	*Entolasia stricta*			
	Gahnia aspera			
	Imperata cylindrica var. major			
	Lepidosperma laterale			
	Lomandra filiformis var. filiformis			
	Lomandra longifolia		✓	
	Microlaena stipoides var. stipoides			
	Oplismenus aemulus		✓	
	Oplismenus imbecillis			
	Panicum simile			
	Paspalidium distans			
	Poa affinis			
	Poa sieberiana var. sieberiana			
	Themeda australis			
VINE	*Billardiera scandens* var. *scandens*			
	Cayratia clematidea			
	Clematis aristata P			
	Clematis glycinoides var. glycinoides			
	Desmodium rhytidophyllum			
	Desmodium varians			
	Eustrephus latifolius			
	Glycine clandestina			
	Glycine microphylla			
	Glycine tabacina			
	Kennedia rubicunda P			
	Pandorea pandorana P			
	Passiflora herbertiana			
	Sarcopetalum harveyanum			

Form	STIF species (per Final Determination)	Present in VZ4a in Areas E and F around buildings		Notes
		As trees in Project Arborist plan	Observed in vegetation plots	
	Smilax australis			
	Smilax glyciphylla			
	Tylophora barbata			

APPENDIX 4

MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE
IMPACT ASSESSMENT

BACKGROUND

Impact assessments are provided for Matters of National Environmental Significance (MNES) that have been recorded on or near the project area, or whose potential habitat may be impacted by works, being the Vulnerable flora species *Syzygium paniculatum* Magenta Lilly Pilly, and the Endangered fauna species *Pommerhelix duralensis* Dural Land Snail.

This impact assessment has been undertaken according to relevant guidelines (DEWHA 2009). The "significant impact criteria" applicable to the relevant category of MNES are discussed below.

Vulnerable species

The significance of the impact of an action on a Vulnerable species is judged by the degree impact on the following factors:

- Size, area of occupancy or fragmentation of an important population;
- Critical habitat;
- Breeding cycle of an important population;
- Availability or quality of habitat;
- Invasive species;
- Disease; and
- Recovery strategies.

A threshold question therefore is whether the subject population is part of an "important population". An "important population" is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

Endangered Species

The significance of the impact of an action on an Endangered species is judged by the degree of impact on the following:

- Size of a population;
- Area of occupancy of the species;
- Fragmentation of an existing population;
- Critical habitat;
- Breeding cycle of a population;
- Availability of quality habitat;
- Invasive species;
- Disease; and
- Recovery strategies.

A threshold question therefore is whether the subject population is part of an "important population". An "important population" is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- A geographically distinct regional population, or collection of local populations; or
- A population, or collection of local populations that occurs within a particular bioregion.

Also, critical habitat requires further definition. Such habitat may be, but not limited to, habitat identified in a recovery plan for the species as critical for that species; and / or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act. "Habitat critical to the survival" of a listed vulnerable species (DEWHA 2009) refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal;
- for the long-term maintenance of the species (including the maintenance of species essential to the survival of the species, such as pollinators);
- to maintain genetic diversity and long term evolutionary development; or
- for the reintroduction of populations or recovery of the species.

Other definitions relied upon for this assessment have been detailed in the **DEFINITIONS** section at the beginning of this BDAR.

***Syzygium paniculatum* Magenta Lily Pilly**

ECOLOGICAL PROFILE

Syzygium paniculatum Magenta Lilly Pilly is listed as Vulnerable under the Schedules of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. It is listed as Endangered under the New South Wales *Biodiversity Conservation (BC) Act 2016*.

During surveys, a total of 18 individuals of Magenta Lilly Pilly were recorded within a landscaped drainage line immediately adjoining the existing IBM building. The individuals range in age from mature trees that were planted as part of landscape works of the IBM site in the 1980s, to younger trees that may have seeded naturally.

Magenta Lilly Pilly is a small to medium sized rainforest species, usually growing up to a height of 8 metres (DPIE 2021). It has flaking bark (Wilson 1991) and a dense crown of opposite, lanceolate, glossy leaves (Fairley and Moore 1989) that are paler underneath (NSW NPWS 2001a). Clusters of white flowers are produced at the end of each branch between November and February, but tend to occur in two distinct flushes (NSW NPWS 2001a). The deep magenta fruits, which may be spherical or egg-shaped, mature in May (DECCW 2009). It is polyembryonic, producing up to nine seedlings pr seed (OEH 2012). Without fruit, it is difficult to differentiate this species from *Syzygium australe* Brush Cherry (NSW NPWS 2001b) with which it often co-occurs.

This species is naturally restricted to a 400 kilometre stretch of coastal habitat within NSW between Conjola National Park in the south to Upper Lansdowne in the north. It is estimated that the total population is approximately 1,200 plants within this extent (OEH 2012). The National Recovery Plan (OEH 2012) identifies five metapopulations based on a 30 kilometre foraging range of *Pteropus poliocephalus* Grey-headed Flying-fox: Jervis Bay; Coalcliff; Botany Bay; Central Coast and Karuah-Manning.

It occurs naturally on sandy soils or stabilised sand dunes in coastal areas (Hyland 1983), littoral rainforest on sand or subtropical rainforest on sandy soils derived from sandstone (Floyd 2008), in sandy soils or stabilised quaternary sand dunes with littoral or subtropical rainforest (Quinn et al 1995), or in subtropical and littoral rainforest on sandy soils or stablished dunes near the ocean (Wilson 2002). It has been recorded mainly in areas of flat to gentle slopes on floodplain, creek banks, perched dunes, swales and old dunal ridges, but also occasionally on steep slopes in gullies (OEH 2012).

In the Sydney area, the Sydney Metropolitan mapping project (OEH 2016) found this species occurring naturally in three vegetation types:

- Coastal Dune Littoral Rainforest -this vegetation is restricted to small, isolated stands of this rainforest occur in the Sydney area on the Kurnell Peninsula and Bundeena;
- Coastal Sand Bangalay Forest – this vegetation is found on flat, low-lying coastal marine sand deposits of the coastal zones; and
- Coastal Freshwater Swamp Forest – this vegetation occupies poorly drained substrates that are periodically inundated by fresh or brackish water across the coastal plain and

> hinterland of the Sydney metropolitan area. Examples have been mapped in the Kings Wetland at Brighton Le Sands, the Lachlan Swamps of Centennial Parklands, in the Warringah area, and near Wallacia.

A number of active threats are recognised for this species and its local populations, including clearing and fragmentation of habitat, low genetic diversity, Myrtle Rust, weed infestations, frequent fire regimes, climate change, recreational activities, and invertebrate pests (OEH 2012, DPIE 2021).

Local populations are defined for this species as those individuals within the same catchment (NSW NPWS 2001b). As it is a long-lived species with potentially large seed dispersal areas, even small populations should be regarded as viable if the conditions enable successful recruitment (NSW NPWS 2001b). However, the subject site is well outside of the Georges River and Cooks River catchments within the closest metapopulation at Botany Bay.

Naturally-occurring populations of this species are considered to be important and, therefore, all habitat in which these populations occur is considered to be critical to the survival of the species (OEH 2012). This raises the question of the contribution of planted specimens to the conservation of this species.

Despite its natural rarity, it is widely cultivated in eastern Australia as an ornamental garden plant (Nicholson and Nicholson 1994, Wrigley and Fagg 1996, Floyd 2008 quoted in OEH 2012), is known by a number of common names, and a range of horticultural varieties have been developed by the nursery industry. The National Recovery Plan (OEH 2012) recognises that the plants in cultivation are hybrids or of unknown genetic origin and therefore should be excluded from "*all actions related to the conservation of the species in the wild*" (OEH 2012).

Although this species is now probably self-seeding on site within the constructed drainage feature, these individuals are naturalised from the original planted specimens and do not constitute a naturally-occurring population in the sense used in conservation policy and regulation.

The provenance and genetic integrity of the plantings and their offspring are unknown and therefore cannot be an important contributor to the conservation of the species, per the National Recovery Plan (OEH 2012). It follows that the individuals recorded on site cannot be regarded as representing an important population *sensu* the *EPBC Act 1999* and the constructed habitats available cannot be considered to be critical to the survival of this species.

IMPACT ASSESSMENT

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

(i) lead to a long-term decrease in the size of an important population of a species

Response:

The 18 individuals in the demolition footprint are made up of 13 planted mature trees and 5 self-seeded younger trees from unknown provenance material in a landscaped drainage feature. Another adult specimen occurs in a landscaped garden area outside of the demolition footprint. As horticultural specimens from unknown provenance in a constructed landscape, they are not considered to constitute part of an important population.

Their loss therefore will not lead to a long-term decrease of an important population.

(ii) ***reduce the area of occupancy of an important population***

Response:

The individuals present do not constitute an important population and occur in an entirely artificial habitat.

According to the Threatened Species Profile available on the BioNet database, this species occurs naturally in BGHF and STIF, although no individuals were observed outside of the gardens. Following this logic, the sheltered gully habitats in the BGHF and STIF areas on site provide potential suitable habitat for this species, all of which will be retained.

All other authoritative sources note that this is a species of coastal and near-coastal Littoral Rainforest communities on sand. The only known specimens in north western Sydney are horticultural ones or their progeny, reflecting its popularity in horticulture.

Nevertheless, natural habitat will be impacted by the proposal.

The potential area of occupancy of an important population will not be reduced.

(iii) fragment an existing important population into two or more populations

Response:

The extent of individuals and suitable habitat on site are not considered to be part of any existing important population or natural habitat within the Sydney metropolitan area. The removal of garden plants of unknown provenance will not fragment any existing population.

(iv) adversely affect habitat critical to the survival of a species

Response:

While no critical habitat for this species has been formally declared, all habitat in which naturally-occurring populations occur is considered to be critical to the survival of the species. The observed individuals on site are naturalised horticultural specimens in artificial habitat, and therefore do not represent critical habitat for the survival of the species.

(v) disrupt the breeding cycle of an important population

Response:

The individuals on site and habitats are not considered to be a part of any identified important population. The removal of reproductive material with the proposed works therefore will not disrupt the breeding cycle of an important population.

(vi) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Response:

The loss of habitat so described in this factor is applicable to natural habitat that supports naturally-occurring populations. The proposal will remove planted individuals – not naturally-occurring plants - and a small constructed drainage feature - not naturally-occurring habitat.

The proposed losses are not relevant to the potential further decline of the species.

(vii) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Response:

Weed species are known to compete with this species for water, nutrients and sunlight. As gully forests in the local area may provide potential habitat for this species, the potential for the proposed works to result in indirect impacts to such habitat has been considered. Although the areas subject to the proposal are managed as part of a landscaped garden, they do support some invasive weed species and thus there is the potential to mobilise weed propagules as part of the works.

This potential will be controlled and ameliorated by the implementation of weed control measures around the demolition footprint as part of a Construction Environmental Management Plan and in all and any other bushland works programs in surrounding lands.

(viii) introduce disease that may cause the species to decline, or

Response:

This species is known to be affected by Myrtle Rust and has been reportedly identified as a known host of this pathogen. There are no other recorded diseases to which this species is susceptible.

Myrtle Rust was not observed on site.

Best practice hygiene controls for Myrtle Rust will be applied as part of a Construction Environmental Management Plan and in all and any other bushland works programs in surrounding lands.

(ix) interfere substantially with the recovery of the species.

Response:

The national recovery plan for this species (OEH 2012) identified the following specific objectives to help protect known subpopulations of this threatened species:

- ensuring a coordinated and efficient approach to the implementation of recovery efforts;
- establishing the full extent of the distribution of the species;
- increasing the understanding of its biology and ecology;
- minimising the decline of the species through *in situ* habitat protection and management;
- reducing impacts of Myrtle Rust on this species and its habitat;
- maintaining a representative *ex situ* collection of this species; and
- raising awareness of the conservation significance of this species and involving the broader community in the recovery program.

The site is not within a subpopulation of this species. Nevertheless, the proposal is consistent with these strategies in the survey and assessment process to identify the total extent of suitable habitats on site, and the implementation of best practice control protocols for Myrtle Rust. In addition but external to this proposal is *in situ* habitat protection and management for the large expanse of native vegetation that will be transferred to Forestry Corporation.

SUMMARY

A total of 18 planted and self-seeding individuals and the constructed habitat in which they occur within the landscaped gardens will be directly impacted by the proposed demolition footprint.

The Recovery Plan (OEH 2012) recognises that plants in cultivation are hybrids or of unknown genetic origin and therefore should be excluded from "*all actions related to the conservation of the species in the wild*". Although this species is now probably self-seeding on site within the constructed drainage feature (but not seen elsewhere in the natural habitats), these individuals are naturalised from the original planted specimens and do not constitute a naturally-occurring population in the sense used in conservation policy and regulation. Similarly, as they occur in artificial habitat, they cannot be regarded as representing an important population *sensu* the *EPBC Act 1999;* the constructed habitats available cannot be considered to be critical to the survival of this species. Nevertheless, all potential natural habitat on site falls outside of the proposed footprint, and will be retained and protected.

It is considered that:

- the impact of the proposal on this species is not significant due to the small scale of the losses, and the losses being of planted horticultural trees of unknown origin planted within constructed habitat.
- this matter need not be referred to the Commonwealth Department of the Environment and Energy.

REFERENCES

Benson, D. and L. McDougall (1998) Ecology of Sydney plant species: Part 6 Dicotyledon family Myrtaceae. *Cunninghamia* 5(4):809-987. Sydney: NSW Royal Botanic Gardens

Conacher Travers Environmental Consultants (Conacher Travers) (2006) Ecological Site Report Coastal and Northern Sectors, Wallarah Peninsula

Council of Heads of Australasian Herbaria (CHAH) (2005) Australian Plant Census. Australian National Herbarium, Australian National Botanic Gardens and Australian Biological Resources Study. Available from: http://www.anbg.gov.au/chah/apc/

Department of Planning, Industry and Environment (2021) Threatened Biodiversity profiles (https://www.environment.nsw.gov.au/threatenedspeciesapp/)

Fairley, A. and Moore, P. (1989). Native Plants of the Sydney District: An Identification Guide. Kangaroo Press, Kenthurst

Floyd, A.G. (1989) Rainforest Trees of Mainland South-eastern Australia. Melbourne: Inkata Press.

Harden, G. J. (Ed) (1991) Flora of New South Wales. Volume 2. University of New South Wales Press, Sydney

Hyland, B.P.M. (1983) A Revision of *Syzygium* and Allied Genera (Myrtaceae) in Australia. *Australian Journal of Botany Supplementary Series* 9:1-164

Mills, K. (1996) Illawarra Vegetation Studies: Littoral Rainforest in Southern NSW, Inventory, Characteristics and Management. Occasional Papers on the Vegetation of the Illawarra Region

NSW National Parks and Wildlife Service (2001a) Threatened Species Information – *Syzygium paniculatum*

NSW National Parks and Wildlife Service (2001b) Environmental Impact Assessment Guidelines – *Syzygium paniculatum*

NSW Scientific Committee (2009) *Syzygium paniculatum* – Endangered Species Listing. Final Determination

Office of Environment and Heritage (2012) National Recovery Plan: Magenta Lilly Pilly Syzygium paniculatum, Office of Environment and Heritage, NSW Government, Sydney.

Payne, R. (1997) The Distribution and Reproductive Ecology of *Syzygium paniculatum* and *Syzygium australe* (Myrtaceae) in the Gosford-Wyong Region. MNatResThesis

Payne, R.J. (1991) New findings of the rare tree *Syzygium paniculatum* (Myrtaceae) in the Wyong area, New South Wales. *Cunninghamia* 2(3):495-498

Quinn, F., J.B. Williams, C.L. Gross and J. Bruhl (1995) Report on rare and threatened plants of north-eastern New South Wales. Armidale: University of New England.

Thurlby, K.A., P.G. Wilson, W.B. Sherwin, C. Connelly and M. Rossetto (2012) Reproductive bet-hedging in a rare yet widespread rainforest tree, *Syzygium paniculatum* (Myrtaceae). *Austral Ecology* 37(8):936-944

Wilson, P. G. (1991) *Syzygium* In: Harden, G. J. (Ed) (1991) Flora of New South Wales. Volume 2. University of New South Wales Press, Sydney

***Pommerhelix duralensis* Dural Woodland Snail**

ECOLOGICAL PROFILE

The Dural Woodland Snail is listed as Endangered under the Schedules of the *Environment Protection and Biodiversity Conservation Act 1999*. This species is also listed as Endangered under the Schedules of the *Biodiversity Conservation Act 2016*.

This species superficially resembles the related species *Meridolum corneovirens* Cumberland Plain Land Snail with which the Dural Land Snail is parapatric (Clark 2009). The Dural Land Snail is endemic to New South Wales and is confined to the northwest fringes of the Cumberland Plain (NSW Scientific Committee 2016).

Pommerhelix duralensis is a woodland snail with a strong preference for shale-influenced transitional landscapes with no individuals of this species confirmed outside such habitats (Ridgeway et al. 2014). This species is generally found in dry habitats resting during the day and foraging at night, typically foraging an hour after dusk through to the morning (NSW Scientific Committee 2016). It forages on hyphae and fruiting bodies of native fungi, and probably on other detritus of the forest floor (OEH 2021).

It has not been observed to climb or burrow in nature (Ridgeway et al. 2014) but instead rests in exposed areas (such as on rock or leaf litter) and shelters under rocks, logs, bark and in leaf litter (Clark 2009). This species occasionally enters a period of aestivation, secreting an epiphragm to seal itself inside the shell (Ridgeway et al. 2014).

It has a low reproduction rate, with only a small number of eggs produced per season, and a very high mortality rate in the first year (90%) and in the subsequent 4-5 years (99.8%) (OEH 2021). It is likely that it lives approximately five years and lays approximately 30 eggs after rain, as in related species, and the average generation length may be between three and four years (Threatened Species Scientific Committee 2014).

To date, the ecological information available regarding this species is largely anecdotal and relies heavily on the study undertaken by Ridgeway et al. (2014). That work indicated that the natural density of animals was low (approximately 3 snails per hectare), that they rested in exposed habitat more often than expected, and that they are slow-moving (with a maximum per night travel distance of 167.1 centimetres).

However, these observations were based on a small number of samples taken under dry conditions: tracking data were collected from only two individuals, and the spool-tracking mechanism failed on 70% of the survey nights (Ridgeway et al. 2014). Therefore, their observations may not be generally applicable to different populations across different areas.

Recent serendipitous observations of a population in the Blue Mountains indicate that survey is best conducted in suitable habitat on wet, warm nights when the leaf litter is moist (personal communication Dr Stephanie Clark). That observation and subsequent surveys undertaken by Dr Clark during similar wet conditions has established that population densities are probably higher

than that previously reported by Ridgeway et al. (2014), and survey guidelines are currently under review (personal communication Dr Stephanie Clark).

This species is known to occur within a number of National Parks and Council bushland reserves (NSW Scientific Committee 2016) including George Thornton Reserve in The Hills LGA (personal communication Dr Stephanie Clark). Due to its occurrence in areas transitional between shale and sandstone, it is also associated with several endangered ecological communities that also occur in that ecotonal habitat, including Blue Gum High Forest, Cumberland Plain Woodland, Sydney Turpentine Ironbark Forest, and Shale Sandstone Transition Forest (NSW Scientific Committee 2016).

Threats to this species include land clearing for agricultural and urban development, habitat fragmentation, and inappropriate fire regimes. Their low dispersal ability may increase the susceptibility to fire and reduce the chance of recolonisation (Clark 2005).

There is no recovery plan or threat abatement plan for this species. However, some recovery activities have been identified (OEH 2021):

1. Implement an ongoing monitoring program to monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary;
2. Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions;
3. Engage local bushcare groups to implement recovery actions for the species;
4. Undertake appropriate maintenance of habitat in which the species may occur e.g. avoid underscrubbing in areas where the species is known to occur and maintain and/or recover coarse woody debris in habitat for this species;
5. Limit use of pile burning (burning composted material) and/or manage pile burning in areas where the species is known to occur;
6. Investigate formal conservation arrangements, management agreements and covenants on private land with known occurrences;
7. Provide advice to developers, consultants and approval authorities about the existence of the species and its significance;
8. Develop and implement a management plan for the control of weeds currently occurring in the region;
9. Where necessary and appropriate, restrict access to important sites by installing gates, fencing and educational signs; and
10. Facilitate research priorities as identified in the Conservation Advice prepared by the Commonwealth Threatened Species Scientific Committee.

Two empty shells of this species were found on the subject lot incidentally during other survey activities - one in the retained natural bushland adjacent to the south eastern corner of the existing development area, and the other at the base of the sandstone retaining wall on the eastern side of the multi-storey car park. These finds prompted additional targeted survey for this species, carried out by Dr Stephanie Clark, an accredited specialist in this fauna group.

This targeted survey concentrated in the areas to be impacted by the demolition works and in the subsequent development footprint, as well as in natural bushland on the subject lot and in immediately adjacent parts of Cumberland State Forest. In total, approximately 4.3 hectares of vegetation was surveyed over two nights (3rd and 14th December 2020). A total of 18 live individuals of this species (comprising both adults and juveniles) were observed in the following 11 locations:

- 4 sites on and above the retaining wall to the north and east of the multi storey car park where one empty shell was found previously;
- 3 sites immediately adjacent and to the east of the car park in Cumberland State Forest;
- 1 site (and 1 individual) in the retained bushland where one empty shell was found previously;
- 1 site to the south of the works area in the retained bushland that is to be transferred to Forestry Corporation; and
- 2 sites in Cumberland State Forest beyond the subject lot to the south.

The habitats across the subject lot were classified in terms of their suitability for this species and potential habitat was mapped in consultation with Dr Clark (see Figure 16 in Appendix 1 of this BDAR). As a result, a total of 12.81 hectares of potential habitat for this species was identified across the subject lot, of which 0.68 hectares occurs in landscaped garden in the demolition footprint. Of the 4.3 hectares surveyed specifically for this species in December, 1.86 hectares occurred within the areas subsequently classified as potential habitat for this species, giving a density of 8 snails per hectare of suitable habitat.

However, survey conditions were not optimal as the rain that fell before and during survey was insufficient to moisten the leaf litter (personal communication Dr Stephanie Clark). The size of the population in the area surveyed is therefore considered to be larger than the 18 live animals observed.

Nevertheless, the observed density of 8 snails per hectare of suitable habitat surveyed gives a likely total population size of 102 across the 12.81 hectares of suitable habitat identified and mapped. Applying the same density measure to the 0.68 hectares of suitable habitat within the demolition footprint means that 5 individuals could be expected to be impacted, or 4.9% of the population on the subject lot.

The suitable habitat on the subject lot is directly connected to realised suitable habitat in Cumberland State Forest. This is in turn directly connected to potential and realised habitat to the south west and beyond, as individuals have also been found in bushland associated with Darling Mills Creek and its tributaries to the west and north west (personal communication Dr Stephanie Clark). The total area of connected bushland that potentially provides habitat for this species (including the subject lot) is therefore 301 hectares; most of this habitat is in reserved land or land otherwise zoned for protection.

The demolition proposal will remove only 0.2% of the contiguous potential habitat judged to occur in the local area.

Notwithstanding the likely small impact to the population, a pre-clearing relocation protocol will be implemented under the supervision of Dr Stephanie Clark prior to demolition works, in order to prevent the loss of individuals. An exhaustive search under optimum conditions will be undertaken and all individuals will be collected and relocated to the closest suitable and secure habitat on the subject lot and / or in Cumberland State Forest. This protocol has been implemented successfully for this species by Dr Clark as an ameliorative measure in other locations (e.g. Halcrows Road Cattai).

IMPACT ASSESSMENT

An action has, will have, or is likely to have a significant impact on an Endangered species if it does, will, or is likely to:

(i) lead to a long-term decrease in the size of a population of a species

Response:

The proposal has the potential to impact on approximately 5 individuals of a population in the immediate area that is likely to be approximately 102 individuals. Although the population may be able to withstand a loss of 4.9%, it is proposed to relocate any and all Dural Land Snails found in suitable habitat in the works area in accordance with an approved relocation protocol.

It is considered therefore that the loss of this 0.68 hectares of suitable habitat will not lead to a long-term decrease of a population of this species.

(ii) ***reduce the area of occupancy of the species***

Response:

The Area of Occupancy (AOO) of this species has been calculated at approximately 638 km^2 (63,800 hectares) (Threatened Species Scientific Committee 2014), although it is likely to be smaller than this due to subsequent ongoing clearing.

The proposal will reduce the area of habitat on the subject lot site from 12.81 hectares to 12.13 hectares, reducing the AOO by 0.001%.

This is considered to be an insignificant loss of habitat, particularly given the spatial context of the habitat loss, being within an otherwise uninterrupted patch of bushland of 301 hectares that is likely to provide suitable habitat.

(iii) fragment an existing population into two or more populations

Response:

The location of habitat to be removed is restricted to lands immediately surrounding existing development that have been previously modified for the previous development works of the IBM site. Connecting habitats across the subject site will be retained.

The spatial configuration of the loss will not divide otherwise uninterrupted bushland and therefore is unlikely to fragment the existing population into two or more populations.

(iv) adversely affect habitat critical to the survival of a species

Response:

No critical habitat for this species has been formally declared.

The suitable habitat to be impacted by the proposed works is small (0.68 hectares) and is comprised of landscaped gardens dating from the 1980s.

Notwithstanding its size or genesis, this 0.68 hectares of habitat is considered likely to support approximately 5 individuals of an immediate population of 102 individuals. The resident snails will be relocated into adjacent secure habitat, and so the population size is unlikely to be reduced.

The area of potential habitat to be lost represents only 0.2% of the 301 hectares of connected habitat estimated to occur within the local area.

The small garden area is unlikely to constitute habitat critical to the survival of the species.

(v) disrupt the breeding cycle of a population

Response:

The population observed on and around the subject lot are considered to be breeding, as both adults and juveniles were observed. Little is known about the factors that influence their breeding cycle, except that they lay eggs after rain. Presumably nest sites for egg-laying and development are important, and that they would need to be sheltered from predators and desiccation.

Habitat features that may contribute to breeding habitat in the impact area will be searched thoroughly for eggs and important elements (such as logs) will be retained and relocated to enrich the areas into which individuals will be relocated.

These actions are considered adequate to ameliorate any likely impacts on the breeding cycle of the small number of animals that may occur within the works area.

(vi) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Response:

The proposal will require the removal of 0.68 hectares of habitat within the demolition footprint. This is considered to be a small area in relation to that identified on the subject lot (12.58 hectares) or in the connected bushland in the local area (301 hectares).

The loss of 0.68 hectares of landscaped garden will not significantly decrease the availability of habitat on site to any appreciable extent. The proposed losses to habitat are considered not of a scale or in a location likely to lead to a decline of this species.

(vii) result in invasive species that are harmful to an Endangered species becoming established in the Endangered species' habitat

Response:

The proposal will not further increase the likelihood of invasive species as it will implement weed control measures around the demolition footprint as part of a Construction Environmental Management Plan and the VMP for the nearby APZ.

(viii) introduce disease that may cause the species to decline, or

Response:

There are no recorded diseases to which this species is susceptible.

Best practice hygiene controls will be applied as part of a Construction Environmental Management Plan and VMP.

(ix) interfere with the recovery of the species.

Response:

There is no recovery plan or threat abatement plan for this species. The proposal will implement pre-clearing survey protocols and a VMP that will implement suitable management and recovery activities on site for this species.

SUMMARY

A total of 10 records of this species occurred on site, including 3 within Cumberland State Forest. The proposal will remove 0.68 hectares of suitable habitat with the site retaining 12.13 hectares of identified suitable habitat within well-connected areas.

The demolition works are to include fauna sensitive demolition activities to be included in a Construction Environmental Management Plan. A relocation protocol for this species is to be implemented prior to demolition works commencing and a VMP will be implemented to provide ongoing management of suitable habitat on site.

It is considered that:

- the loss and modification to a relatively small area of suitable habitat is unlikely to significantly impact this species or available habitats on site.
- this matter need not be referred to the Commonwealth Department of the Environment and Energy.

REFERENCES

Clark, S.A. (2005) Systematics, spatial analysis and conservation genetics of *Meridolum corneovirens* (Pfeiffer, 1851) and related forms (Gastropoda: Camaenidae) from the Sydney Region of Australia. PhD thesis, University of Western Sydney, Richmond

Clark, S.A. (2009) A review of the land snail genus *Meridolum* (Gastropoda: Camaenidae) from central New South Wales, Australia. *Molluscan Research* 29:61–120

Cox, J.C. (1868) Monograph of Australian land shells. Maddock: Sydney

Department of the Environment (2016) *Pommerhelix duralensis* in Species Profile and Threats Database, Department of the Environment, Canberra. http://www.environment.gov.au/cgi/bin/sprat/public/publicspecies.pl?taxon_id=85268

Iredale, T. (1942) Guide to the land shells of New South Wales. Part IV. *The Australian Naturalist* 11:33–40

IUCN Standards and Petitions Subcommittee (2014) Guidelines for Using the IUCN Red List Categories and Criteria. Version 11. Prepared by the Standards and Petitions Subcommittee. http://www.iucnredlist.org/documents/RedListGuidelines.pdf.

NSW Scientific Committee (2016) Final Determination Threatened species *Pommerhelix duralensis* Dural Woodland Snail

Office of Environment and Heritage (2021) Dural Land Snail – profile. Available at https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20283

Pilsbry, H.A. (1894) Helicidae. In 'Manual of conchology structural and systematic. With illustrations of the species', Series 2, Vol. 9. (Eds GW Tryon, HA Pilsbry) pp. 1–160 (Conchological Section, Academy of Natural Sciences of Philadelphia: Philadelphia)

Ridgeway, P.A., Lindsay, K., Pou, D. and Visintin, A. (2014) Indications of diverse behavioural ecologies in the morphologically conservative Australian land snails *Pommerhelix* and *Meridolum* (Stylommatophora: Camaenidae). *Molluscan Research* DOI: 10.1080/13235818.2013.866179

Smith, P. and Smith, J. (2008) Native Vegetation Communities of Hornsby Shire – 2008 update. Report prepared for Hornsby Shire Council. P & J Smith Ecological Consultants, Hornsby NSW

Stanisic, J, Shea, M., Potter, D., and Griffiths, O. (2010) *Australian land snails Volume 1 – A field guide to eastern Australian species*. Bioculture Press: Revière des Anguilles, Mauritius

Threatened Species Scientific Committee (2014) Conservation Advice *Pommerhelix duralensis* Dural Land Snail. Available at http://www.environment.gov.au/biodiversity/threatened/species/pubs/85268-conservation-advice.pdf (accessed Feb 2021).

***Pteropus poliocephalus* Grey-headed Flying-fox**

ECOLOGICAL PROFILE

The Grey-headed Flying-fox is listed as Vulnerable under Schedule 1 of the *Biodiversity Conservation Act 2016*. This species is listed as Vulnerable under the Schedules of the *Environment Protection and Biodiversity Conservation Act 1999*.

The Grey-headed Flying-fox is a large flying-fox with a white or greyish head, reddish mantle around the neck and thick, shaggy fur extending to the ankles (Strahan 1995). This species has a distribution along eastern coastal Australia from Rockhampton in Queensland to western Victoria (Churchill 2008). The Grey-headed Flying-fox occurs in a variety of habitats including subtropical and temperate rainforests, sclerophyll forests, woodlands, as well as urban areas (OEH 2019). It also frequents mangroves, paperbark swamps and cultivated areas (Churchill 1998). It is usually seen in large, noisy colonies, or in day 'camps' usually placed close to water in gullies with dense forest canopies (Tidemann 1995). This is a highly mobile species, and camps are regularly moved in response to local food availability (Churchill 1998). Most births occur around October (Strahan 1995).

They forage widely at night mainly for rainforest fruits and native blossoms (Strahan 1995), and this species is likely to be an important pollinator for many native species (Tidemann 1995). Seventy-five percent of foraging forays are within 20 kilometres of the camp but some individuals may commute 50 kilometres to a productive food sources (Tidemann et al. 2008).

They have been recorded as feeding on 201 plant species of 50 families, with almost half of these in the Myrtaceae (Churchill 2008) but the pollen and nectar of Eucalyptus, Melaleuca and Banksia (Eby 2000) are their principal foods. Native figs are also important, and they also appear to eat the salt glands from mangrove trees (Churchill 2008).

The availability of native fruits, nectar and pollen varies over time and throughout the range of the species. This species is highly nomadic in response to the uneven distribution of their food plants, sometimes travelling hundreds of kilometres to find suitable resources and / or feeding in domestic gardens, parks, and orchards. Such characteristics make it very difficult to define key habitat areas (Eby and Lunney 2002). Also, the areas that offer foraging resources at any time are small and vary in location between years (Eby and Lunney 2002).

Although variable, a general pattern of movement can be discerned. Almost half of the eucalypt species used by the Grey-headed Flying-fox flower in summer and such summer-flowering species are distributed throughout their range. Thus, in summer, this species is generally widely dispersed.

However, the winter-flowering species they use are largely restricted to the woodlands of the western slopes or the lowland coastal communities (Eby and Lunney 2002). Thus, they are usually highly aggregated in winter, depending on where the nectar is flowing.

This winter convergence makes the species vulnerable to changes in these coastal communities, particularly as it coincides with the areas of greatest development. High rates of mortality can

result from result from losses of small areas of key winter habitat (Eby and Lunney 2002). These losses are compounded by removal and fragmentation of other resource patches used at other times.

Even in areas of remaining forest, nectar flow itself is impacted upon by dieback, drought, fire, and local fluctuations in temperature and rainfall (Eby and Lunney 2002).

The spring also presents potential bottlenecks for this species as several key spring-flowering trees are primarily confined to relatively flat and fertile land such as has already been extensively cleared and is still favoured by development (Eby and Lunney 2002). This also coincides with the time of birth of young when there is an added nutritional requirement and the females do not venture far from the maternity camp to feed.

These camps may contain tens of thousands of animals, depending upon the abundance of locally available food sources. They are generally located in close proximity (20 km or less) to a regular food source, often in stands of riparian rainforest, Paperbark or Casuarina forest (Eby 1995). Site fidelity is high and some camps in NSW have been used for over a century (Eby 2000). Such a long term camp is located at Gordon, approximately 2.4 kilometres to the east of the subject site.

Being so highly mobile, connectivity of forest patches is not critical for this species to be able to exploit different areas of vegetation. However, they are impacted by direct loss of habitat as well as via long term changes on critical features such as nectar flow wrought by dieback and other consequences of forest fragmentation.

The number of species of fruits and flowers exploited by this species is large, as befitting its extraordinarily broad distribution along the east coast of Australia.

A recent study of threatened nomadic pollinators in NSW (Eby 2016) has concluded that a resource bottleneck for vertebrate pollinators occurs in winter and early spring. The tree species relied upon by the Grey-headed Flying-fox at that time in coastal habitats is *Banksia integrifolia* Coast Banksia, *Corymbia maculata* Spotted Gum, *Eucalyptus robusta* Swamp Mahogany, *Eucalyptus sideroxylon* Mugga Ironbark, and *Melaleuca quinquenervia* Broad-leaved Paperbark; and the early spring flowering *Eucalyptus siderophloia* Northern Grey Ironbark.

Large areas of foraging habitat for this species were lost in the 2019-2020 bushfire season up and down the coastal region and hinterland of eastern Australia, thus making existing unburnt foraging habitat even more important until the burnt forests recover.

In a recent study of the response of this species to those mega fires, Baranowski et al. (2021) established that the critical factor for the survival of this species is the relative amount of unburnt winter habitat that remains. Large areas of important winter feeding grounds burnt on the mid north coast and the south coast, but such habitat remained relatively unscathed in the latitudes from -33^{0}S to -32^{0}S, being from Sydney north to approximately Forster on the mid north coast.

The entire population of this species is intimately interconnected and so the individuals that would normally feed on vegetation lost in the fires can be reasonably expected to exploit other resources anywhere within their natural range.

However, while the urban habitats (including the subject site) may provide post-fire refugia for bats that would otherwise use habitats to the north and south, the camp population counts for Parramatta Park do not indicate any unusual patterns across the seasons since the mega-fires (National Flying-fox monitoring viewer, https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf). This may indicate that the entire population has decreased so that refugee bats cannot be detected, and / or that refugee bats have not concentrated into these urban habitats.

A number of individuals of this species were detected foraging on the eucalypt blossom in the project area and beyond in Cumberland State Forest. Given the timing of this observation (December) and their location (trees to the north east of the demolition footprint and in trees near the Coonara Avenue entry), it is likely they were feeding on Sydney Blue Gum trees.

The subject lot supports 17.45 hectares dominated by woody vegetation that may provide potential foraging resources for this species (see Figures 10 and 11 in Appendix 1 of this BDAR), of which 2.9 hectares of Vegetation Zone 4a landscaped gardens will be impacted.

IMPACT ASSESSMENT

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

(i) lead to a long-term decrease in the size of an important population of a species

Response:

An *important population* is one that is necessary for a species' long-term survival and recovery.

The Grey-headed Flying Foxes recorded during survey are likely to be part of the nearby Parramatta Park camp, which is a recognised nationally important camp (EcoLogical Australia 2020). This is due to it being a significant long-term site (noted as early as 1798), and is now protected and managed for the long term survival of the species.

Importantly, this camp and its functioning will not be directly affected by the proposal.

However, the proposal will remove some foraging resources that may be used by some individuals of this important population. Although the total area to be impacted for the demolition is 2.9 hectares, not all of that area is likely to provide foraging habitat as it is dominated by landscaped gardens which in places is dominated by trees that do not provide forage (such as *Casuarina glauca* Swamp Oak – see Photograph 7 in Appendix 2 in this BDAR), or is occupied by young and stunted trees in poor condition due to their growing conditions that also are unlikely to provide forage (such as in much of the open air car parks – see Photograph 8 in Appendix 2 in this BDAR).

The size of this important population is determined by factors affecting the camp site, the availability of food within their foraging range (which is largely driven by season), and factors that

affect the available habitats external to the local area (such as fire-affected breeding grounds). The available forage in the footprint is only a small part of this complex web of influences.

This species flies long distances between the camp site and its foraging grounds, and although this species has been tracked up to 60 kilometres from camp to feeding tree (personal observation), areas within 20 kilometres of a camp site are considered to be within the foraging range of the individuals using a camp.

Although this area around the Parramatta Park camp is highly urbanised, it includes large areas of intact (and largely reserved) bushland such as in the Berowra Valley to the north, along vegetated gullies and creeklines, in the north west, Western Sydney Parklands to the south west, and in the Holsworthy area near the Georges River to the south. These large areas of bushland alone represent in the order of 19,377 hectares of potential foraging habitat within the 20 kilometre foraging range. The surrounding urban matrix also provides food for this species, as it exploits trees in streets, gardens, and parks.

In this context, the area of foraging habitat to be removed is very small – representing only approximately 0.01% of the large intact areas of vegetation.

The removal of this small area that contains at least some poor foraging habitat is considered unlikely to result in a long-term decrease in the size of this important population.

(ii) ***reduce the area of occupancy of an important population***

Response:

The area of occupancy for this species in NSW has been mapped by Office of Environment and Heritage as part of the Saving Our Species program[1] and is at least approximately 7.7 million hectares along the eastern seaboard and adjacent ranges.

This species is highly mobile such that an individual can occupy any part of the known distribution of the species. The impact area of 2.9 hectares represents only 0.00004% of its area of occupancy.

In this context, the area of loss is considered to be negligible and the proposal is unlikely to reduce its area of occupancy to any appreciable degree.

(iii) fragment an existing important population into two or more populations

Response:

The proposal is not of a scale to be able to fragment an existing important population into two or more populations. Most of the potential foraging habitat on site will be retained and the proposal will not alter the fundamental nature of the local area. This species is highly mobile, and its ability to move through the landscape will not be impeded by the proposed development.

[1] *https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10697*

(iv) adversely affect habitat critical to the survival of a species

Response:

Habitat critical to the survival of species can include important winter foraging areas, and breeding / roosting habitat.

Some of the species of trees on site are known to flower in the late winter, but the dominant species provide resources in the spring and summer months.

The site is 5 kilometres from the known camp site in Parramatta Park and will not be impacted by the development.

(v) disrupt the breeding cycle of an important population

Response:

The proposal is unlikely to disrupt the breeding cycle of this species due to its distance from known breeding habitat, the relatively small area of the habitat to be removed, and the nature of this habitat.

(vi) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Response:

The removal of a small area of relatively unimportant habitat is unlikely to result in a decline of the species. Such declines occur at the scale of landscape disruption, not at the scale of a few hectares of garden trees.

(vii) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Response:

The subject site contains a many weed species, some of which are recognised as high threat weeds. The implementation of conservation management across the areas of natural vegetation to be retained under Community title will be of advantage to this species.

(viii) introduce disease that may cause the species to decline, or

Response:

Although they are a vector for human disease, there is little reported regarding diseases affecting the Grey-headed Flying-fox. Parasites are few, principally bat-flies, nematodes and protozoans.

However, despite this dearth of information, it is unlikely that the development will influence the level of disease in this species.

(ix) interfere substantially with the recovery of the species.

Response:

The proposal will not interfere substantially with the recovery of the Grey-headed Flying Fox as the habitat on site is considered to be relatively unimportant and will not contribute in any significant way to recognised threats to this species.

SUMMARY

A total of 2.9 hectares of planted gardens that contain potential habitat will be removed for the demolition footprint. This species is highly mobile, and the critical components of its habitat are those connected to their camp sites, and available forage in the lean winter months. Since the mega fires of 2019-2020, this winter forage is even more important for populations near the fire grounds.

However, the habitat to be impacted is very small in the context of what remains available to this species in the local area.

It is considered that:

- the loss of habitat for this species is relatively small in the context of what is available within its foraging range.
- this matter need not be referred to the Commonwealth Department of the Environment and Energy.

REFERENCES

Augee, M.L. and Ford, D. (1999) Radio-tracking studies of Grey-headed Flying-foxes, *Pteropus poliocephalus*, from the Gordon colony, Sydney. *Proceedings of the Linnaean Society of New South Wales* 121:61-70

Baranowski, K., Faust, C.L., Eby, P., and Bharti, P. (2021) Quantifying the impacts of Australian bushfires on native forests and gray-headed flying foxes. *Global Ecology and Conservation* Volume 27, e01566, ISSN 2351-9894, https://doi.org/10.1016/j.gecco.2021.e01566

Birt, P. (2000) Summary information on the status of the Grey-headed (*Pteropus poliocephalus*) and Black (*P. alecto*) In 'Proceedings of a Workshop to Assess the Status of the Grey-headed Flying Fox'. (Eds G. Richards and L. Hall.). (Australasian Bat Society: Canberra)

Churchill, S. (1998) *Australian Bats*. New Holland, Sydney

Conder, P. (1994) *With Wings on their Fingers*. Angus and Robertson, Sydney

Catterall, C.P., Storey, R.J. and Kingston, M.B. (1997) Reality versus rhetoric: a case study monitoring regional deforestation. In 'Conservation Outside Nature Reserves.' (Eds P. Hale and D. Lamb.) pp. 367-377. (Centre for Conservation Biology, University of Queensland: Brisbane)

Eby, P. (1996) Interactions between the Grey-headed Flying Fox *Pteropus poliocephalus* (Chiroptera: Pteropodidae) and its diet plants - seasonal movements and seed dispersal. Ph.D. Thesis, University of New England, Armidale

Eby, P. (2000) The results of four synchronous assessments of relative distribution and abundance of Grey-headed Flying-fox *Pteropus poliocephalus*. In 'Proceedings of a Workshop to Assess the Status of the Grey-headed Flying Fox'. (Eds G. Richards and L. Hall.) (Australasian Bat Society: Canberra)

Eby, P., Collins, L., Richards, G. and Parry-Jones, K. (1999) The distribution, abundance and vulnerability to population reduction of a nomadic nectarivore, Pteropus poliocephalus during a period of resource concentration. *Australian Zoologist* 31: 240-253

Eco Logical Australia (2020) Parramatta North Flying-fox Camp Management Plan. Prepared for Department of Planning, Industry and Environment

Flora and Fauna Guarantee - Scientific Advisory Committee (2001) Final recommendation on a nomination for listing - *Pteropus poliocephalus* Temminck 1825 - Grey-headed Flying-fox. Department of Natural Resources and Environment, Melbourne

Hall, L.S. (2000) In 'Proceedings of a Workshop to Assess the Status of the Grey-headed Flying Fox'. (Eds G. Richards and L. Hall.) (Australasian Bat Society: Canberra)

Hall, L. and Richards, G. (2000) Flying Foxes; fruit and blossom bats of Australia. UNSW Press, Sydney

Lunney, D. and Moon, C. (1997) Flying-foxes and their camps in the remnant rainforests of north-east New South Wales. In 'Australia's Ever-Changing Forests III: Proceedings of the Third National Conference on Australian Forest History'. (Ed. J. Dargavel.) pp. 247-277. (Centre for Resource and Environmental Studies, Australian National University: Canberra)

Martin, L., Kennedy, J.H., Little, L., Luckhoff, H., O'Brien, G.M., Pow, C.S.T., Towers, P.A., Waldon, A.K. and Wang, D.Y. (1996) The reproductive biology of Australian flying-foxes (genus). *Symposium of the Zoological Society of London* 67:167-184

Martin, L. (2000) In 'Proceedings of a Workshop to Assess the Status of the Grey-headed Flying Fox'. (Eds G. Richards and L. Hall.) (Australasian Bat Society: Canberra)

Menkhorst, P.W. (1995) Grey-headed Flying-fox *Pteropus poliocephalus* Temminck, 1825. In 'Mammals of Victoria'. (Ed. P.W. Menkhorst). pp. 156-158. (Oxford University Press: Oxford)

NSW Scientific Committee (2001) Grey-headed flying fox - Vulnerable species determination - final. DEC (NSW), Sydney

Pallin, N. (2000) Ku-ring-gai Flying-fox reserve: habitat restoration project, 15 years on. *Ecological Management and Restoration* 1:10-20

Parry-Jones, K.A. (1993) The movements of *Pteropus poliocephalus* in New South Wales. Ph.D. Thesis, University of New South Wales, Sydney

Parry-Jones, K.A. (2000) In 'Proceedings of a Workshop to Assess the Status of the Grey-headed Flying Fox'. (Eds G. Richards and L. Hall.) (Australasian Bat Society: Canberra.)

Pressey, R.L. and Griffith, S.J. (1992) Vegetation of the coastal lowlands of Tweed Shire, Northern New South Wales: plant communities, species and conservation. *Proceedings of the Linnaean Society of New South Wales* 113:203-243

Ratcliffe, F.N. (1932) Notes on the fruit bats (*Pteropus* spp.) of Australia. *Journal of Animal Ecology* 1:32-57

Richards, G. (2000) In 'Proceedings of a Workshop to Assess the Status of the Grey-headed Flying Fox'. (Eds G. Richards and L. Hall.) (Australasian Bat Society: Canberra)

Tidemann, C.R. (1995) Grey-headed Flying-fox *Pteropus poliocephalus*. Pp. 439-40 in Strahan, R. (ed.) The Mammals of Australia. Reed Books, Sydney

Tidemann, C.R. (1999) Biology and management of the Grey-headed Flying-fox, *Pteropus poliocephalus*. *Acta Chiropterologica* 1:151-164

Vardon, M.J. and Tidemann, C.R. (1995) Harvesting of Flying-foxes (*Pteropus* spp.) in Australia: could it promote the conservation of endangered Pacific Island species? In 'Conservation Through the Sustainable Use of Wildlife.' (Eds G. Grigg, P. Hale and D. Lunney.) pp. 82-85. (University of Queensland: Brisbane)

Vardon, M.J. and Tidemann, C.R. (2000). The black flying-fox (*Pteropus alecto*) in north Australia: juvenile mortality and longevity. *Australian Journal of Zoology* 48:91-97

Webb, N. and Tidemann, C.R. (1995). Hybridisation between Black (*Pteropus alecto*) and Grey-headed (*P. poliocephalus*) Flying-foxes (Megachiroptera: Pteropodidae). *Australian Mammalogy* 18:19-26

APPENDIX 5

HYGIENE PROTOCOLS
FOR PATHOGEN CONTROL

Preventing spread of Myrtle Rust in bushland

Myrtle Rust Local Control Centre, Gosford

Handout prepared for Myrtle Rust response 2010–11

Myrtle Rust is an exotic plant fungal disease that can be spread in bushland containing plants from the Myrtaceae family. Myrtle Rust is spread by people moving infected plant material, dirty equipment including containers and tools, contaminated clothing and vehicles.

Bushland workers such as bushland regenerator groups, bush care groups, Landcare, forestry workers, and National Parks & Wildlife Services staff should take reasonable measures to prevent the spread of Myrtle Rust between and within areas of bushland. Other regular bushland visitors could also apply the following measures.

Prior to bushland visits

Evaluate the risks associated with the activities to be conducted in the bushland, including the risk of introducing and/or spreading Myrtle Rust. Use the reasonable measures detailed in this handout to plan the day's activities.

Where the bushland contains or may contain Myrtaceae plants stricter measures should be in place as the risk is greater.

Measures to prevent spread

Vehicles

Leave vehicles in areas not surrounded by Myrtaceae plants in a designated car park.

Wash vehicles between site visits inside and out.

Personnel

Workers should shower and change into clean clothes (including hats, gloves and footwear) before moving to another site with Myrtaceae plants.

Minimise the amount of personal items you carry as all items (for example, watches, wallets and items in pockets) will need to be cleaned between bushland sites.

Clothing

Launder clothing including hats and work gloves before re-use.

Disposable overalls may be worn over clothing and removed when leaving the site. However, in high risk cases, showering and changing clothes is also recommended.

Protective equipment such as chainsaw chaps and reflective vests also require laundering. Hard hats, visors, protective eyewear, and glasses should be washed in detergent/soap or sprayed with 70% w/v ethanol or methylated spirits. (Read and comply with the manufacturer's MSDS for the chemicals.)

Footwear

Footwear should be appropriate to the task and terrain and be easily cleaned.

Cleaning footwear should start with the removal of gross contamination (soil, mud), followed by disinfection using detergent such as truck wash or spraying the bottom of footwear with 70% w/v ethanol/methylated spirits.

Cleaning should occur when leaving each site.

Equipment/tools

Minimise the number of items brought to the site to reduce opportunity for spread.

Equipment such as secateurs, shovels and chainsaws should be cleaned between sites.

Remove gross contaminants (soil, mud) and clean with a detergent such as truck wash or spray with 70% w/v ethanol or methylated spirits.

Use tools that do not have wooden or cracked handles to aid the cleaning process.

Electronic items such as mobile phones and GPS can be wiped with alcohol wipes. If possible, use the item in a waterproof protector to aid cleaning.

Plant material

Plant waste should be disposed of by burial on site if possible. If this is not possible, dispose of waste so that possible infected material is not spread. Possible methods may be bagging waste and spraying bags with 70% ethanol/methylated spirits before removal. If trailers, trucks or skips are used, secure the load completely; disinfect vehicles on departure and after tipping. Dispose of waste responsibly – not at another bushland site.

Work plans

Organise work to account for measures to prevent spread and allow for decontamination/cleaning requirements. Rosters and equipment resourcing may be affected.

High risk sites may require a pre-operations visit which includes an inspection of Myrtaceae plants for Myrtle Rust.

If Myrtle Rust is suspected, contact the Exotic Plant Pest Hotline on **1800 084 881**. See 'Reporting suspect Myrtle Rust' (below).

Entering the site

Designate and mark safe access point(s) to the site, avoiding Myrtaceae plants where possible, particularly high risk known susceptible hosts.

Have only the necessary people and equipment on site.

Set up a 'wash down' area to enable people to wash their face and hands and clean their footwear when leaving the site.

Where there are multiple sites in an area, limit movement of people and equipment between these sites.

Reporting suspect Myrtle Rust

Stop work and report any plants that are suspected of being infected with Myrtle Rust. Contact the Exotic Plant Pest Hot Line on 1800 084 881.

Provide the following details (where possible):

- name and contact details
- site details – GPS points, access route
- species affected
- approximate number of plants
- number of people on site

Leaving the site

Remove gross contamination from equipment and footwear and disinfect using detergent or 70% ethanol/methylated spirits before leaving the site.

Wash hands, arms and face.

Place all personal rubbish in a bag, seal, disinfect outside of bag before removal from site and dispose of responsibly.

Dispose of detergent from footbaths or other containers from the 'wash down' area in an area where it will be dispersed without impact on the environment. If this is not possible, empty into a waste container and remove from site.

After leaving the site

After leaving the site, do not go near Myrtaceae plants until the following steps are taken:

- Wash the car – inside and out.
- Shower and launder clothes.
- Dispose of any rubbish responsibly.

Further steps:

- Do NOT remove any plant material from site.
- Ensure all personnel and equipment are clean before exiting the site.
- Record contact details of all personnel on site.
- All personnel to shower and change clothes before going to other sites.

Scrub turpentine with Myrtle Rust

Further reading

I&I NSW website for Myrtle Rust which includes:

- Genera in the Myrtaceae family
- Identification of Myrtle Rust (*Uredo rangelii*)
- Myrtle Rust – *Uredo rangelii*
- Photos of myrtle rust

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NSW GOVERNMENT Primary Industries

FACTSHEET

Myrtle rust: everyday management

Plant Biosecurity Unit

Myrtle rust continues to spread across the Australian landscape in the bushland reserves, amenity settings such as parks and street plantings, home gardens and commercial operations such as plant nurseries and timber plantations.

The rust can be spread by different means including wind, movement of infected plants and by spores accidentally falling onto people engaged in activities where rust occurs. Myrtle rust is not harmful to people but can be spread by people.

The rust is known to be commonly found in the Red Zone in NSW where it has been reported from the full range of landscapes and settings. Actions to minimise the movement of the rust in the Red Zone are associated with the threats to enterprises and landscapes that will be adversely affected by the rust.

Areas containing significant plant communities such as those with threatened species and many nurseries are vulnerable to the negative effects of the rust. Putting in place actions to reduce the likelihood of them becoming infected is appropriate.

The Green Zone is the area outside the Red Zone and the rust is not commonly found in this zone. Actions should be taken to reduce the likelihood of spreading rust from the Red Zone to the Green Zone.

Should I Take Action?

Where there is potential to spread Myrtle rust to a vulnerable species or plant community or into the Green Zone actions should be taken to reduce the chances of that happening.

People engaged in activities which are most likely to spread the rust are those who are actively moving around plants known to have, or likely to have the rust. People going about their normal activities inside the Red Zone are not likely to need to take action unless they are involved with vulnerable enterprises such as a nursery or entering locations identified to contain at-risk plants and plant communities.

Important questions to ask are:

- Will my actions spread the rust to the Green Zone?
- Will my actions spread the rust to a vulnerable and important plant species or community – even if they are in the Red Zone?
- What can I do and how can I change my actions so that I do not spread Myrtle rust?

Thinking about and answering these questions is like doing a risk assessment. To help you, an example of a risk assessment matrix is attached in Appendix 1. This is a guide only and shows the steps taken to assess risk in various hypothetical situations. Using this guide you may choose to develop a similar matrix to assess and mitigate risk in your particular circumstances.

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Biosecurity

What Can I Do?

Actions to reduce the risk of spreading Myrtle rust depend on reducing the chances of moving the rust from an infected area to an uninfected or vulnerable area. The Red Zone is known to be infected; the Green Zone is not (see http://www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/zones). Within the Red Zone there will be locations such as nurseries and specific at-risk plant communities where efforts should be taken to assist in keeping the rust out.

For example:

- Do not move plants known to be infected with Myrtle rust
- Relocate planned activities from known or likely infected areas to another place if possible
- Consider an alternative activity(s)
- Implement simple measures to reduce the risk of moving rust spores including
  - » Launder clothing, hats and gloves worn during activities in high risk areas before re-using them in areas where plants may be susceptible to the rust.
  - » Normal laundering is adequate although some special attention may be required for clothing such as chainsaw PPE.
  - » Wash external surfaces of equipment and vehicles. Although no special cleansing agents are required, products such as *Farmcleanse* can be used to decontaminate machinery and equipment prior to washing.
  - » Always try to start new jobs with clean equipment and clean vehicles.
  - » The surfaces of equipment that may be sensitive to washing or vehicle seats and interiors can be wiped down with alcohol wipes or similar products.
- Comply with risk management and mitigation measures that business enterprises and sites of vulnerable plants and plant communities have in place.

Where suspect rust is found at a location thought to be free of the rust, such as in the Green Zone, the details of the location should be reported to 1800 084 881 or biosecurity@industry.nsw.gov.au. Where new species of plants which are not listed as Myrtle rust hosts at http://www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/hosts are suspected to be affected by Myrtle rust, send photos to biosecurity@industry.nsw.gov.au

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Activity	Source of risk	Area of impact	Risk rating	Mitigation steps	Overall Risk Rating
Clearing bushland, bush regeneration and working in direct contact with plants.	Movement of Myrtle rust spores from the Red Zone to unaffected areas on - clothing - equipment - machinery - vehicles	Green Zone or Red Zone clean area commercial plantations threatened species	**High**	Implement strong biosecurity measures such as: • Apply contact fungicide to plants before moving or removing them • Dispose of waste securely • Use disposable overalls over clothing when working among diseased plants and waste • Launder clothing including hats and gloves before moving to next site • Wash vehicles and equipment following decontamination with Farmcleanse or 70% ethanol after completion of work at contaminated sites	**Low**
Surveying and jobs involving some direct contact with plants.	Movement of Myrtle rust spores from the Red Zone to unaffected areas on - clothing - equipment - vehicles	Green Zone or Red Zone clean area commercial plantations threatened species	**Medium**	Implement basic biosecurity measures such as: • Launder clothing including hats and gloves before moving to a new worksite • Wash vehicles and equipment following decontamination with Farmcleanse or 70% ethanol before moving to a new worksite	**Low**
Trimming trees and mulching.	Movement of Myrtle rust spores from the Red Zone to unaffected areas on - clothing - equipment - machinery - vehicles	Green Zone or Red Zone clean area street trees gardens	**High**	If target trees appear infected, implement strong biosecurity measures • see the example “clearing bushland” • In addition, include solarisation or composting of mulch before on-selling. If target trees appear clean, implement basic biosecurity measures : • see the example “surveying”	**Low**
Using bush and forest roads and tracks	Movement of Myrtle rust spores from the Red Zone to unaffected areas on - clothing - vehicles	Green Zone or Red Zone clean area, commercial plantations, threatened species gardens	**Medium**	Implement general precautionary biosecurity measures such as: • Stay on cleared roads or tracks • Wash vehicles, before going home • Launder clothing, helmets etc upon returning home	**Low**

- provide spray bottles with 70% methylated spirits diluted with water to disinfect tools while working
- install footwear cleaning stations (footbaths with quaternary ammonium based disinfectant or spray bottles with 70% methylated spirits diluted with water to disinfect shoes & tools).

4 Inform all staff, contractors & visitors

- Install interpretive signage
- Provide information for planning activities to staff and contractors. Include information and maps developed during the risk assessment
- Provide brochures and information to visitors
- Encourage visitor participation to monitor sites.

DON T BE A CARRIER
START OUT CLEAN
AND STAY CLEAN

5 Treat infections

Attempts to eradicate *Phytophthora* from infected areas have largely been unsuccessful. Treating with the fungicide Phosphonate (Phosphite) boosts the plant's natural defences and research has shown that it increases the resistance of susceptible plants to Phytophthora Dieback but it does not kill the pathogen. Infected plants remain a reservoir of the pathogen, even after they die.

Treatments with Phosphonate are most effective during the active growth months, generally spring and summer. This fungicide is manufactured by a number of companies and is widely available. Spraying provides one to two years protection. Spray when at least two rain-free days are forecast and there is little or no wind.

Treatment instructions

- Follow safety instructions on the fungicide label: wear protective clothing and spray downwind
- Equipment needed is a clean backpack sprayer, a surfactant, Phosphonate solution and water
- To make 10 litres of spraying solution:
  Using 20% Phosphonate solution, mix 25 mL surfactant and 250 mL phosphonate, and fill with water.

Keep mixture well mixed while spraying, soaking the plants and ensuring all surfaces are wet.

You may need to apply for a permit for off-label use of the fungicide.

KEEP IT OUT
LIMIT THE SPREAD
REDUCE THE IMPACT

MUD
STICKS

There are only three management objectives for Phytophthora Dieback

- Keep areas free of infection
- Reduce the spread of infection
- Manage infected sites.

Contacts and further information

The following web sites have information on susceptible and resistant plants, and details on how to assess your site for *Phytophthora*, alter work practices and apply treatments.

Botanic Gardens Trust Sydney
www.rbgsyd.nsw.gov.au/plant_info/pests_diseases

Commonwealth Government
www.environment.gov.au/biodiversity/invasive/diseases/phytophthora-cinnamomi.html

Centre for Phytophthora Science & Management
www.cpsm.murdoch.edu.au/

NSW Statement of Intent for infection of native plants by *Phytophthora cinnamomi.*
www.threatenedspecies.environment.nsw.gov.au/tsprofile/threat_profile.aspx?id=20026

For more information please contact
Plant Disease Diagnostic Unit
Royal Botanic Gardens Sydney
Mrs Macquaries Road
Sydney NSW 2000

Phone (02) 9231 8186 or 9231 8189
Fax (02) 9241 1135
Email pddu@rbgsyd.nsw.gov.au

STAMP OUT
the spread of **Phytophthora Dieback**

Phytophthora (pronounced fy-TOFF-thora) **is a silent killer in our midst** with the potential to have devastating impacts on ecosystems. It is a water mould that survives in water, soil and plant roots and kills plants by attacking and rotting their roots.

Use this five strategies approach to manage Phytophthora Dieback in your bushland.

PROTECT YOUR ENVIRONMENT

INFECTION IS PERMANENT

Botanic Gardens Trust SYDNEY
NSW GOVERNMENT
NSW Environmental TRUST

This disease kills plants and infection is permanent.

We can help by

- Keeping it out
- Limiting the spread and
- Reducing the impact, using
  - Hygiene
  - Quarantine and
  - Treatment of infected plants.

Phytophthora is spread naturally in water and via infected roots, and faster and further by humans moving contaminated soil or plant material. It can remain dormant for long periods during dry weather and is virtually impossible to remove from infected areas.

So limit its spread by managing water and soil movement.

Phytophthora Dieback attacks many native plants and it also has the potential to have a significant impact on nursery, horticulture, floriculture, tourism, mining and forestry industries.

This killer can also impact on native animals, including marsupials, birds, reptiles and insects, by reducing or eliminating vegetation they rely on for survival.

1 Understand Phytophthora Dieback

Phytophthora Dieback attacks plants where you can't see it occurring, at the roots. It travels in water and along root systems and is spread in contaminated soil.

What you can see above ground is

- wilting, yellowing and dieback of the plant
- quick death of susceptible* plants
- greater loss of plants during dry weather
- decline in diversity of natural ecosystems
- change in vegetation structure
- loss of animals dependent on those plants for food and shelter
- change in the functions of ecosystems.

Even plants that are not highly susceptible will succumb during long periods of dry weather. The loss of root mass limits the amount of water and nutrients a plant can absorb, leaving it susceptible to insect attack, plant diseases and drought stress.

The spores of *Phytophthora* can persist indefinitely in an area protected in the roots of plants, even those that are not susceptible to Phytophthora Dieback. Disease depends on three essential components: plant host, environment and the pathogen.

Phytophthora occurs in areas with rainfall greater than 500 mm per annum. It is most active when the soil is moist and warm. It can also survive for long periods in plant tissue and soil during dry soil conditions.

Favourable soil conditions for the disease are

- warm moist conditions between 15–30°C
- poor drainage and/or open textured soil
- soil low in nutrients and organic matter.

The only effective ways to combat Phytophthora Dieback are by

- preventing introduction — keep it out
- limiting the spread
- reducing the impact of the disease.

Assess the risk of disease for the site and use data from the assessment to set up an appropriate management plan. Include a site monitoring program and routines to evaluate effectiveness.

* **For a list of resistant and susceptible native plants, visit www.environment.gov.au/biodiversity/invasive/publications/pubs/appendix4.pdf**

2 Assess for risk of disease

Record data from the site assessment in a way that it can be used to monitor changes in vegetation over time.

Assess the risk on a yearly cycle.

a) Define climatic risk

Phytophthora is likely to be present in warm moist conditions between 15–30°C with rainfall greater than 500 mm a year.

b) Gather information and quantify risk

Quantify the risk across your site, using information from a survey, and by mapping:

- vegetation, noting known susceptible* plant species and conservation values. Include any historical changes. Over time develop a list of 'plants at risk' in your area
- plant health, including any changes
- soil type, taking into account texture, amount of organic matter, pH and drainage
- movement of water across the landscape
- levels of human activity
- results of soil analysis for *Phytophthora*
- proximity to infected areas
- proximity to high levels of human activity.

c) Soil sampling

As all spores and structures of *Phytophthora* are microscopic, only laboratory analysis of soil is definitive.

The Botanic Gardens website has more details
www.rbgsyd.nsw.gov.au/plant_info/pests_diseases

Sampling soil for laboratory analysis

- select an appropriate site, based on disease symptoms
- use disinfected sampling tools (70% methylated spirits), to ensure you don't spread the disease while sampling
- scrape back organic layer above fine roots of plant
- dig 3–4 holes around plant 10–15 cm deep
- take a small hand trowel of soil and fine roots from each hole, collecting around two cups per plant
- mix in a plastic bag, seal and label well and clearly
- record GPS location
- do not refrigerate.

d) Develop a reassessment and monitoring program

Establish a program to reassess sites and monitor changes in risk, including updating maps. Stay informed, and review work practices and education programs. Monitor these for effectiveness and alter where needed.

3 Adjust work practices to reflect risk

Human activities cause the most significant, rapid and widespread distribution of Phytophthora Dieback. Any activity that moves soil, water or plant material, or alters the natural movement of water, could spread the disease.

Soil can be moved **inadvertently** or **deliberately.**

Examples of inadvertent movement of soil or plant material during work or recreation are by:

- footwear, clothing, backpacks, tent pegs, walking sticks
- companion and work animals (dogs, cats, horses)
- stock movement
- tools and equipment
- machinery and vehicles, including off road driving, motorbikes & bicycles or soil in the foot area of vehicles.

Work activities likely to create movement of soil, water and plant material include:

- road & track construction
- controlling water movement
- revegetation
- plant propagation
- pest and weed management
- earth moving
- mulching
- bush regeneration
- forestry
- fire fighting activities.

Prevent introduction and minimise the spread to unaffected areas by controlling the movement of soil, plant material and water by:

- **planning and modifying activities and work practices**
  - develop management plans, work protocols and contracts to manage risk of Phytophthora Dieback
  - avoid activities when soil is wet and muddy
  - control water runoff, including from roads & tracks
  - maintain roads & tracks regularly to control water movement and to reduce pooling.
- **controlling access**
  - provide designated parking facilities
  - install, label and use roads, tracks or boardwalks
  - introduce quarantine areas and buffer zones (fencing, barriers).
- **adopting hygiene procedures**
  - ensure shoes, tyres and equipment are free of soil at the start and end of an activity
  - install cleaning bays/wash-down areas for vehicles and machinery