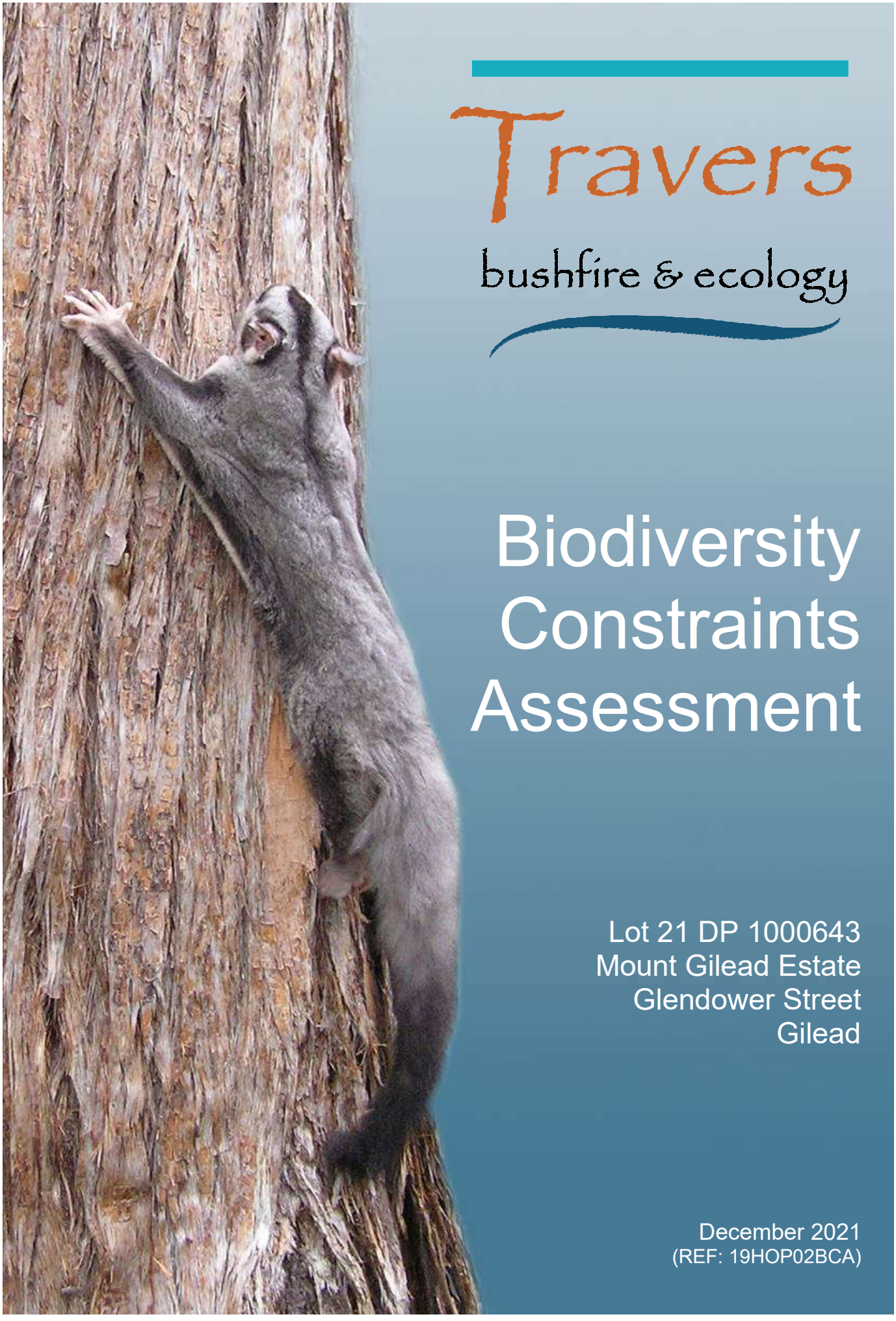

Travers

bushfire & ecology

Biodiversity Constraints Assessment

Lot 21 DP 1000643
Mount Gilead Estate
Glendower Street
Gilead

December 2021
(REF: 19HOP02BCA)

Biodiversity Constraints Assessment

Lot 21 DP 1000643
72 Glendower Street
Gilead

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Original Date:	24 June 2019
As amended	23 December 2021
Amendments approved by	Lindsay Holmes
File:	19HOP02BCA

Disclaimer:

This report has been prepared to provide advice to the client on matters pertaining to the particular and specific development proposal as advised by the client and / or their authorised representatives. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person, including the client, then this firm advises that the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be interpreted without reference to the entire report.

The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

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Executive Summary

A biodiversity constraints assessment has been undertaken for Lot 21 in DP 1000643 located at 72 Glendower Street Gilead. The figure below depicts the development intent, and shows;

- The 2006 approved 50m wide APZ (1.8 ha) within Lot 21 (green colour).
- The proposed conservation zone (1.72 ha) as uncoloured
- The proposed independent living units (pink and yellow).
- The new APZ in Lot 21 (1.56 ha) as light green
- The proposed 8m wide perimeter road

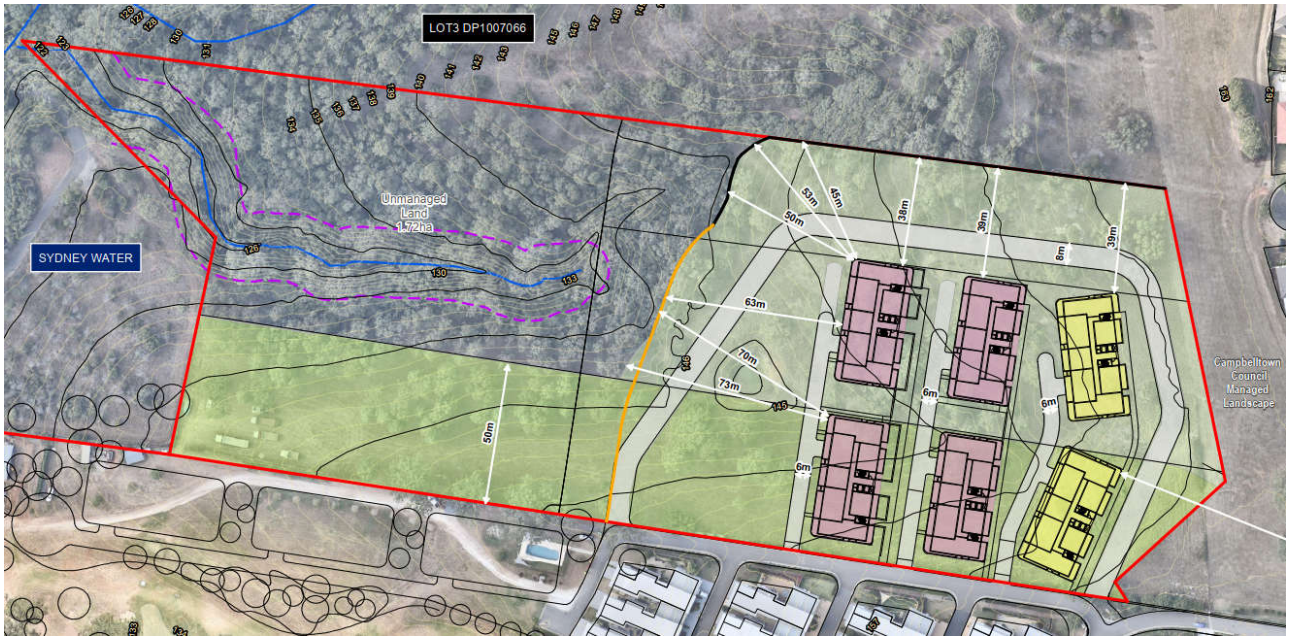

Figure X – proposed development layout

Environmental survey and assessment have been undertaken to determine a suitable environmental development envelope within Lot 21. The specialist consultants included;

- *Travers bushfire & ecology* (2019-2021) who undertook survey on the site since 2002 and prepared the VMP.

- *Hayes Environmental* has undertaken a draft BDAR in response to biodiversity impact as required by the Biodiversity Conservation Act. The draft BDAR included a 25m portion of land immediately north of Lot 21 and that 25m zone is now not part of the development proposal. Therefore, impacts are less than advised in the draft BDAR and will be re-evaluated when the final BDAR is required to be undertaken.

- *Biolink* has provided specialist advised in respect of koala activity on the site (2019-2021) and subsequently advised in respect of how to respond to the needs of Campbelltown City Council Koala Plan of Management.

- A geomorphic assessment was undertaken by *Strategic Environmental and Engineering Consulting* to determine the presence of natural drainage features within Lot 21.

In essence, there was one (1) endangered ecological community, no threatened plant species, three (3) threatened fauna species on the landscape.

As per the requirements *Biodiversity Conservation Regulation 2017*, an initial assessment has been undertaken using the Biodiversity Offsets Scheme (BOS).

Biodiversity values land is recorded within the study area. Of those lands 1.72 ha of Cumberland Plain Woodland (CPW) will be retained as a conservation zone.

Within the remaining land not subject to the 2006 fifty metre wide APZ there will be an area of 1.56 ha subject to a new APZ. In that zone approximately 60% is currently cleared and regularly mowed or subject to goat grazing; whilst approximately 40% of that area has trees commensurate with CPW. Therefore, as per the BOS scheme the assessment will be based on the loss of CPW within that 40% portion (i.e. 0.624 ha).

The BOS report (dated 23 December 2021), as shown below, determines that a BDAR will be required and offsets provide for the biodiversity values loss.

NSW GOVERNMENT

Biodiversity Values Map and Threshold Report

Results Summary

Date of Calculation	23/12/2021 1:11 PM	**BDAR Required***
Total Digitised Area	9.06 ha	
Minimum Lot Size Method	Lot size	
Minimum Lot Size	0.97 ha	
Area Clearing Threshold	0.25 ha	
Area clearing trigger Area of native vegetation cleared	Unknown #	Unknown #
Biodiversity values map trigger Impact on biodiversity values map(not including values added within the last 90 days)?	yes	yes
Date of the 90 day Expiry	N/A	

Arising from the loss of biodiversity values and to which we have undertaken a draft BDAR to determine those values we can advise that together with the advice by Biolink there is not a significant impact. This is manifested by the work of *Biolink* in that no core koala habitat is affected and no likely impact will arise from habit and or vegetation contiguity issues.

Indeed, the advice herein, inclusive of *Biolink* and *Hayes Environmental* is to retain the core koala habitat within the intact CPW parcel.

The following measures are proposed to achieve a better overall outcome for the whole of the development proposal landscape;

- The intact 1.72 ha vegetation parcel of CPW should be protected by a E2 zoning namely Environmental Conservation.

- A vegetation management plan should be prepared for the remnant CPW within Lot 2 and Lot 21 with a view that they provide a link to Noorumba Reserve (Lot 102 DP611552) in the east via compensatory plantings in the west of Lot 2 and revegetated lands along Menangle Creek in the south; and other reserves in the west and the north.

- As per the provisions of the CKPoM, and as advised by *Biolink*, monetary contributions be made to Council for the betterment of koala habitat via the Koala Habitat Rehabilitation Program.

- Future landscaping should utilise species drawn from Cumberland Plain Woodland including shrubs and ground covers to encourage local fauna use, to consolidate remnant vegetation linkage for native flora and fauna species within the locality.

- As permitted, by the RFS 10% of the APZ can be planted with trees.

- The non-contiguous CPW trees, where lost, should be offset as required by the Biodiversity Conservation Act.

- Control and eradication of invasive ecological weeds should be undertaken to prevent further invasion by these species. Invasive species such as African Olive, Lantana and Small-leaved Privet.

Table of Contents

Tables

Appendices

List of abbreviations

APZ	asset protection zone
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BC Act	*Biodiversity Conservation Act (2016)*
BC Reg	*Biodiversity Conservation Regulation (2017)*
BCAR	Biodiversity Certification Assessment Report
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Scheme
BPA	bushfire protection assessment
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically endangered ecological community
CM Act	*Coastal Management Act 2016*
CPW	Cumberland Plain Woodland
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DCP	development control plan
DEC	NSW Department of Environment and Conservation (superseded by DECC from April 2007)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from October 2009)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from April 2011)
DEWHA	Commonwealth Department of Environment, Water, Heritage & the Arts (superseded by SEWPAC)
DOEE	Commonwealth Department of Environment & Energy (superseded by DAWE)
DPIE	Department of Planning, Industry and Environment
EEC	endangered ecological community
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act (1979)*
EPBC Act	*Environment Protection and Biodiversity Conservation Act (1999)*
FM Act	*Fisheries Management Act*
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	local environmental plan
LGA	local government area
LLS Act	*Local Land Services Act (2013*)
NES	national environmental significance
NPW Act	*National Parks and Wildlife Act (1974)*
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage (superseded by DPIE from July 2019)
PCT	plant community type
PFC	projected foliage cover
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SAII	Serious And Irreversible Impacts
SEPP	State Environmental Planning Policy
SEWPAC	Commonwealth Dept. of Sustainability, Environment, Water, Population & Communities (superseded by DOEE)
SIS	species impact statement
SULE	safe useful life expectancy

TEC	threatened ecological community
TPZ	tree preservation zone
TSC Act	*Threatened Species Conservation Act (1995) – Superseded by the Biodiversity Conservation Act (2016)*
VMP	vegetation management plan

Biodiversity Assessment

1.0 Background

Travers bushfire & ecology has been engaged to undertake a biodiversity constraints assessment within Lot 21 DP 1000643 Glendower Street, Gilead, within Campbelltown local government area (LGA). The extent of this entire lot is shown in Figure 1 and will hereafter be referred to as the 'study area'.

Figure 1 – Study area

1.1 Development history

In 2006 Campbelltown City Council consented to the Mount Gilead retirement village, covering Lot 2 and Lot 21. Councils consent formalised two (2) conservation areas within the landscape and a vegetation management plan (VMP) for those areas was prepared in 2006.

The development occurred within Lot 2 however a part of the bushfire asset protection zone was located within the southern portion of Lot 21 in the north of Lot 2.

The thin retained vegetation zone in the northwest of Lot 2 was also approved as a bushfire asset protection zone in the form of an outer protection zone – see blue colouring on Figure 2.

The site was fenced following development consent with weeds removed leaving the 29 mature trees and associated shrubs to expand naturally. This vegetation community was the endangered River-Flat Eucalypt Forest (RFEF).

In the south, land adjacent to Menangle Creek, is subject to the VMP and also to the GTA's issued by the DNR in 2005. This land will be set aside, and conserved as native vegetation, as per the 2006 VMP. Rehabilitation works are yet to begin in this landscape due to the staging of development and agreements with Council.

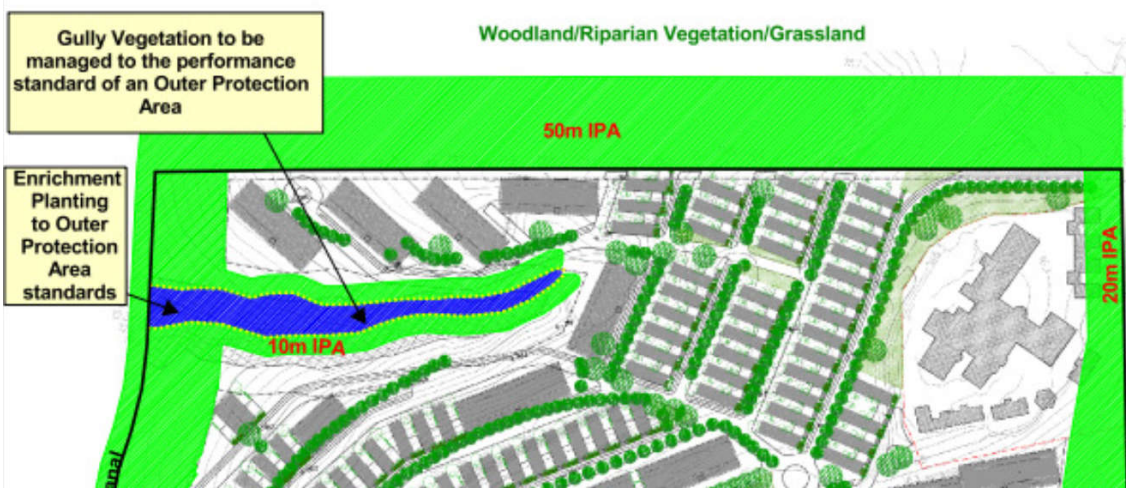

Figure 2 – location of the smaller conservation zone within Lot 2

In 2013 Council and the Applicant agreed to a strategy for that landscape in correspondence between *Travers bushfire & ecology* and CCC (David Henry) 23 December 2013. In that correspondence we advised;

> '*Works within waterfront lands will be done as part of Stages 4 and 5 in conjunction with the golf course in this area which abuts the riparian zone. In the interim it is intended that only minor weed control will be undertaken for presentation purposes which will meet the fuel reduction requirements. Only low impact weed control methods (excluding machine clearance) will be undertaken across the northern portion of the riparian zone as there are limited occurrences of noxious and environmental weeds. Low impact methods generally include hand weeding and backpack spraying (no machinery) which minimise the risk of off-target damage and allow natural regeneration of the insitu vegetation communities.*
>
> *We have undertaken an inspection of the site and identified areas that would be suitable for both mechanical and low impact weed control. The extent of Blackberry amongst non-native groundcovers in the far west of the site are suitable for mechanical slashing, spraying or removal. Privets along the northern side of the riparian zone can also be removed within this zone at the same time.*
>
> *Within the central portion of the riparian corridor to the south of the development is another patch of Blackberry with low densities of native groundcovers which is also suitable for machine removal. The clump of Camphor Laurel trees within the same area can also be dismantled and removed mechanically.*
>
> *All other areas have sufficient regenerative capacity or contain a canopy with some native shrub layer which would be unsuitable for machine removal / control. In this instance low impact hand weeding and backpack spraying are the most suitable approaches.*
>
> *The attachment shows areas which we consider to be suitable for each method based upon the level of native groundcover growth, regenerative capacity and influx of invasive or noxious weeds.".*

In 2018 a weed report for a Lot 21 was prepared by *Travers bushfire & ecology* – see the results of the weed mapping at Figure 3. In response to that report and advice the landowner contracted *Toolijooa* to remove the African Olive infestation.

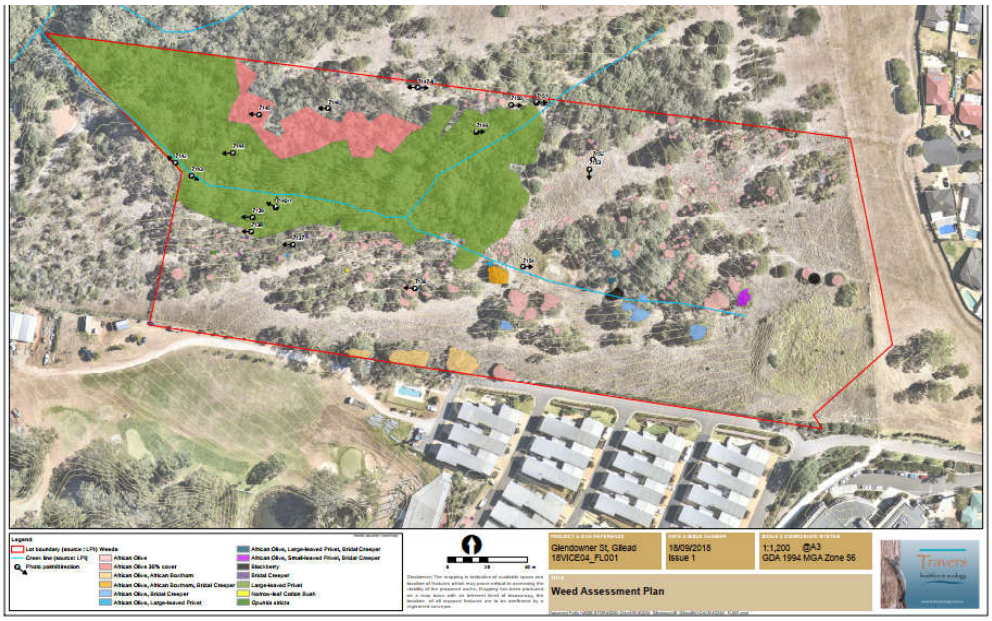

Figure 3 - Weed map of Lot 21

In 2019 Council consented to a DA 2828/2005/DA-SL/C being the extension of the clubhouse and required the removal of two Koala feed trees *Eucalyptus tereticornis*. The Council consent was an amendment to DA 2828/2005 and was based on the advice within Biodiversity Assessment - 72 Glendower Street Gilead *Travers bushfire & ecology* December 2018, the Koala Plan of Management - 72 Glendower Street Gilead *Travers bushfire & ecology* February 2019 and supporting advice to *Travers bushfire & ecology* dated 8 May 2019 by Koala experts '*Biolink*' in their review and advice for the development at 72 Glendower Street Gilead.

The Consent Condition no 87 (of the May 2019 consent) required a Koala Habitat Offset Strategy to be prepared for Council's review and written approval and this was issued to Council in August 2019.

Council required 50 compensatory trees would be planted in an area that is not already subject to the existing Vegetation Management Plan (VMP - *Conacher Travers*, June 2006) so as to avoid duplication of revegetation commitments. That area was agreed to be as shown in Figure 4.

Figure 4 – location of proposed tree planting

1.2 Development Proposal

Figure 5 below depicts the development intent an specifically;

- The 2006 approved 50m wide APZ (1.8 ha) within Lot 21 (green colour).
- The proposed conservation zone (1.72 ha) as uncoloured
- The proposed independent living units (pink and yellow).
- The new APZ in Lot 21 (1.56 ha) as light green
- The proposed 8m wide perimeter road

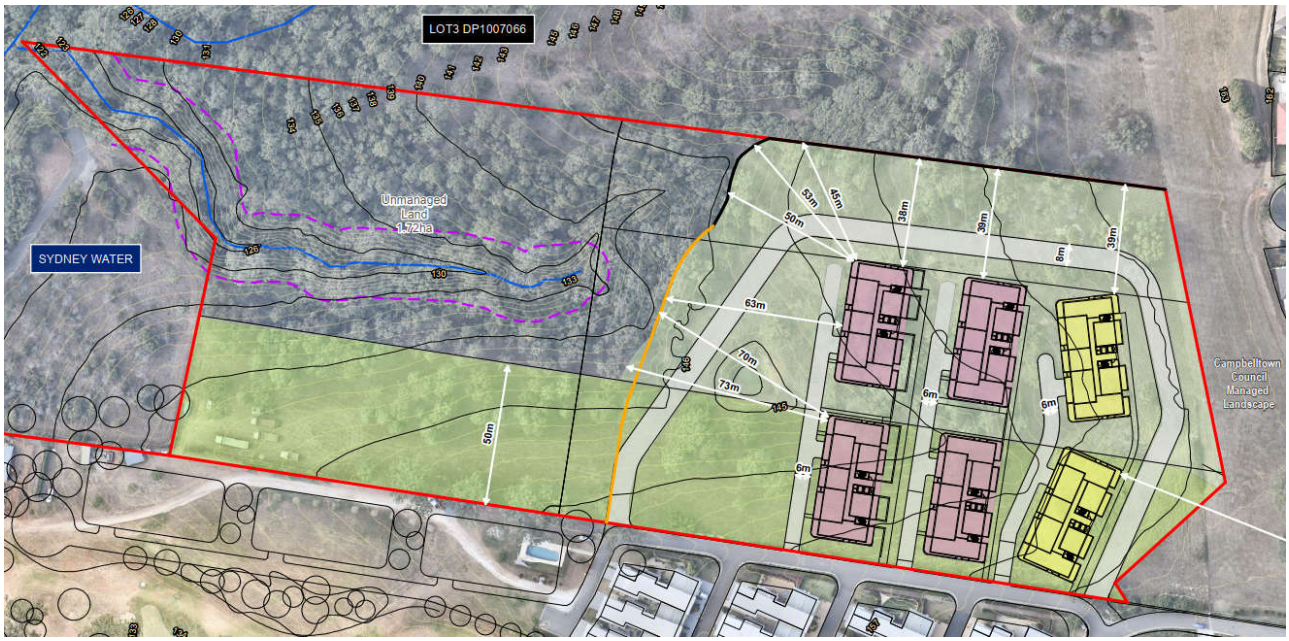

Figure 5 – proposed development layout

1.3 Site description

Table 1 provides a summary of the planning, cadastral, topographical, and disturbance details of the subject site.

Table 1 – Site features

Location	Lot 21 DP 1000643 and Lot 3 Glendower Street, Gilead
Size	Approximately 5.14 ha
Local government area	Campbelltown
Grid reference	295569E 6223512N
Elevation	Approximately 130–166m AHD
Topography	Situated in a valley that is oriented east to west. Slopes vary from 5–25°.
Geology and soils	Geology: Ashfield Shale. Soil landscape: Blacktown
Catchment and drainage	Topographic maps show two first-order streams converging into a second-order stream that flows east to west into an unnamed tributary to Menangle Creek. A small farm dam exists in the eastern portion of the site.
Vegetation	Remnant vegetation covers most of the study area and is commensurate with disturbed Cumberland Plain Woodland. The remainder of the site is cleared.
Existing land use	Vacant. The site is zoned RU2 – Rural Landscape.
Clearing	40% of the original canopy vegetation has been previously cleared.

2.0 Biodiversity Offsets Scheme (BOS)

The *BC Act* repeals the *Threatened Species Conservation Act 1995*, the *Nature Conservation Trust Act 2001* and the animal and plant provisions of the *National Parks and Wildlife Act 1974*.

Together with the *Biodiversity Conservation Regulation 2017*, the *BC Act* establishes a new regulatory framework for assessing and offsetting biodiversity impacts on proposed developments and clearing. It establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme (BOS). Where development consent is granted, the authority may impose as a condition of consent an obligation to retire a number and type of biodiversity credits determined under the new Biodiversity Assessment Method (BAM).

2.1 Threshold assessment

The BOS includes two (2) elements to the threshold test – an area trigger and a Sensitive Biodiversity Values Land Map trigger. If clearing exceeds either trigger, the BOS applies to the proposed clearing. The BOS may also be triggered if the test of significance concludes a 'significant impact'.

2.1.1 Biodiversity values land map

Biodiversity values land has been mapped within the study area. Figure 6 shows the site (yellow) in relation to those areas (purple) as having biodiversity values. Clearing of native vegetation within the mapped biodiversity values land triggers this threshold and will require biodiversity offsets to be obtained.

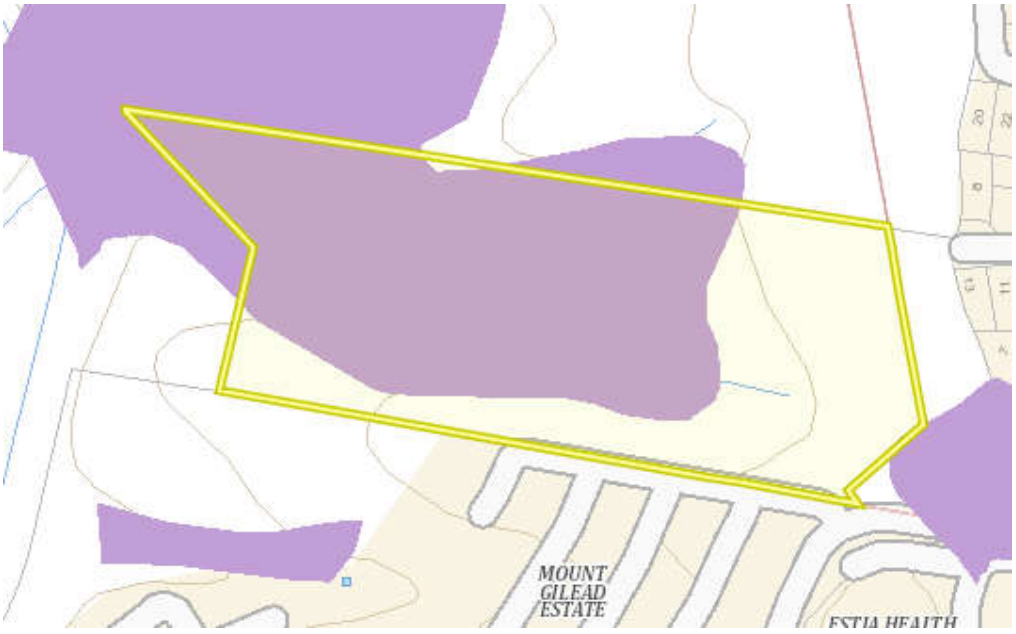

Figure 6 – Biodiversity value land (purple) relative to the study area (yellow boundary)
(Source: OEH – Biodiversity Values Map, December 2021)

2.1.2 Area clearing threshold

The area threshold varies depending on the minimum lot size (shown in the Lot Size Maps made under the relevant Local Environmental Plan (LEP)), or actual lot size (where there is no minimum lot size provided for the relevant land under the LEP).

Table 2 – BOS entry threshold report

NSW GOVERNMENT

Biodiversity Values Map and Threshold Report

Results Summary

Date of Calculation	23/12/2021 1:11 PM	**BDAR Required***
Total Digitised Area	9.06 ha	
Minimum Lot Size Method	Lot size	
Minimum Lot Size	0.97 ha	
Area Clearing Threshold	0.25 ha	
Area clearing trigger Area of native vegetation cleared	Unknown #	Unknown #
Biodiversity values map trigger Impact on biodiversity values map(not including values added within the last 90 days)?	yes	yes
Date of the 90 day Expiry	N/A	

Table 2 identifies that the BOS entry threshold report has determined the area threshold based on the lot size, and the area clearing threshold for which the BOS applies is 0.25 ha. Clearing of 'native vegetation' that exceeds 0.25ha will require a biodiversity offset to be obtained.

Table 2 identifies that a BDAR is required to be prepared. On the basis that 1.72 ha is to be retained intact and a 50m wide strip of land is already approved as an APZ then it is only the vegetated potion of the residual 1.56 ha that would be subject to the BDAR. Therefore, in that 1.56 ha zone approximately 60% is currently cleared and regularly mowed or subject to goat grazing; whilst approximately 40% of that area has trees commensurate with CPW. Therefore, as per the BOS scheme the assessment will be based on the loss of CPW within that 40% portion (i.e. 0.624 ha).

2.2 Serious and irreversible impacts on biodiversity values

The determination of serious and irreversible impacts (SAII) is to be made in accordance with principles prescribed section 6.7 of the *BC Regulation* (2017). The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales.

Candidate SAII entities recorded or with potential to occur within the study area include:

- Cumberland Plain Woodland
- Eastern Bentwing-bat

- Little Bentwing-bat
- Large-eared Pied Bat
- Swift Parrot
- Regent Honeyeater

Impacts on Cumberland Plain Woodland (CPW) are considered as a potential SAII as Cumberland Plain Woodland meets two (2) of the four (4) principles for nomination as a potential SAII. Therefore, for any future impact on CPW, a biodiversity assessment of the additional impact assessment provisions for SAII entities will need to be completed in accordance with Section 10.2.3 of the Biodiversity Assessment Method (BAM 2017).

None of the above listed candidate fauna species have been recorded during surveys to date and the Regent Honeyeater is only considered with an unlikely potential to occur. There is no breeding habitat (caves) present for these select microbat species and the site is not likely to provide important foraging for the migratory Swift Parrot or Regent Honeyeater. Therefore, any future development within the study area is not considered to constitute an SAII on the above listed fauna species.

3.0 Flora

3.1 Survey

Botanical survey was undertaken by Travers bushfire & ecology on 7 June 2019 over a time frame of approximately 2hrs. Survey included a random meander in accordance with *Cropper* (1993) to gain a full species list of the plants within the site, and then three (3) BAM quadrats of 0.1ha undertaken within areas of native vegetation.

A review of the *Atlas of NSW Wildlife* (OEH 2019) was undertaken prior to the site visit to determine threatened species previously recorded within 10km of the subject site, and relevant target searches were undertaken as suited during the random meander and quadrat surveys. All naturally occurring species were identified to species level where possible and are listed in Appendix 1.

Additional survey was undertaken by *Hayes Environmental* in March 2021.

A general botanical survey was conducted throughout the Development Site by Mr Daniel Clarke on the 29th March 2021, including random spot surveys in grassland areas to identify and map the relative proportion of native species;

In accordance with the BAM (Ch 4.3.4, Table 3), two BAM plot surveys were conducted within the Development Site by Mr Daniel Clarke and Ms Rebecca Hogan on the 29th March 2021. One plot was placed within each vegetation zone (see Figure 3), the locations selected randomly using the Hayes Environmental small area random point method. The method uses a 20m x 20m plot to assess composition and structure, within a 20m x 50m plot to assess function attributes, with five 1m2 sub-plots to assess litter cover.

A thorough '*random meander*' (Cropper, 1993) was conducted throughout the Development Site by Mr Daniel Clarke on the 29th March 2021 over a period of 2 hours, to target candidate threatened plant species.

Targeted survey for *Caladenia tessellata*: Targeted searches for this species were conducted in areas of potential habitat within the Development Site by orchid specialist, Mr Graeme Bradburn, on the 8th October 2021, after ascertaining that a reference population was in flower on the 7th October 2021. Mr Bradburn recorded no specimens during his

survey.

The *NSW survey guide: Surveying threatened plants and their habitats* (DPIE 2020) prefers the parallel field traverse method for survey for threatened plants. However, there is no shrub layer within the site and the understorey throughout is close mown.

The survey guide states (pg 17) that height and density of ground or mid-layer vegetation, light and weather conditions, and visibility of species, will impact detectability and are relevant considerations when designing traverse spacing.

Further, the vegetation zones within the site that provide suitable habitat for threatened plants are very small, such that the two BAM plots placed within the Native Woodland vegetation zone of the site (in 2019 & 2021) occupy a large proportion of this zone.

Grassland areas are mapped as 'native grassland' where the presence of native plants exceeds 15% cover. These areas are highly degraded and dominated by exotic grass and weed species. Two random meanders (2019 & 2021) have been conducted throughout the Development Site, including in grassland areas to identify areas of higher quality and potential habitat for threatened species.

In 2021, these included random spot surveys to identify plant species for calculation of percent cover of native plants. A buffer distance of 7.5m has been applied to the random meander tracks, spot surveys and BAM plots, to show coverage appropriate to sub-shrubs in open vegetation using Table 1 of the survey guide. The combination of methods employed within the Development Site during two separate years by two separate field assessors is considered sufficient to detect presence of candidate species of the tree, shrub and climbing growth forms.

Two of the candidate species listed in Table 3 are herbaceous with BAM survey periods in Spring. These species could not have been adequately surveyed on the site during the survey periods, regardless of method used. Refer to Chapter 2.5 Survey Limitations for further discussion of these species. See Figure 7 for location of BAM plots, fauna survey points, grassland spot surveys, and the botanical survey site coverage based on random meanders with a 15m wide surveillance area in 2019 and 2021. Due to equipment mishap, the GIS tracking path during the 2021 random meander is not complete – additional areas were investigated in the north of the Development Site and linking the grassland spot buffers in the south-eastern part of the site.

Figure 7 – Survey location

3.2 Vegetation communities

The Cumberland Plain West vegetation mapping (NPWS 2002) has mapped the majority of the remnant vegetation on site as Shale Hills Woodland (equivalent to PCT 850 Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion), with smaller portions of Shale Sandstone Transition Forest (Low Sandstone Influence) (equivalent to PCT 1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion) and Shale Plains Woodland (equivalent to PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion) in the west of the site.

Field verification of the study area found the following vegetation communities:

- PCT 850 Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion
- Managed Lands

PCT 850 - Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion

This community occupies 3.08ha within the study area.

Canopy – Dominated by *Eucalyptus tereticornis,* with *Eucalyptus crebra*, *Eucalyptus moluccana* and *Eucalyptus fibrosa* occurring in lower abundance. The canopy is of a height of 15-30m with a projected foliage cover (PFC) of approximately 35–50%.

Mid-storey – In the south and eastern parts of the site the vegetation has been underscrubbed in the past and the mid-storey is generally absent. In central and western areas there is a moderate to dense midstorey of native and exotic species. Native species are represented by *Bursaria spinosa, Acacia implexa* and *Acacia parramattensis* providing up to 50% PFC. In many areas the exotic shrubs *Olea europaea* and *Ligustrum lucidum* are

very dense, particularly along the creek lines, although weed control works appear to have been undertaken recently.

Ground layer – Native species provide up to 37% PFC and include *Microlaena stipoides, Dichondra repens, Glycine tabacina, Carex inversa, Cyperus gracilis, Brunoniella australis, Lomandra filiformis, Einadia* spp., *Desmodium varians, Cheilanthes sieberi, Themeda triandra, Chloris ventricosa* and *Solanum prinophyllum.* Exotic species provide 1–10% PFC and include *Asparagus asparagoides, Ehrharta erecta, Bidens pilosa, Senecio madagascariensis, Sida rhombifolia, Plantago lanceolata* and *Solanum pseudocapsicum.*

Classification - This vegetation is commensurate with Cumberland Plain Woodland (CPW) which is listed within the NSW *BC Act* (2016) as a Critically Endangered Ecological Community (CEEC). It is also commensurate with Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest which is also listed within the the Commonwealth *EPBC Act* (1999) as a Critically Endangered Ecological Community (CEEC). The vegetation meets the *EPBC* condition thresholds as the patch size is greater than 0.5ha and there is greater than 30% native groundcover.

Managed Lands

This vegetation community describes the majority of the study area where remnant trees are absent. There are occasional exotic and non-indigenous trees or shrubs including *Olea europaea*, *Ligustrum sinense, Schinus molle, Lycium ferocissimum, Rubus fruticosus* sp. agg. and naturalised *Corymbia citriodora* (Photo 6). The ground layer is dominated by exotic grasses and groundcovers including *Paspalum dilatatum*, *Ehrharta erecta, Bidens pilosa, Cenchrus clandestinus, Setaria parvifolia, Cirsium vulgare* and *Verbena bonariensis.*

Photo 1 – PCT 850 - Grey Box - Forest Red Gum grassy woodland within Quadrat 1 in the north-west of the study area.

Photo 2 – Underscrubbed PCT 850 - Grey Box - Forest Red Gum grassy woodland within Quadrat 3 in the south-west of the study area. This is an approved asset protection zone (DA consent 2006).

Photo 3 – PCT 850 - Grey Box - Forest Red Gum grassy woodland with a dense midstorey of Olea europaea (African olive) and Ligustrum lucidum (Large-leaved privet) along the main creek line.

Photo 4 – PCT 850 - Grey Box - Forest Red Gum grassy woodland in the east of the study area surrounded by managed lands

Photo 5 – Managed lands in the east of the study site.

Photo 6 – Managed lands in the centre of the study site

3.3 Threatened flora species

BC Act – A search of the *Atlas of NSW Wildlife* (OEH, 2019) indicated a list of species that have been recorded within a 10 km radius of the subject site. These species are listed in Appendix 2 Table A2.1 and are considered for potential habitat within the subject site.

EPBC Act – A review of the schedules of the *EPBC Act* indicated the potential for a list of threatened flora species to occur within a 10km radius of the subject site. These species have also been listed in Appendix 2 Table A2.1 for consideration of potential to occur.

Based on the habitat assessment within Table A2.1 it is considered that the subject site provides potential habitat for the following threatened flora species. These species will need to be considered in detail for any future development application.

Table 2 – Threatened flora species with suitable habitat present

Scientific name	*BC Act*	*EPBC Act*	Potential to occur	Survey period (OEH)
Pimelea spicata	E1	E	✓	All months
Pultenaea pedunculata	E1	-	low	Sept–Nov
Pterostylis saxicola	E1	E	unlikely	Sept–Nov
Caladenia tessalata	E1	E	Unlikely	Sept- November

Survey for threatened flora has been limited to opportunistic searches during stratified surveys. Targeted searches will be needed in the appropriate survey period for *Pimelea spicata, Pultenaea pedunculata, Caladenia tessalata* and *Pterostylis saxicola*, as shown in Table 2, depending on the nature of any future development proposal.

All remaining threatened species in both the BioNet (NSW) and *EPBC Act* coordinate search (National) were considered to have low potential suitable habitat within the study area because of previous clearing, past and ongoing land management practices, unsuitable soils / geology, unsuitable previous vegetation type or large distance to known specimens.

3.4 Endangered flora populations

One (1) endangered flora population occurs within the Campbelltown LGA:

- *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas.

The study area contains potential habitat for this species, however the closest record is 7km away to the north-west. It is considered that this population has very unlikely potential to occur within the study area.

No specimens of *Marsdenia viridiflora* subsp. *viridiflora* were observed within the study area during the flora survey.

3.5 Threatened ecological communities

One (1) threatened ecological community (TEC) was observed within the study area:

- Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW)

CPW is listed within the NSW *BC Act* (2016) as a Critically Endangered Ecological Community (CEEC). This vegetation community is also commensurate with the Critically Endangered Ecological Community (CEEC) listed within the Commonwealth *EPBC Act* (1999) which is known as Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

3.6 State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017

The *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017* (Vegetation SEPP) was one of a suite of Land Management and Biodiversity Conservation (LMBC) reforms that commenced in New South Wales on 25 August 2017. The Vegetation SEPP (the SEPP) works together with the *Biodiversity Conservation Act 2016* and the *Local Land Services Amendment Act 2016* to create a framework for the regulation of clearing of native vegetation in NSW.

The SEPP will ensure the BOS (established under the Land Management and Biodiversity reforms) will apply to all clearing of native vegetation that exceeds the offset thresholds in urban areas and environmental conservation zones that does not require development consent.

Vegetation SEPP applies to the following local government areas:

Bayside, City of Blacktown, Burwood, Camden, City of Campbelltown, Canterbury-Bankstown, Canada Bay, Cumberland, City of Fairfield, Georges River, City of Hawkesbury, Hornsby, Hunter's Hill, Georges River, Inner West, Ku-ring-gai, Lane Cove, City of Liverpool, Mosman, Newcastle, North Sydney, Northern Beaches, City of Parramatta, City of Penrith, City of Randwick, City of Ryde, Strathfield, Sutherland Shire, City of Sydney, The Hills Shire, Waverley, City of Willoughby, Woollahra.

The Vegetation SEPP also applies to land within a variety of zones as set out in the legislation 'Land to which the policy applies'.

3.6.1 Is an authority to clear vegetation required

As 'development consent' is required for any future DA, the Vegetation SEPP does not apply.

4.0 Fauna

4.1 Survey and habitat

Preliminary fauna survey and threatened species habitat assessment was undertaken on the 11/6/19. Diurnal fauna survey included:

- Snail habitat searches in the eastern and northern portions,
- 3x bird census points (out to a radius of 30-40m for a minimum of 15 minutes),
- Opportunistic bird call and activity survey between census points,
- 1x Koala Spot Assessment Technique SAT – searching 2m around the base of 30 trees (>10cm DBH) for scats indicating presence and then activity levels in accordance with *Phillips & Callaghan* (2008).

Consideration to the presence of hollows, their size and type was also undertaken.
Weather conditions at the time of diurnal survey was 2/8 cloud, light west wind, no rain, 24-16^{o}C between 13:45 – 17:15. Adjacent survey to the south was undertaken on the 18/3/19, the weather conditions at this time were 8/8 cloud, light south wind, previous rain, 20^{o}C between 14:50 – 18:20.

Nocturnal fauna survey included:

- Spotlighting,
- Frog call identification,
- Ultrasonic microbat recording (x2 passive recording stations),
- Owl call-playback (Powerful Owl, Masked Owl & Barking Owl),
- Bush Stone-curlew call-playback,
- Glider call-playback (Yellow-bellied Glider & Squirrel Glider), and
- Koala call-playback.

Weather conditions at the time of nocturnal survey were 4/8 cloud, no wind, no rain, 2/4 moon, 16-13^{o}C between 17:15 – 20:00. Adjacent nocturnal survey to the south on the 18/3/19, had 7/8 cloud, no wind, no rain, 20^{o}C between 19:00 – 20:30.

Specific survey effort locations and results are shown on Figure 2. All fauna species recorded during survey within the subject site and nearby surrounds are listed in Table A1.2 in Appendix 1.

A review of the Atlas of NSW Wildlife (OEH 2019) was undertaken prior to the site visit to determine threatened species previously recorded within 10km of the subject site.

The following notable habitat features were observed present:

- Recorded Koala habitat with notable use of larger Forest Red Gum and Grey Box trees in the gully areas,
- Large and significant habitat trees containing good quality large and medium hollows
- Summer, winter and spring nectar producing tree species, principally *Eucalyptus sp*
- Fruit producing fig trees
- Ephemeral deeply scoured drainage lines
- Dense mid and upper-storey foliage areas in the gully areas attributed to African Olive and Privet weed species,
- A small dam at low level and weed choked during survey

Additional fauna survey was undertaken by *Hayes Environmental* in 2021 across the development site and adjacent lands over a range of seasons, as set out in Table 1 below. Survey points are shown on Figure 8 above.

Table 1 *Fauna survey seasons, methods and effort.*

Date & Weather	Survey Methods & Effort
Development Site - Rebecca Hogan	
2021 - 29th March morning Warm (22°C), clear and sunny, with no wind. Heavy rainfall occurred through the week preceding the survey	3 hours (9:00-12:00) Habitat assessment, with a focus on identifying features and resources of potential value for candidate threatened fauna species. Assessment of hollow-bearing trees included consideration of occupancy, such as recent chew marks around the entrance, scratchings on the tree trunk, scats, feathers, birds roosting nearby or guarding the entrance, *etc.* Dedicated bird census (including aural detection of amphibians) within each of the BAM plots for a minimum period of 15 minutes, in addition to opportunistic records whilst carrying out BAM field assessment tasks. Census times 9:00-9:15am and 10:30-11:00am. Herpetofauna and snail searches in leaf litter at the base of trees, and beneath debris and refuse on the site.
Landholding - Travers Bushfire & Ecology	
2019 - 11th June morning Warm (16°C to 24°C), 2/8 cloud, with a light westerly wind. Conditions were dry	3.5 hours (13:45-17:15) Assessment of tree hollows. Snail habitat searches (including within the Development Site). Dedicated bird census (radius of 30-40m for a minimum of 15 minutes). 1 x Koala Spot Assessment Technique (SAT) – searching for 2m around the base of 30 trees (>10cm DBH) for scats indicating presence and then activity levels in accordance with Phillips & Callagahan (2008).
2019 - 11th June evening Mild (13°C to 16°C), 4/8 cloud, with no wind, half-moon. Conditions were dry	2 hrs 45mins (17:15-20:00) Spotlighting. Frog call identification; Ultrasonic call recording to target microchiropteran bats Call playback to target owls (Powerful Owl, Masked Owl & Barking Owl), Bush Stone-curlew, gliders (Yellow-bellied Glider & Squirrel Glider), and Koalas.
Landholding - Biolink	
2021 – 21st February	Koala Assessment in accordance with requirements of Campbelltown Comprehensive Koala Plan of Management (including 5 x SAT, Vegetation Assessment and Koala Activity Assessment) – see separate report (Biolink, 2021)

Date & Weather	Survey Methods & Effort
Adjacent land to south - Travers Bushfire & Ecology	
2019 - 18th March morning Warm (20°C), overcast, with a light southerly wind. There had been some rain preceding the survey	3.5 hours (14:50-18:20) Unspecified surveys
2019 - 18th March evening Warm (20°C), 7/8 cloud, with no wind	1.5 hours (19:00-20:00) Ultrasonic call recording to target microchiropteran bats Additional unspecified surveys.

4.2 Fauna survey limitations

Furthermore, detailed fauna survey is required within the study area before an effective assessment on threatened fauna species can be made in accordance with the *BC Act*. This future survey is to include:

- All habitat tree locations within the proposed subject site (proposed development area). Significant habitat tree locations within the study area – these being any large (30cm+) hollow-bearing trees, trees containing two or more medium (10-30cm) hollows and/or trees containing several small (<10cm) hollows. Significant habitat trees status may also be provided for a tree of threatened fauna species value, such as a high use Koala tree. Biolink has been engaged to undertake this work (September 2020).
- Microbat ultrasonic recording during warmer months (Oct-Mar). Recent March 2019 survey on the adjacent lot to the south has been incorporated to account for a separate season and reduce this limitation.
- Complete snail habitat searches.

4.3 Threatened fauna species

BC Act – A search on *Bionet* (OEH, 2019) provided a list of threatened fauna species previously recorded within a 10km radius of the subject site. These species are listed in Appendix Table A2.2 and are considered for potential habitat within the subject site.

FM Act – No habitats suitable for threatened aquatic species were observed within the subject site and as such the provisions of this act do not require any further consideration.

EPBC Act – A review of the schedules of the *EPBC Act* identified a list of threatened fauna species or species habitat likely to occur within a 10km radius of the subject site. These species have also been listed in Appendix Table A2.2.

In accordance with Table A2.2 the following state and nationally listed threatened fauna species are considered to have suitable habitat with varying potential to occur within the subject site. The state listed species will need to be considered in a test of significance.

Table 3 – Threatened fauna species with suitable habitat present

Common name	*BC Act*	*EPBC Act*	Potential to occur
Little Lorikeet	V	-	recorded
Koala	V	V	recorded
Grey-headed Flying-fox	V	V	recorded
Little Eagle	V	-	✓
Gang-gang Cockatoo	V	-	✓
Swift Parrot	E	E	✓
Powerful Owl	V	-	✓
Varied Sittella	V	-	✓
Dusky Woodswallow	V	-	✓
Yellow-bellied Sheathtail-bat	V	-	✓
East-coast Freetail Bat	V	-	✓
Large-eared Pied Bat	V	V	✓
Eastern Falsistrelle	V	-	✓
Little Bentwing-bat	V	-	✓
Eastern Bentwing-bat	V	-	✓
Large-footed Myotis	V	-	✓
Greater Broad-nosed Bat	V	-	✓
Cumberland Plain Land Snail	E	-	✓
White-bellied Sea Eagle	V	-	low
Scarlet Robin	V	-	low
Spotted Harrier	V	-	unlikely
Masked Owl	V	-	unlikely
Brown Treecreeper	V	-	unlikely
Speckled Warbler	V	-	unlikely
Regent Honeyeater	E4A	CE	unlikely
Black-chinned Honeyeater	V	-	unlikely
Hooded Robin	V	-	unlikely
Flame Robin	V	-	unlikely
Diamond Firetail	V	-	unlikely
Yellow-bellied Glider	V	-	unlikely
Squirrel Glider	V	-	unlikely
Greater Glider	-	V	unlikely

The recorded Koala will cause constraint to development. Any future survey recording of Little Lorikeet utilising hollows on site for nesting / roosting would also cause constraint to development. The Grey-headed Flying-fox will not constrain development.

4.4 Koala occupancy

Koala assessment of the site has been undertaken by *Biolink*.

Biolink was commissioned in early 2019 to review the draft Koala Management Plan prepared by *Travers bushfire & ecology* for Lot 2 and Lot 21.

They provided their advice in a letter dated 15th April 2019. They advised on Page 4 "*As part of a broader assessment across a network of east-west Strategic Linkage Areas (SLAs) located in the south-west corner of the CCC LGA, a field assessment using Rapid-SAT*

sampling protocols was previously conducted by us in vegetation communities identified as Potential koala habitat *in the KMP. As part of this assessment, no koala faecal pellets were recorded under eight forest red gums. This result is supported by faecal pellet searches in the same area by Corey Mead (Travers Ecology) (*pers. comm.*), whereby 25 eucalypts (including 19 x forest red gum) were searched, and again no scats were recorded".*

They concluded on page 6 that *"given the preceding reviews and available information, we generally agree with the premise preferred by the KMP that* Potential Koala Habitat *exists on site, and that there is little in the way of evidence to indicate the presence of* Core Koala Habitat *as defined by the SEPP 44. It also appears clear that connectivity values for koalas across the landscape are primarily concentrated in areas adjacent to the site (*e.g. *Menangle Creek riparian zone), rather than including the site itself".*

Note: Biolink letter (15th April 2019) provided at the end of this report.

Subsequent, to the initial advice by Biolink a further specialist report was commissioned.

Their subsequent report, *Compliance with the Campbelltown Comprehensive Koala Plan of Management (June 2021)* advised that the proposed development on Lot 21/1000643, Gilead) on the presence of Koala on site advised the aim of State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP44) is to support the conservation and management of areas of natural vegetation that provide habitat for koalas (*Phascolarctos cinereus*) across New South Wales (NSW), to ensure the persistence of a permanent free-living population across the species' range.

SEPP44 is a prescribed consideration under the NSW Environmental Planning and Assessment Act, 1979 (EP&A Act) for all Development Applications (DA) that may impact koalas or their habitat. A path to achieving this is through the preparation of Koala Plans of Management, either for an entire Local Government Area (LGA) – known as a Comprehensive Koala Plan of Management (CKPoM) - or some portion therein.

Campbelltown City Council (CCC) requires that developments seeking approval on lands which support native vegetation and / or are > 1 ha, be assessed for koala occupancy and habitat by following the guidelines in the approved Campbelltown CKPoM (Phillips 2018).

One way in which areas of native vegetation in the Campbelltown LGA are assessed for potential koala habitat is through the requirement for a Vegetation Assessment Report (VAR).

In areas of potential koala habitat, this standardises the habitat assessment process to ensure that best practices are applied to identify core koala habitat. Identification of core koala habitat further relies on the CKPoMs requirement for a Koala Activity Assessment Report (KAAR) to delineate areas of habitat that are contemporaneously occupied by resident koalas.

Through this process Council planners are provided with standardised data to inform the determination process for Development Applications (DA), among other matters. The Campbelltown CKPoM also identifies the location of Strategic Linkage Areas (SLA) – these being areas that support major movement corridors for koalas. Council cannot approve a DA that falls within a SLA unless it is satisfied that the proposal will not interfere with the movement of koalas

The Campbelltown Local Government Area (LGA) supports one of the last known koala (*Phascolarctos cinereus*) populations inhabiting the Sydney region. In accord with the stated goals of the State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP44),

the Campbelltown Comprehensive Koala Plan of Management (CKPoM) provides a strategic approach to the protection, management and restoration of koala habitat for the entire LGA. Compliance with the CKPoM therefore constitutes compliance with the provisions of SEPP44.

The Biolink report (June 2021) outlines the requirements for compliance with the Campbelltown CKPoM for a proposed development on Lot 21/1000643 and partial Lot 3/1007066 in Gilead, south west Campbelltown. These requirements include the preparation of a Vegetation Assessment Report (VAR), a Koala Activity Assessment Report (KAAR) and addressing the obligation for compensation and offsetting arising from the loss of Preferred Koala Food Trees (PKFTs).

Collectively, the outcomes of the VAR and KAAR indicate that Lot 21/1000643 supports a mix of core koala habitat (with contemporaneous koala occupancy) and potential koala habitat, as defined by the Campbelltown CKPoM.

The concept development footprint, as it is currently proposed, falls outside of core koala habitat and is situated entirely in potential koala habitat. Given its proximity to core koala habitat which is adjacently located within the same land parcel, as well as mapped to the south-east according the CKPoM, the proponent will need to follow development controls for core koala habitat, as it pertains to the retention of PKFTs, swimming pools, domestic dogs, fencing, road design and protection of koalas from disturbance. The most effective way of achieving this outcome is likely to be the enclaving of the proposed development.

Compensatory requirements arising from the loss of PKFTs, as mapped in the VAR, are intended to be met via a monetary contribution to the Koala Habitat Rehabilitation Program, as outlined in Part 7 of the CKPoM. Adhering to the measures set out in this document will be an effective means of establishing compliance of the proposed development with the Campbelltown CKPoM.

Other threatened fauna with most potential to occur

Further site fauna survey is required to satisfy minimum requirements. Of the non-recorded threatened species, the Cumberland Plain Land Snail is considered with most potential to occur. This species may be relocated from development areas only provided that suitable recipient areas are supported by DA approval. Such recipient areas would also need to have recorded presence. Most notably here is that the higher slopes are expected to provide most suitable habitat, if present. Searches in these areas thus far have concentrated in the east and northern portions.

The recording of other important habitat features for threatened fauna with potential to occur, and likely causing additional constraint to development, are currently not expected based on survey observations so far. Such habitat if found to be present include recorded nesting by Little Eagle, Gang-gang Cockatoo, Powerful Owl, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Eastern Falsistrelle and/or Greater Broad-nosed Bat.

4.4 Protected migratory species (National)

The EPBC Act Protected Matters Report provides additionally listed terrestrial, wetland and marine migratory species of national significance likely to occur, or with habitat for these species likely to occur, within a 10km radius of the subject site. The habitat potential of migratory species is considered in Table A2.3 (Appendix 2). The habitat potential of threatened migratory species is considered in Table A2.3 Table A2.2 (Appendix 2).

No nationally protected migratory bird species were recorded present within the study area during the preliminary survey. If found to be present and breeding within the vegetated gully areas only the Black-faced Monarch and Rufous Fantail may cause constraint in the areas. Otherwise protected migratory species protected under the *EPBC Act* and with potential to occur are not likely to cause constraint to development.

4.5 Endangered fauna populations

There are no endangered fauna populations within the Campbelltown LGA.

4.6 Connectivity

The intact vegetation within the study area is mostly confined to the gully areas which flow and connect with further vegetation assemblages in the west. The combined connectivity of gully, woodland and disturbed grassland habitats west of the suburb of Rosemeadow are connected via Menangle creek from the larger woodland habitat of Noorumba Reserve to the south-east, which then continues across Appin Road to more extensive open forest habitat along and beyond the Georges River (refer to Figure 7).

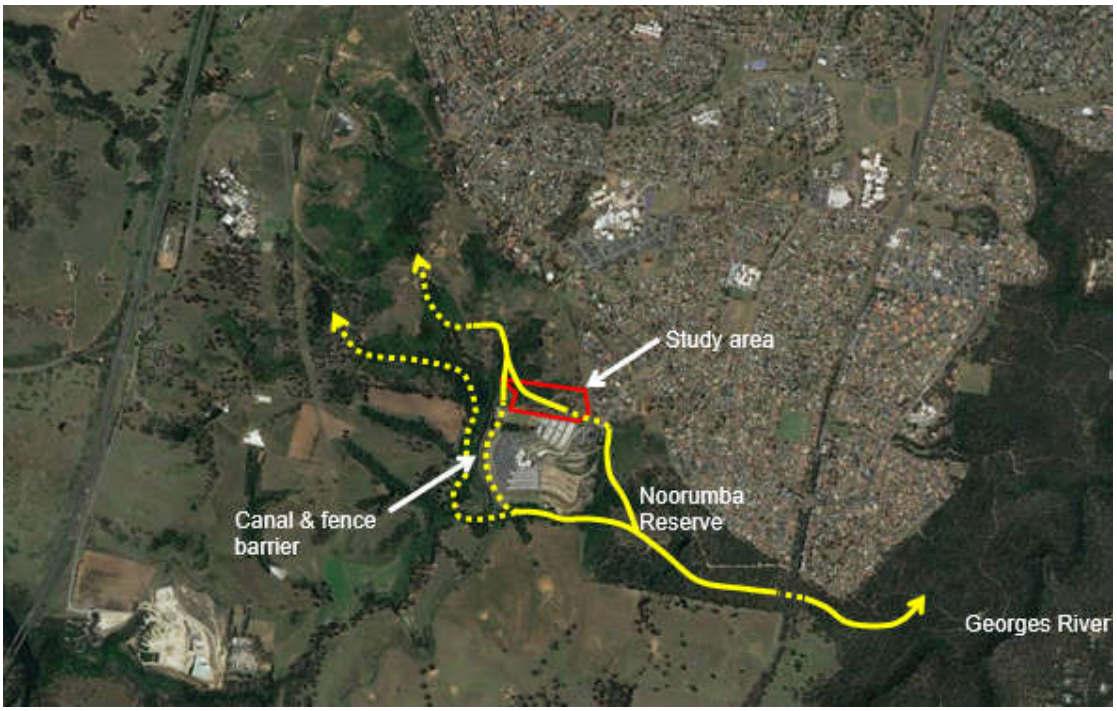

Figure 7 – Local connectivity

A review of local threatened species records and site survey results identifies local connectivity as being most valued for Koala movements, above all others. The recording of Koala activity within the study area now highlights the need to restore connectivity for Koala between these parcels.

Fencing along the western boundary of the retirement village combined with a constructed canal provide partial barriers to Koala movements directly to the west. There is a passage around this canal further north and further south. The northern passage is via the western portions of the study area and connects more directly to large habitats further to the north-west. These habitats form part of the Gilead Biodiversity Offset Site. The Hume Motorway

further west creates a barrier to any further westward movements and therefore the combined connective landscape for Koala incorporating the study area is nearing its end point.

Connectivity between the study area and Noorumba Reserve will be restored / enhanced by the planting of 50 trees on the western boundary and the revegetation of the Menangle creek zone in the south.

5.0 Watercourses and wetlands

5.1 Endangered wetland communities

A number of wetland communities have been listed as an 'endangered ecological community' under the NSW *BC Act*. We note that ‘wetlands’ are included in the definition of ‘waterfront lands’ in accordance with the *Water Management Act* (*WM Act*) 2000, due to their inclusion in the definition of a ‘lake’ under the same act.

Impacts on wetland communities must be assessed under the *BC Act* and if present the management of wetland communities must be given due consideration in accordance with the objectives and principles of management as contained within the NSW Wetlands Policy (2010), and appropriate management as determined by NSW DPI - Office of Water in their general terms of approval (GTAs). This may include but not limited to the provision of buffers, management of stormwater runoff and maintenance of natural inflows or runoff into those wetland communities.

- Artesian springs ecological community - endangered ecological community listing
- Castlereagh swamp woodland community - endangered ecological community listing
- Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing
- Kurri sand swamp woodland in the Sydney Basin Bioregion - endangered ecological community listing
- Lagunaria swamp forest on Lord Howe Island - endangered ecological community listing
- Maroota Sands swamp forest - endangered ecological community listing
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion - endangered ecological community listing
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological listing
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion - endangered ecological community listing
- The shorebird community occurring on the relict tidal delta sands at Taren Point - endangered ecological community listing
- Upland wetlands of the drainage divide of the New England Tableland Bioregion - endangered ecological community listing
- Wingecarribee Swamp - endangered ecological community listing

In accordance with the *WM Act*, endangered wetland communities are through the definition of ‘lakes’ potentially classed as waterfront land. Referral to DPI WaterNSW may be required

for determination under the *WM Act* as a controlled activity. As well as protection, a buffer may be applied to these communities as specified by DPI WaterNSW.

No endangered wetland communities were present within the subject site and therefore no referral is required.

5.2 Groundwater dependent ecosystems (GDEs)

Groundwater dependent ecosystems are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater. Groundwater Dependent Ecosystems (GDEs) were not observed within the subject site and therefore the policy does not require any further consideration. A referreal is not required.

5.3 Watercourse assessment

A geomorphic assessment was undertaken by *Strategic Environmental and Engineering Consulting* (Andrew Macleod) to determine the presence of natural drainage features within Lot 21. SEEC determined that there are no fluvial features in two of the mapped sections marked as 'blue lines' from the NSW Government (2020) Hydrolines portal, and so these are not 'watercourses' as understood by a fluvial geomorphologist. As noted in Section 3 of their assessment works within the sections from A to C and B to C, see Figure 8 below, do not require Controlled Activity Approval. (Their report is attached).

Figure 8 – Extract from fluvial report prepared by SEEC showing the two fluvial lines assessment i.e. C-A and C-B.

A plan showing the termination point of the water course as determined by *Strategic Environmental and Engineering Consulting* and prepared by surveyors *J.M Daley* is provided below in Figure 9.

Protected riparian buffers are to be placed 10m from top-of-bank (TOB) of the first order streams, and of 20m from the second-order stream TOB and are shown on Figure 9. Controlled activity approval is required under the *WM Act* for any controlled activity within these buffers.

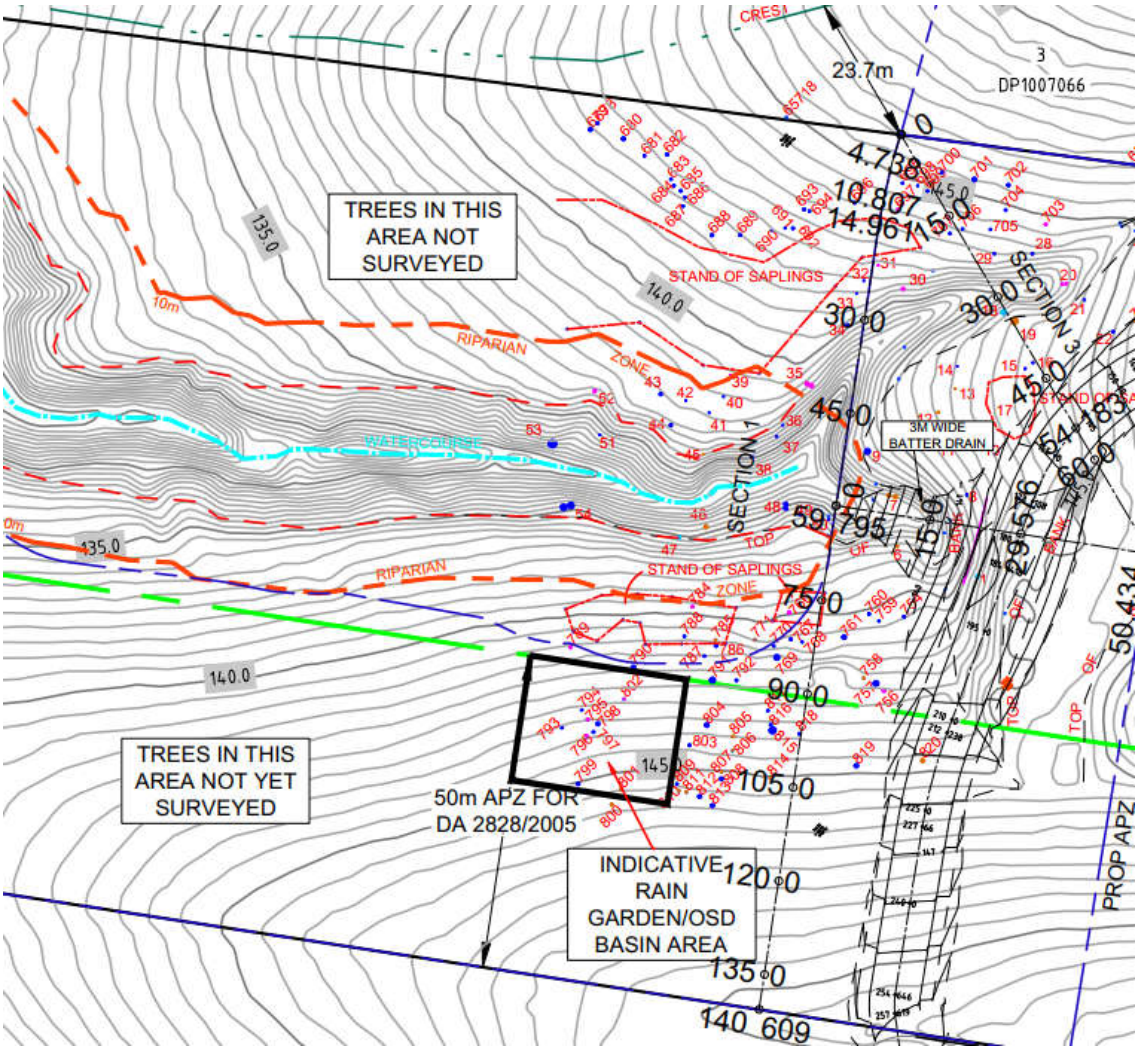

Figure 9 - location of the watercourse eastern termination point (blue line) as defined by *Strategic Environmental and Engineering Consulting* (Andrew Macleod)

6.0 Summary of recorded biota

Ecological survey and biodiversity constraints assessment has been undertaken by several ecologists, namely *Travers bushfire & ecology, Biolink* and *Hayes Environmental*. Their work occurred between 2019 and November 2021.

The surveys and assessments were undertaken in consideration to the *BC Act* through the relevant process outlined by the *EP&A Act*. The schedules and assessment criteria under the *EPBC Act* and the *FM Act* have also been considered.

No threatened flora species have been observed or likely due to the intensity of the weed permeation and the young revegetation stage of the CPW community.

Surveys undertaken by *Hayes Environmental* found no threatened plant species.

Fauna survey has recorded presence of three (3) threatened fauna species including Koala (*Phascolarctos cinereus*), Little Lorikeet (*Glossopsitta pusilla*) and Grey-headed Flying-fox (*Pteropus poliocephalus*).

It is the intention of the development to retain 1.72 ha of CPW as one contiguous patch in the western half of Lot 21.

7.0 Mitigation of Impact

The basis of mitigating impact has been to protect and conserve 1.72 ha of CPW, protect and conserve koala habitat and create linkage for CPW and Koala.

Hayes (2021) found that there are potential impacts on threatened species and their habitat in addition to, or instead of, impacts from clearing of vegetation, as set out in Clause 6 of the BC Reg – see Table 6.1.

Table 6.1 – Biodiversity Impacts

Prescribed Biodiversity Impact	Details
Impacts on threatened entities associated with karst, caves, crevices cliffs, rocks and other geological features of significance	No karst or rock features occur within the site would be indirectly affected by the proposal.
Impacts on the habitat of threatened entities associated with human made structures or non-native vegetation.	No human made structures occur within the site would be indirectly affected by the proposal. Areas of non-native vegetation would not be of value for any of the relevant threatened fauna species.
Impacts of on connectivity of habitat of threatened entities	The site comprises the degraded tip of a finger of native vegetation, beyond which is cleared land and suburban development. The site is not part of a movement corridor. The proposed development would not further isolate any area of habitat and would not impact upon connectivity of habitats for relevant threatened species.
Impacts on water quality, water bodies and hydrological processes that sustain threatened entities	An existing farm dam (surface area 530m2) would be filled as part of the proposed development. This foraging habitat for *Myotis macropus* would be lost. The dam is approximately 20m wide by 30m long and does not contain macrophytic vegetation nor evidence of a well-functioning ecosystem. It is not likely to be of particular or sole importance as a food resource for the Myotis. There are several larger dams within 100-200m to the north and south of the site, in addition to nearby creek lines and canals. Loss of the dam could cause local individuals of the bat to relocate their roosts closer to other water sources, but would not be likely to reduce the size or viability of a local population of the species. The proposed development could impact upon the quality of downstream hydrologies that support Cumberland Plain Woodland and other TECs, more-so during construction than during future occupation and use of the site. Temporary impacts associated with erosion and sedimentation during earthworks, and construction wastes, would be minimised through installation of standard sediment and pollution control features. Stormwater from the finished development would be directed into Council's existing stormwater management system and

	would be unlikely to impact upon TECs.
Impacts of wind turbine strikes on protected animals.	Not applicable.
Impacts of vehicle strikes on threatened fauna or fauna that are part of a TEC	Glendower Street, which provides access to the development, already passes through residential suburbs and services an existing retirement village beyond the site. The proposed development would provide a small incremental increase to traffic movements on this road. New internal roads within and around the development would be used by local site traffic only, with a speed limit of 40kph. Threatened species would not be anticipated to continue to use the site once developed. It is highly unlikely that the development would result in an increase in vehicle strikes on threatened species.

Biolink advised to contain core koala habitat following mapping of the insitu trees and their ID.

Their advice outlined the requirements for compliance with the Campbelltown CKPoM for a proposed development on Lot 21/1000643. These requirements include the preparation of a Vegetation Assessment Report (VAR), a Koala Activity Assessment Report (KAAR) and addressing the obligation for compensation and offsetting arising from the loss of Preferred Koala Food Trees (PKFTs).

Collectively, the outcomes of the VAR and KAAR indicate that Lot 21/1000643 supports a mix of core koala habitat (with contemporaneous koala occupancy) and potential koala habitat, as defined by the Campbelltown CKPoM.

The concept development footprint, as proposed, falls outside of core koala habitat and is situated entirely in potential koala habitat. Given its proximity to core koala habitat which is adjacently located within the same land parcel, as well as mapped to the south-east according the CKPoM, the proponent will need to follow development controls for core koala habitat, as it pertains to the retention of PKFTs, swimming pools, domestic dogs, fencing, road design and protection of koalas from disturbance. The most effective way of achieving this outcome is likely to be the enclaving of the proposed development.

Compensatory requirements arising from the loss of PKFTs, as mapped in the VAR, are intended to be met via a monetary contribution to the Koala Habitat Rehabilitation Program, as outlined in Part 7 of the CKPoM. Adhering to the measures set out in Biolink (2021) report, using their words, ‘will be an effective means of establishing compliance of the proposed development with the Campbelltown CKPoM’.

Native vegetation within the study area is commensurate with Cumberland Plain Woodland (CPW) which is listed within the NSW *BC Act* (2016) as a Critically Endangered Ecological Community (CEEC). It is also commensurate with Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest which is also listed within the the Commonwealth *EPBC Act* (1999) as a Critically Endangered Ecological Community (CEEC). Extensive weed mapping reveals the significant extent of African Olive within the CPW community.

Cumberland Plain Woodland is considered a potential SAII (*Reference - Guidance to assist a decision-maker to determine a serious and irreversible impact Office of Environment &*

Heritage - OEH 2017). OEH have not published any thresholds to determine what meets the criteria for determining an SAII.

7.1 Proposal to Minimise Impact

The advice herein, inclusive of Hayes and *Biolink*, is to retain the core koala habitat and the intact CPW parcel and the following measures are proposed to achieve those aspirations;

- The intact 1.72 ha vegetation parcel of CPW should be protected by a E2 zoning namely Environmental Conservation.

- A vegetation management plan should be prepared for the remnant CPW within Lot 2 and Lot 21 with a view that they provide a link to Noorumba Reserve (Lot 102 DP611552) in the east via compensatory plantings in the west of Lot 2 and revegetated lands along Menangle Creek in the south; and other reserves in the west and the north.

- As per the provisions of the CKPoM, and as advised by *Biolink*, monetary contributions be made to Council for the betterment of koala habitat via the Koala Habitat Rehabilitation Program.

- Future landscaping should utilise species drawn from Cumberland Plain Woodland including shrubs and ground covers to encourage local fauna use, to consolidate remnant vegetation linkage for native flora and fauna species within the locality.

- The non-contiguous CPW trees, where lost, should be offset as required by the Biodiversity Conservation Act.

- Control and eradication of invasive ecological weeds should be undertaken to prevent further invasion by these species. Invasive species such as African Olive, Lantana and Small-leaved Privet.

7.2 Biodiversity Conservation Act

The Biodiversity Offsets Scheme (BOS) and The Regulation (2017) and Biodiversity Assessment Method (2017) came into force under the *BC Act* on the 25th of August, 2017. There are two (2) elements to the threshold test – an area trigger and a Sensitive Biodiversity Values Land Map trigger. If clearing exceeds either trigger, the BOS applies to the proposed clearing.

- Biodiversity Values Land has been mapped within the study area. Clearing of native vegetation within the mapped biodiversity values land triggers this threshold and will require a biodiversity offset to be obtained.

- The threshold for clearing above which the BAM and offsets scheme apply is 0.5ha or more. Any future development proposal impacting 0.5ha or more will require offsetting.

Any future development proposal will need to be assessed in accordance with the Significance of Impact Test of the *BC Act* to determine if the proposal constitutes a significant impact upon threatened species, endangered populations or threatened ecological communities.

As Koala is listed under the *EPBC Act* and potential habitat impacts of development, a referral to the *Commonwealth Department of Agriculture, Water and the Environment (DAWE)* would likely be required in respect to this species.

Candidate SAII entities recorded or with potential to occur within the study area include:

- Cumberland Plain Woodland
- Eastern Bentwing-bat
- Little Bentwing-bat
- Large-eared Pied Bat
- Swift Parrot
- Regent Honeyeater

Impacts on Cumberland Plain Woodland (CPW) are considered as a potential SAII as Cumberland Plain Woodland meets two (2) of the four (4) principles for nomination as a potential SAII. Therefore, for any future impact on CPW, a biodiversity assessment of the additional impact assessment provisions for SAII entities will need to be completed in accordance with Section 10.2.3 of the Biodiversity Assessment Method (BAM 2017).

None of the above listed candidate fauna species have been recorded during surveys to date and the Regent Honeyeater is only considered with an unlikely potential to occur. There is no breeding habitat (caves) present for these select microbat species and the site is not likely to provide important foraging for the migratory Swift Parrot or Regent Honeyeater. Therefore, any future development within the study area is not considered to constitute an SAII on the above listed fauna species.

Appendix 1
Flora Species List

Table A1.1 – Flora species recorded

Family	Scientific name	Common name
TREES		
Fabaceae	*Acacia parramattensis*	Sydney Green Wattle
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark
Myrtaceae	*Eucalyptus fibrosa*	Broad Leaved Ironbark
Myrtaceae	*Eucalyptus moluccana*	Grey Box
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Moraceae	*Ficus rubiginosa*	Port Jackson Fig
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive
Anacardiaceae	*Schinus molle**	Pepper Tree
SHRUBS		
Fabaceae	*Acacia implexa*	Hickory Wattle
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet
Oleaceae	*Ligustrum sinense**	Small-leaved Privet
Solanaceae	*Lycium ferocissimum**	African Boxthorn
Rosaceae	*Rubus fruticosus* sp. agg.*	Blackberry complex
GROUNDCOVERS		
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
Asphodelaceae	*Aloe striatula**	
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed
Primulaceae	*Anagallis arvensis**	Scarlet Pimpernel
Poaceae	*Aristida ramosa*	Purple Wiregrass
Rubiaceae	*Asperula conferta*	Common Woodruff
Poaceae	*Rytidosperma fulvum*	Wallaby Grass
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Poaceae	*Bothriochloa macra*	Red Grass
Acanthaceae	*Brunoniella australis*	Blue Trumpet
Convolvulaceae	*Calystegia sepium*	
Cyperaceae	*Carex inversa*	Knob Sedge
Apiaceae	*Centella asiatica*	Swamp Pennywort
Adiantaceae	*Cheilanthes sieberi*	Rock Fern
Poaceae	*Chloris ventricosa*	Tall Chloris
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza bonariensis**	Flax-leaf Fleabane
Poaceae	*Cymbopogon refractus*	Barbwire Grass
Poaceae	*Cynodon dactylon*	Common Couch
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Cyperaceae	*Cyperus gracilis*	Slender Flat Sedge
Convolvulaceae	*Dichondra repens*	Kidney Weed
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Chenopodiaceae	*Einadia polygonoides*	-
Chenopodiaceae	*Einadia trigonos*	Fishweed
Poaceae	*Eragrostis curvula**	African Lovegrass
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass
Geraniaceae	*Geranium homeanum*	Northern Cranesbill

Family	Scientific name	Common name
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort
Juncaceae	*Juncus usitatus*	Common Rush
Asteraceae	*Lagenophora stipitata*	-
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush
Poaceae	*Microlaena stipoides*	Weeping Grass
Poaceae	*Oplismenus imbecillis*	-
Cactaceae	*Opuntia aurantiaca**	Tiger Pear
Oxalidaceae	*Oxalis perennans*	Yellow-flowered Wood Sorrel
Poaceae	*Panicum* sp.	-
Poaceae	*Paspalum dilatatum**	Paspalum
Sinopteridaceae	*Pellaea falcata*	Sickle Fern
Poaceae	*Cenchrus clandestinus**	Kikuyu, Kikuyu Grass
Poaceae	*Phalaris* sp.*	
Plantaginaceae	*Plantago lanceolata**	Ribwort
Lamiaceae	*Plectranthus parviflorus*	Cockspur Flower
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria parviflora**	
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Solanaceae	*Solanum pseudocapsicum**	Jerusalem Cherry
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Poaceae	*Sporobolus elongatus*	Slender Rat's Tail Grass
Poaceae	*Themeda triandra*	Kangaroo Grass
Verbenaceae	*Verbena bonariensis**	Purpletop
VINES		
Asclepiadaceae	*Araujia sericifera**	Mothvine
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper
Ranunculaceae	*Clematis aristata*	Old Man's Beard
Fabaceae/faboideae	*Desmodium varians*	Slender Tick-trefoil
Fabaceae/faboideae	*Glycine tabacina*	Twining Glycine
Fabaceae/faboideae	*Kennedia rubicunda*	Dusky Coral Pea
Bignoniaceae	*Pandorea pandorana*	Wonga Vine
AQUATIC / SEMI-AQUATIC		
Onagraceae	*Ludwigia peploides* subsp. *montevidensis*	Water Primrose
Cyperaceae	*Machaerina articulata*	Jointed Twig-Rush
Poaceae	*Paspalum distichum*	Water Couch
* denotes exotic species TS denotes threatened species		

It should be noted that not all garden, cultivar or landscape species have been identified as part of this assessment.

Table A1.2 – Fauna species recorded

Common name	Scientific name	Method observed	
Birds		March 19	June 19
Australasian Grebe	*Tachybaptus novaehollandiae*	✓	
Australian King Parrot	*Alisterus scapularis*		W
Australian Magpie	*Cracticus tibicen*		O
Australian Raven	*Corvus coronoides*	✓	O W
Bar-shouldered dove	*Geopelia humeralis*		O
Bell Miner	*Manorina melanophrys*	✓	W
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		W
Brown Thornbill	*Acanthiza pusilla*		W
Common Myna *	*Sturnus tristis*	✓	
Eastern Rosella	*Platycercus eximius*	✓	
Fairy Martin	*Hirundo ariel*	✓	
Galah	*Eolophus roseicapillus*		O W
Grey Butcherbird	*Cracticus torquatus*	✓	O W
Lewin's Honeyeater	*Meliphaga lewinii*		W
Little Lorikeet TS	*Glossopsitta pusilla*		O W
Magpie-lark	*Grallina cyanoleuca*	✓	O
Masked Lapwing	*Vanellus miles*	✓	O W
Musk Lorikeet	*Glossopsitta concinna*	✓	W
Noisy Miner	*Manorina melanocephala*	✓	O W
Pied Butcherbird	*Cracticus nigrogularis*	✓	
Pied Currawong	*Strepera graculina*	✓	W
Purple Swamphen	*Porphyrio porphyrio*	✓	
Rainbow Lorikeet	*Trichoglossus haematodus*		O W
Red Wattlebird	*Anthochaera carunculata*		O W
Spotted Pardalote	*Pardalotus punctatus*		W
Spotted Turtle-Dove *	*Streptopelia chinensis*		W
Sulphur Crested Cockatoo	*Cacatua galerita*		W
Welcome Swallow	*Hirundo neoxena*	✓	
Willie Wagtail	*Rhipidura leucophrys*	✓	
Yellow-faced Honeyeater	*Caligavis chrysops*		W
Mammals			
Domesticated Dog *	*Canis lupus familiaris*		O
Eastern Freetail-bat	*Mormopterus ridei*	✓	U PR
European Red Fox *	*Vulpes vulpes*	✓	P
Gould's Wattled Bat	*Chalinolobus gouldii*	✓	U
Grey-headed Flying-fox TS	*Pteropus poliocephalus*	✓	
Koala TS	*Phascolarctos cinereus*		O
Forest Bat	*Vespadelus sp.*		U
Little Forest Bat	*Vespadelus vulturnus*		
Rabbit *	*Oryctolagus cuniculus*		P
Tawny frogmouth	*Podargus strigoides*		O
Wambat	*Vombatidae*		FB P

Common name	Scientific name	Method observed	
Reptiles			
Cream-striped Shining Skink	*Cryptoblepharus virgatus*	✓	
Delicate Skink	*Lampropholis delicata*	✓	
Eastern Water Skink	*Eulamprus quoyii*	✓	
Amphibians			
Common Eastern Froglet	*Crinia signifera*	✓	W
Dwarf Tree Frog	*Litoria fallax*	✓	
Striped Marsh Frog	*Limnodynastes peronii*		O
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	✓	
Whistling Tree Frog	*Litoria verreauxii*	✓	W
Mollusc			
Brown Garden Snail *	*Cornu aspersum*		O
Invertebrates			
Monarch butterfly	*Danaus plexippus*		O

Note: * indicates introduced species
TS indicates threatened species
MS indicates Migratory species

All species listed are identified to a high level of certainty unless otherwise noted as:

PR indicates species identified to a 'probable' level of certainty – more likely than not
PO indicates species identified to a 'possible' level of certainty – low-moderate level of confidence

E - Nest/roost	H - Hair/feathers/skin	P - Scat	W - Heard call
F - Tracks/scratchings	K - Dead	Q - Camera	X - In scat
FB - Burrow	O - Observed	T - Trapped/netted	Y - Bone/teeth/shell
G - Crushed cones	OW - Obs & heard call	U - Anabat/ultrasound	Z - In raptor/owl pellet

Appendix 2
Threatened Flora and Fauna Species Habitat Assessment

Table A2.1 – Threatened flora species habitat assessment

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements *Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Further assessment required (✓)**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Acacia bynoeana OEH EPBC	E1	V	Erect or spreading shrub to 0.3m high growing in heath and dry sclerophyll open forest on sandy soils. Often associated with disturbed areas such as roadsides. *Distribution limits N-Newcastle S-Berrima.*	x	x	-	-	x	x
Acacia pubescens OEH EPBC	V	V	Spreading shrub 1-4m high open sclerophyll growing in open forest and woodlands on clay soils. *Distribution limits N-Bilpin S-Georges River.*	x	✓	7km ENE	2008	not likely	x
Allocasuarina glareicola EPBC	E1	E	Small shrub 1-2m high growing in open sclerophyll forest on lateritic soils derived from tertiary alluviums. *Distribution limits Castlereagh NR region.*	x	x	-	-	x	x
Astrotricha crassifolia EPBC	V	V	Shrub to 2.4m high. Grows in dry sclerophyll woodland on sandstone. *Distribution limits N-Patonga S-Royal NP.*	x	x	-	-	x	x
Caladenia tessellata EPBC	E1	V	Terrestrial orchid. Clay-loam or sandy soils. LHCCREMS guidelines suggest the species grows in Map Unit 34 – Coastal Sand Wallum Woodland - Heath. Flowers in September – November. *Distribution limits N-Swansea S-south of Eden.*	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements *Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Further assessment required (✓)**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Callistemon linearifolius OEH	V	-	Shrub to 4m high. Dry sclerophyll forest on coast and adjacent ranges. *Distribution limits N-Nelson Bay S-Georges River.*	x	x	-	-	x	x
Cryptostylis hunteriana EPBC	V	V	Saprophytic orchid. Grows in swamp heath on sandy soils. *Distribution limits N-Gibraltar Range S-south of Eden.*	x	x	-	-	x	x
Cynanchum elegans OEH EPBC	E1	E	Climber or twiner to 1m. Grows in rainforest gullies, scrub & scree slopes. *Distribution limits N-Gloucester S-Wollongong.*	x	marginal	x	x	x	x
Eucalyptus benthamii OEH EPBC	V	V	Blue gum to 40m high. Wet forest on sandy alluvial soils. *Distribution limits N-Yarramundi S-Bents Basin.*	x	x	-	-	x	x
Eucalyptus nicholii OEH	V	-	This species is widely planted as an urban street tree and in gardens but is quite rare in the wild. *It is confined to the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield, largely on private property.*	x	x	-	-	x	x
Eucalyptus scoparia OEH	E1	V	Smooth-barked tree only known from vicinity of Bald Rock.	x	x	-	-	x	x
Genoplesium baueri OEH EPBC	E1	E	A terrestrial orchid that grows in sparse sclerophyll forest and moss gardens over sandstone. Flowers Feb–Mar. *Distribution limits N – Hunter Valley S – Nowra.*	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements *Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Further assessment required (✓)**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Grevillea parviflora subsp. *parviflora* OEH EPBC	V	V	Open to erect shrub to 1m. Grows in woodland on light clayey soils. *Distribution limits N-Cessnock S-Appin.*	x	x	-	-	x	x
Gyrostemon thesioides OEH	E1	-	Multi-stemmed shrub to 70cm. Grows on hillsides and riverbanks. *Confined to Georges and Nepean Rivers and believed extinct.*	x	x	-	-	x	x
Haloragis exalata subsp. *exalata* EPBC	V	V	Shrub to 1.5m high. Grows in damp places near watercourses. *Distribution limits N-Tweed Heads S-south of Eden.*	x	x	-	-	x	x
Hibbertia puberula OEH	E1	-	Shrublets with branches up to 30cm long. It favours dry sclerophyll woodland or low heath on sandy soils or rarely in clay, with or without rocks underneath. *It extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. Early records are from Hawkesbury River area in Sydney and the Blue Mountains.*	x	x	-	-	x	x
Leucopogon exolasius OEH EPBC	V	V	Erect shrub to 2m high. Rocky hillsides and creek banks in Sydney Sandstone Gully Forest. Confined to Woronora and Georges Rivers and Stokes Creek.	x	x	-	-	x	x
Leucopogon fletcheri subsp. *fletcheri* OEH	E1	-	Shrub to 1.8m high growing in woodland on lateritic soils. Distribution limits N-St Albans S-Springwood.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements *Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Further assessment required (✓)**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Melaleuca deanei OEH EPBC	V	V	Shrub to 3m high. Grows in heath on sandstone. *Distribution limits N-Gosford S-Nowra.*	x	x	-	-	x	x
Persoonia bargoensis OEH EPBC	E1	V	Erect shrub to 1m high. Grows in woodland to Dry sclerophyll forest, on sandstone and laterite. *Restricted to the Bargo area.*	x	x	-	-	x	x
Persoonia hirsuta OEH EPBC	E1	E	Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. *Distribution limits N-Glen Davis S-Hill Top.*	x	x	-	-	x	x
Persoonia nutans EPBC	E1	E	Erect to spreading shrub. Grows in dry sclerophyll forest and woodland on laterite and alluvial sands. *Distribution limits Cumberland Plain.*	x	x	-	-	x	x
Pimelea curviflora var. *curviflora* EPBC	V	V	Woody herb or sub-shrub to 0.2-1.2m high. Grows on Hawkesbury Sandstone near shale outcrops. *Distribution Sydney.*	x	x	-	-	x	x
Pimelea spicata OEH EPBC	E1	E	Decumbent or erect shrub to 0.5m high. Occurs principally in woodland on soils derived from Wianamatta Shales. *Distribution limits N-Lansdowne S-Shellharbour.*	x	✓	2.5km NE	2018	✓	✓

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements *Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Further assessment required (✓)**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Pomaderris adnata OEH	E1	-	*Occurs near the edge of the plateau behind the Illawarra escarpment.* Associated vegetation is *Eucalyptus sieberi* (Silver-top Ash) - *Corymbia gummifera* (Red Bloodwood) forest with occasional *Hakea salicifolia* (Willow-leaved Hakea). Soil is a sandy loam over sandstone. Flowers in late September although buds are present on the plant for many months before the flowers open. Fruit matures in November - December. Estimated longevity of 10 to 25 years. Killed by fire	x	x	-	-	x	x
Pomaderris brunnea OEH EPBC	V	V	Shrub to 3m high. *Confined to Upper Nepean and Colo Rivers where it grows in open forest.*	x	x	-	-	x	x
Pterostylis saxicola OEH EPBC	E1	E	Terrestrial orchid. Grows in shallow sandy soil above rock shelves, usually near Wianamatta / Hawkesbury transition. *Distribution limits N-Hawkesbury River S-Campbelltown.*	x	marginal	4km SW	2018	unlikely	✓

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements *Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Further assessment required (✓)**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Pultenaea aristata OEH EPBC	V	V	A small shrub, mostly 20-40cm tall. *Restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Kiera above Wollongong.* Occurs in either dry sclerophyll woodland or wet heath on sandstone. Flowers in winter and spring.	x	x	-	-	x	x
Pultenaea pedunculata OEH	E1	-	Prostrate shrub. Grows in dry sclerophyll forest and disturbed sites. *Confined to Prestons and Villawood in NSW.*	x	✓	5km SW	2015	low	✓
Syzygium paniculatum OEH EPBC	V	V	Small tree. Subtropical and littoral rainforest on sandy soil. *Distribution limits N-Forster S-Jervis Bay.*	x	x	-	-	x	x
Thesium australe OEH EPBC	V	V	Erect herb to 0.4m high. Root parasite. Themeda grassland or woodland often damp. *Distribution limits N-Tweed Heads S-south of Eden.*	x	marginal	6km ENE	1803	not likely	x

OEH	- Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife*
EPBC	- Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search
V	- Denotes vulnerable listed species under the relevant Act
E or E1	- Denotes endangered listed species under the relevant Act
E4A or CE	- Denotes critically endangered listed species under the relevant Act
NOTE:	. This field is not considered if no suitable habitat is present within the subject site . 'records' refer to those provided by the *Atlas of NSW Wildlife* . 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle

.

Table A2.2 – Threatened fauna species habitat assessment

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Giant Burrowi Fr *Heleiopor australiac* OEH EP	V	V	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. *Distribution limit: N-Near Singleton S-South of Eden.*	x	x	-	-	x	x
Red-crown Toad *Pseudophry austra* C	V	-	Prefers sandstone areas, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non-breeding periods. *Distribution limit: N-Pokolbin. S-near Wollongong.*	x	x	-	-	x	x
Green a Golden B Fr *Litoria aur* OEH EP	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. *Distribution limit: N-Byron Bay S-South of Eden.*	x	Sub-optimal	x	✓	Not likely	x

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Littlejohn's Tr Fr *Litoria littlejoh* OEH EP	V	V	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1,000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. *Distribution limit: N-Hunter River S-Eden.*	x	x	-	-	x	x
Rosenberg Goan *Varan rosenbe* C	V	-	Hawkesbury sandstone outcrop specialist. Inhabits woodlands, dry open forests and heathland sheltering in burrows, hollow logs, rock crevices and outcrops. *Distribution limit: N-Nr Broke. S-Nowra Located in scattered patches near Sydney, Nowra and Goulburn.*	x	x	-	-	x	x
Broad-head Sna *Hoplocephal bungaroid* OEH EP	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. *Distribution limit: N-Mudgee Park. S-Nowra.*	x	x	-	-	x	x

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Blue-billed Du *Oxyura austra* C	V	-	A completely aquatic species occurring mainly throughout the Murray-Darling basin in cool to warm temperate deep permanent freshwater lakes, lagoons and swamps with extensive reed-beds. *Distribution limit: N-Tenterfield. S-Albury.*	x	x	-	-	x	x
Freckled Du *Stictone naevo* C	V	-	Occurs mainly within the Murray-Darling basin and the channel country within large cool temperate to sub-tropical swamps, lakes and floodwaters with cumbungi, lignum or melaleucas. *Distribution limit: N- Tenterfield. S-Albury.*	x	x	-	-	x	x
Black-neck Sto *Ephippiorhyn us asiatic* C	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. *Distribution limit: N-Tweed Heads. S-Nowra.*	x	margin al	✓	x	Not likely	x

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Australasi Bitte *Botaur poiciloptil* EP	E	E	Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, brackish wetlands. *Distribution limit: N-North of Lismore. S- Eden.*	x	x	-	-	x	x
Spotted Harri *Circus assimi* C	V	-	Utilises grassy plains, crops and stubblefields; saltbush, spinifex associations; scrublands, mallee, heathlands; open grassy woodlands. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	✓	✓	x	Unlikely	✓
White-belli Sea Eag (*Haliaeet leucogaste* C	V	-	Occupies coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs. *Sedentary; dispersive. N-Tweed Heads. S-South of Eden.*	x	margin al	✓	✓	low	✓
Little Eag *Hieraaet morphnoid* C	V	-	Utilises plains, foothills, open forests, woodlands and scrublands; river red gums on watercourses and lakes. *Distribution limit - N-Tweed Heads. S-South of Eden.*	x	✓	✓	✓	✓	✓

Common nam *Scientifi nam* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Black Falc *Falco subnig* C	V	-	Inhabits plains, grasslands, foothills, timbered watercourses, wetland environs, crops; occasionally over towns and cities. *N-Tweed Heads. S-South of Eden*	x	Sub-optimal	x	x	Not likely	x
Gang-ga Cockat *Callocephal fimbriatu* C	V	-	Prefers wetter forests and woodlands from sea level to > 2,000m on the Great Dividing Range, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. *Distribution limit: mid north coast of NSW to western Victoria.*	x	✓	✓	✓	✓	✓
Glossy Blac Cockat *Calyptorhync s latha* C	V	-	Open forests with *Allocasuarina* species and hollows for nesting. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	margin al	✓	✓	Not likely	x
Little Lorike *Glossopsi pusi* C	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. *Distribution limit: N-Tweed Heads. S-South of Eden.*	✓	-	-	-	-	✓

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Swift Parı *Latham discolo* OEH EP	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	✓	✓	✓	✓	✓
Turquoi Parı *Neopher pulche* C	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. *Distribution limit: N-Near Tenterfield. S-South of Eden.*	x	✓	x	x	Not likely	x
Eastern Grou Parı *Pezopor wallic wallic* C	V	-	Inhabits low heath, sedgeland and buttongrass plains with dense vegetation to provide suitable roosting cover. *Distribution limit: N-North of Tweed Heads. S-South of Eden.*	x	x	-	-	x	x
Powerful O *Ninox stren* C	V	-	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. *Distribution limits: N-Border Ranges National Park. S-Eden.*	x	✓	✓	✓	✓	✓

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Masked O *Ty novaehollandi* C	V	-	Open forest and woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. *Distribution limit: N-Border Ranges National Park. S-Eden.*	x	✓	✓	x	unlikely	✓
Brov Treecreep *Climacte picumn victori* C	V	-	Occupies eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. *Distribution limit: (Sub species victoriae) Central NSW west of Great Div. Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.*	x	✓	✓	x	unlikely	✓
Easte Bristlebi *Dasyorn brachypter* OEH EP	E	E	Coastal woodlands, dense scrubs and heathlands, especially where low heathland borders taller woodland or dense tall tea-tree. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	x	-	-	x	x

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**To be Considered in assessment of significance test**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Speckl Warbl *Chthonicc sagitta* C	V	-	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution limit: N-Urbanville. S-Eden.*	x	✓	x	✓	unlikely	✓
Rege Honeyeat *Xanthomy Phryg* OEH EP	E4A	CE	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution limit: N-Urbanville. S-Eden.*	x	✓	✓	x	unlikely	✓
Black-chinn Honeyeat *Melithrept gularis gula* C	V	-	Found in woodlands containing box-ironbark associations and River Red Gums, also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence. *Distribution limit: N-Cape York Pen. Qld. S-Victor H. Mt Lofty Ra & Flinders Ra. SA.*	x	✓	x	x	unlikely	✓

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Varied Sitte *Daphoenosi chrysopte* C	V	-	Open eucalypt woodlands / forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golf courses, shelterbelts, orchards, parks, scrubby gardens. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	✓	✓	✓	✓	✓
Dus Woodswallo *Artam cyanopter cyanopter* C	V	-	Found in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. Prefers habitat with an open understorey. Often observed in farmland tree patches or roadside remnants. *Widespread in eastern, southern and south-western Australia.*	x	✓	✓	✓	✓	✓

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Hooded Rob *Melanodry cucullа cucullа* C	V	-	Found in eucalypt woodlands, *Acacia* scrubland, open forest, and open areas adjoining large woodland blocks, with areas of dead timber. *Distribution limit: N-Central Qld. S-Spencer Gulf SA.*	x	✓	x	x	unlikely	✓
Scarlet Rob *Petroi booda* C	V	-	Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum woodlands, golf courses, parks, orchards, gardens. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	✓	x	✓	low	✓
Flame Rob *Petroi phoenic* C	V	-	Summer: forests, woodlands, scrubs, from sea-level to *c.* 1800 m. Autumn-winter: open woodlands, plains, paddocks, golf courses, parks, orchards. *Distribution limit: N northern NSW tablelands. S-South of Eden.*	x	✓	x	x	unlikely	✓

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Diamon Firet *Stagonopleu gutta* C	V	-	Found in eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. *Distribution limit: N-Rockhampton Q. S-Eyre Pen Kangaroo Is. SA.*	x	✓	x	x	unlikely	✓
Spotted-tail Qu *Dasyur maculat* OEH EP	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. *Distribution limit: N-Mt Warning National Park. S-South of Eden.*	x	Sub-optimal	x	x	Not likely	x
Southern Brov Bandicc *Isood obesul* OEH EP	E	E	Utilises a range of habitats containing thick ground cover - open forest, woodland, heath, cleared land, urbanised areas and regenerating bushland. *Distribution limit: N-Kempsey. S-South of Eden.*	x	x	-	-	x	x
Koa *Phascolarct cinere* OEH EP	V	V	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. *Distribution limit: N-Tweed Heads. S-South of Eden.*	✓	-	-	-	-	✓

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Eastern Pygr Possu *Cercatet nan* C	V	-	Found in a variety of habitats from rainforest through open forest to heath. Feeds on insects but also gathers pollen from banksias, eucalypts and bottlebrushes. Nests in banksias and myrtaceous shrubs. *Distribution limit: N-Tweed Heads. S-Eden.*	x	x	-	-	x	x
Yellow-belli Glid *Petaur austra* C	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	Sub-optimal	x	✓	unlikely	✓
Squirrel Glid *Petaur norfolcens* C	V	-	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. *Distribution limit: N-Tweed Heads. S-Albury.*	x	Sub-optimal	x	x	unlikely	✓

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Greater Glid *Petauroid vola* EP	-	V	Favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. Population density is optimal at elevation levels at 845 m above sea level. Prefer overstorey basal areas in old-growth tree stands. Highest abundance typically in taller, montane, moist eucalypt forests, with relatively old trees and abundant hollows *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	Sub-optimal	x	x	unlikely	✓
Grey-head Flying-f *Pterop poliocephal* OEH EP	V	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. *Distribution limit: N-Tweed Heads. S-Eden.*	x	✓	✓	✓	✓	✓

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Yellow-belli Sheathtail-b *Saccolaim flavivent* C	V	-	Rainforests, sclerophyll forests and woodlands. *Distribution limit: N-North of Walgett. S-Sydney.*	x	✓	✓	✓	✓	✓
East-coa Freetail B *Micronom norfolkens* C	V	-	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. *Distribution limit: N-Woodenbong. S-Pambula.*	x	✓	✓	✓	✓	✓
Large-ear Pied B *Chalinolob dwy* OEH EP	V	V	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. *Distribution limit: N-Border Ranges National Park. S-Wollongong.*	x	✓	✓	✓	✓	✓
Easte Falsistre *Falsistrell tasmanien* C	V	-	Recorded roosting in caves, old buildings and tree hollows. *Distribution limit: N-Border Ranges National Park. S-Pambula.*	x	✓	✓	✓	✓	✓

Common nam *Scientifi nam* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Golden-tipp B *Kerivou papuens* C	V	-	Rainforest and adjoining moist open forest habitats, roosting in tree hollows and dense vegetation. *Distribution limit: N-Border Ranges Nation Park. S-South of Eden.*	x	x	-	-	x	x
Little Bentwin b *Miniopter austra* C	V	-	Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. *Distribution limit: N-Border Ranges National Park. S-Sydney.*	x	✓	✓	✓	✓	✓
Easte Bentwing-b *Miniopter orian oceanens* C	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains and well-timbered areas. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	✓	✓	✓	✓	✓
Large-foot Myo *Myo macrop* C	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	✓	✓	✓	✓	✓

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Greater Broa nosed B *Scotean rueppe* C	V	-	Inhabits areas containing moist river and creek systems, especially tree lined creeks. *Distribution limit: N-Border Ranges National Park. S-Pambula.*	x	✓	✓	✓	✓	✓
Cumberla Plain Land Sn *Meridolu corneovire* C	E	-	Inhabits remnant eucalypt woodland of the Cumberland Plan. Shelters under logs, debris, clumps of grass, around base of trees and burrowing into loose soil. *Distribution limit: Cumberland Plain of Sydney Basin Bioregion.*	x	✓	✓	✓	✓	✓

	- Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildl*
	- Denotes species listed within 10km of the subject site in the *EPBC Act* habitat sear
	- Denotes vulnerable listed species under the relevant A
	- Denotes endangered listed species under the relevant A
	- Denotes critically endangered listed species under the relevant A
	1. 1. This field is not considered if no suitable habitat is present within the subject s 2. 2. 'records' refer to those provided by the *Atlas of NSW Wildl* 3. 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cyc

Common nan *Scientifi nan* Database sou	*BC Act*	*EPBC Act*	Preferred habitat *Distribution limit*	Recorded on site (✓)	If not recorded on site				To be Considered in assessment of significance test
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
	4. Represents such a low margin but not enough to 100% rule it one. A significance of impact test is require								
	5. Means 0% change of occurring, despite there being potential habitat. A significance of impact test is not applied these specie								

A detailed assessment in accordance with Section 1.7 of the *EP&A Act* will need to be completed.

Table A2.3 provides an assessment of potential habitat within the subject site for nationally *protected* migratory fauna species recorded within 10 km on the *EPBC Act* Protected Matters Tool. Nationally *threatened* migratory species are considered in Table A2.3.

Table A2.3 – Migratory fauna habitat assessment

Common name ***Scientific name***	**Preferred habitat** ***Migratory breeding***	**Suitable habitat present (✓)**	**Recorded (✓)**	**Comments on potential impacts**
Oriental or Horsfield's Cuckoo (*Cuculus optatus*)	It mainly inhabits forests, occurring in coniferous, deciduous and mixed forest. It feeds mainly on insects and their larvae, foraging for them in trees and bushes as well as on the ground.	✓	x	-
White-throated Needletail (*Hirundapus caudacutus*)	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. *Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.*	✓	x	-
Black-faced Monarch (*Monarcha melanopsis*)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. *Summer breeding migrant to coastal south east Australia, otherwise uncommon.*	✓	x	-
Spectacled Monarch (*Monarcha trivirgatus*)	Understorey of mountain / lowland rainforest, thickly wooded gullies, waterside vegetation, mostly well below canopy. *Summer breeding migrant to south-east Qld and north-east NSW down to Port Stephens from Sept/Oct to May. Uncommon in southern part of range.*	x	-	-
Yellow Wagtail (*Motacilla flava*)	The yellow wagtail typically forages in damp grassland and on relatively bare open ground at edges of rivers, lakes and wetlands, but also feeds in dry grassland and in fields of cereal crops.	x	-	-
Satin Flycatcher (*Myiagra cyanoleuca*)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. *Breeds mostly south east Australia and Tasmania over warmer months, winters in north east Qld.*	x	-	-

Common name *Scientific name*	Preferred habitat *Migratory breeding*	Suitable habitat present (✓)	Recorded (✓)	Comments on potential impacts
Rufous Fantail (*Rhipidura rufifrons*)	Undergrowth of rainforests / wetter eucalypt forests / gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. *Breeding migrant to south east Australia over warmer months. Altitudinal migrant in north east NSW in mountain forests during warmer months.*	✓	x	-

Appendix 3

Biolink

Koala Assessment
15th April 2019

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ecological consultants
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Travers Bushfire & Ecology
Attn: Mr John Travers
38A The Avenue, Mt Penang Parklands
Kariong NSW 2250

15th April 2019

Dear Mr Travers,

I refer to your request for advice on a Koala Management Plan (KMP) (Travers 2019) for a proposed building extension to the 'Mount Gilead Estate' Retirement Village[1], located at 72 Glendower Street, Mt. Gilead, New South Wales (NSW) (**Figure 1**). The purpose of what follows is to assemble all available information and (ideally) come to an informed and objective conclusion about the potential implications of the proposal on koalas, and how this relates to the requirements under the *State Environmental Planning Policy No. 44 (Koala Habitat Protection)* (SEPP 44) and the Campbelltown City Council (CCC) draft Comprehensive Koala Plan of Management (CKPoM).

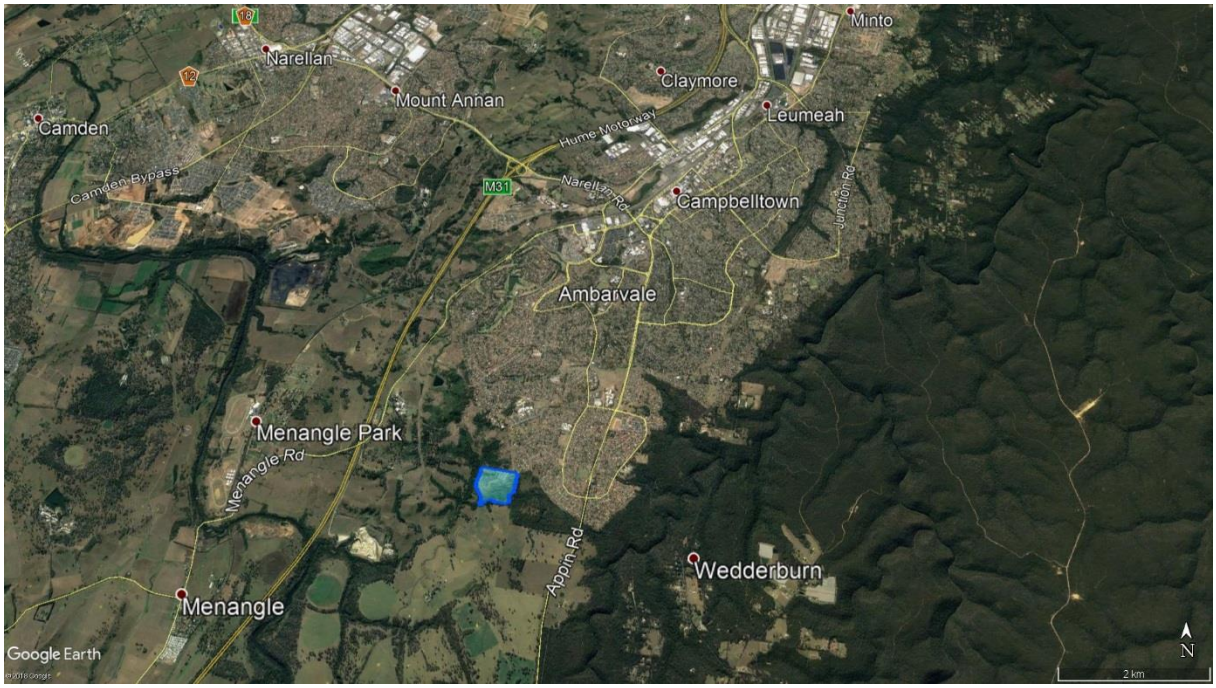

Figure 1 Regional context of the site (shown in blue) in the Campbelltown Local Government Area.

[1] Lot 2 DP 1065919 and (part) Lot 21 DP 1000643

The proposal

As detailed in the KMP, the proposed building extension (**Figure 2**) will result in the loss of two native trees, one of which is listed under SEPP 44 as a koala feed tree (forest red gum *Eucalyptus tereticornis*). Outside of the removal of these two trees, no further environmental impacts are proposed, and all Asset Protection Zones (APZs) established in 2005 will remain unchanged.

Figure 2 Location of the propose building extension (source: Travers 2019).

Koala Management Plan review

On the basis of a review of the KMP, the approach appears to be well informed and objective. Relevant aspects of the desktop assessments are supported to varying degrees by field assessment, and SEPP 44 Koala Habitat Protection guidelines are addressed.

The presence of forest red gum on site, which comprised 15% of the total number of trees, identified an area of *Potential Koala Habitat* as defined under the SEPP 44. Koala records (both anecdotal and historical) are also associated with the site; however, due to the scarcity of these records, it was deemed that *"the property is not a viable landscape for the koala to both forage and or breed",* and subsequently was not considered to conform definition of *Core Koala Habitat* as defined by SEPP 44. The KMP outlines koala habitat management strategies that will be implemented for the long term management of the koala within, and adjacent to the site.

Additional considerations

In order to further consider any potential impacts on koalas we refer to the following reports:

- Biolink (2018a). *Review of koala generational persistence across the Campbelltown City Council LGA 2012 – 2017*. Report to Campbelltown City Council.

Based on this recent review and update of koala generational persistence across the CCC Local Government Area (LGA), it is evident that the 'Mount Gilead Estate' site is not located in an area of generational persistence when considering the three most recent koala generations[2] (Biolink 2018a). This outcome also remains true when considering the three most recent koala generations outlined in the original GPA report (time frames: 1994-1999, 2000–2005 and 2006–2011) (Biolink 2016[3]).

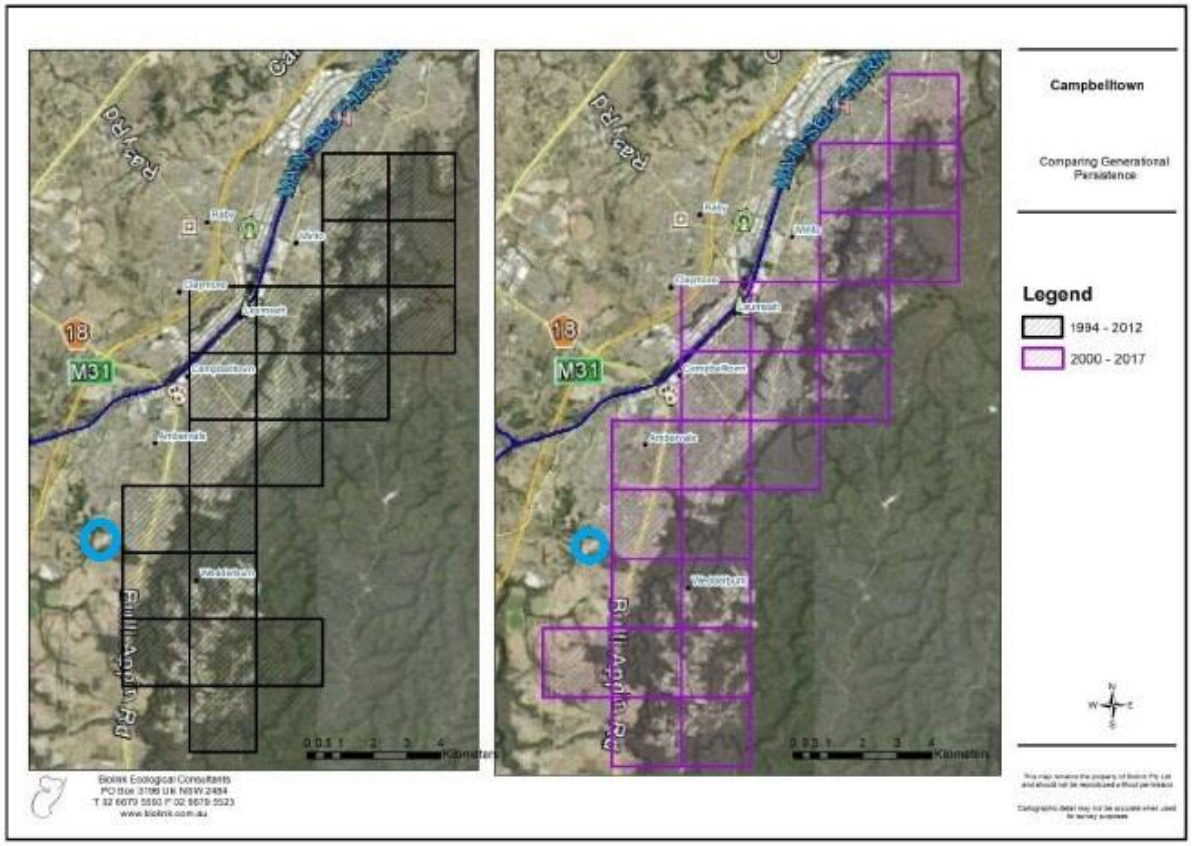

Figure 3 Areas of Generational Persistence (diagonally crossed grid cells) comparing the three most recent koala generations (1994-2012) considered by the Biolink (2016) report, to the three most recent koala generations (2000 – 2017) (source: Biolink 2018).

[2] Time frames: 2000–2005, 2006–2011, 2012-2017.

[3] Biolink (2016). Analysing the historical record: aspects of the distribution and abundance of koalas in the Campbelltown City Council Local Government Area 1900 – 2012, Final Report to Campbelltown City Council. Biolink Ecological Consultants, Uki NSW.

- Biolink (2017). (Revised and updated April 2018). *South Campbelltown Connectivity Study*. Final Report to Campbelltown City Council.

As part of a broader assessment across a network of east-west Strategic Linkage Areas (SLAs) located in the south-west corner of the CCC LGA, a field assessment using Rapid-SAT sampling protocols was previously conducted by us in vegetation communities identified as *Potential koala habitat* in the KMP. As part of this assessment, no koala faecal pellets were recorded under eight forest red gums. This result is supported by faecal pellet searches in the same area by Corey Mead (Travers Ecology) (*pers. comm*.), whereby 25 eucalypts (including 19 x forest red gum) were searched, and again no scats were recorded.

The Campbelltown draft CKPoM defines the location of one SLAs as being directly to the south of the 'Mount Gilead Estate' site. This SLA is associated with the Menangle Creek riparian zone and extends from the general area of the Wedderburn Plateau within the George's River catchment to the adjoining Nepean River catchment (**Figure 4**). The Menangle Creek riparian zone was protected as part of the original 2005 development consent and has been subject to ongoing regeneration and weed management.

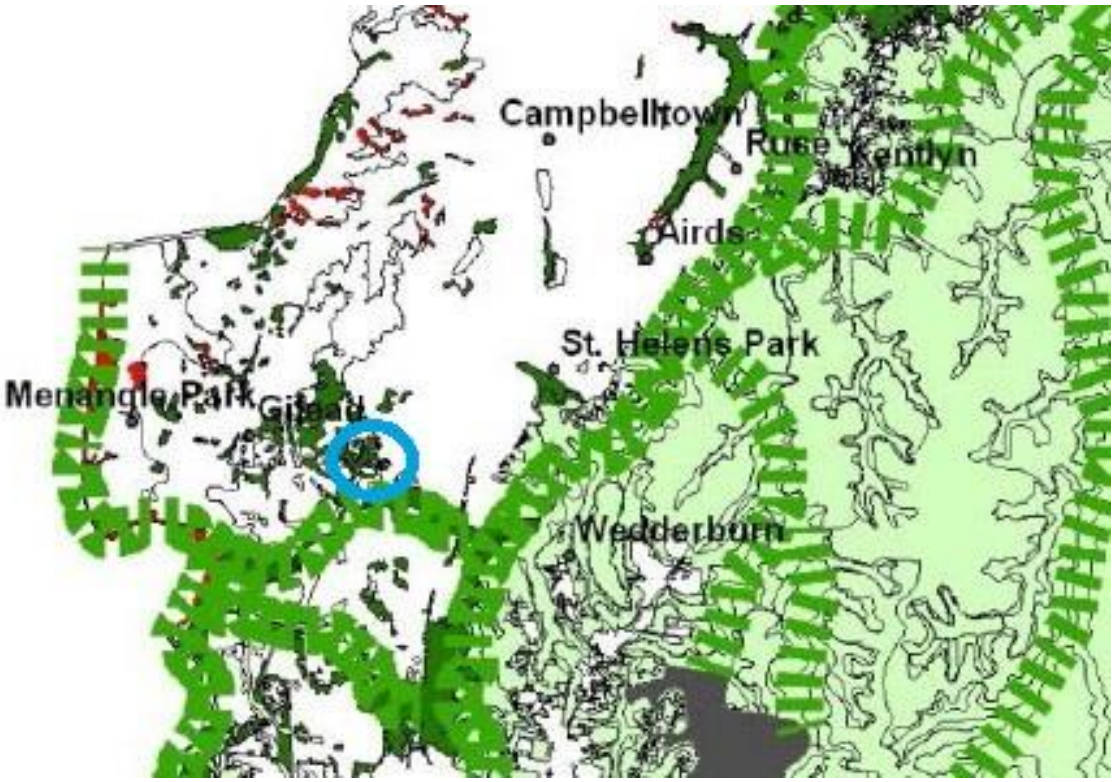

Figure 4 Location of the site (shown in blue) in relation to koala Strategic Linkage Areas (shown as dashed green areas) as defined in the Campbelltown City Council (CCC) draft Comprehensive Koala Plan of Management.

- Biolink (2018b). *Identifying Least-cost dispersal pathways for koalas within the Campbelltown City Council Local Government Area*. Final Report to Campbelltown City Council.

The Generalised Approach to Planning Connectivity at Local and Regional Scales (GAP CLoSR) developed by Lechner and Lefroy (2014) offers a GIS-based approach with a supporting analytical and spatial framework that enables objective examination of issues associated with processes of historical habitat fragmentation and landscape-scale connectivity.

Providing independent support to the aforementioned conclusions on koala connectivity, outputs from the GAP CLoSR approach identified that habitat areas to the south of the site (*i.e*. Menangle Creek riparian zone) functioned to provide koalas with a 'least-cost' dispersal pathway, while woodland habitat to the north of the site provides koalas with another 'least-cost' dispersal pathway. Conversely, the site itself was identified as a 'high-cost' area for koalas due to a lack of vegetation cover and a high likelihood of hazards that could be encountered (**Figure 5**).

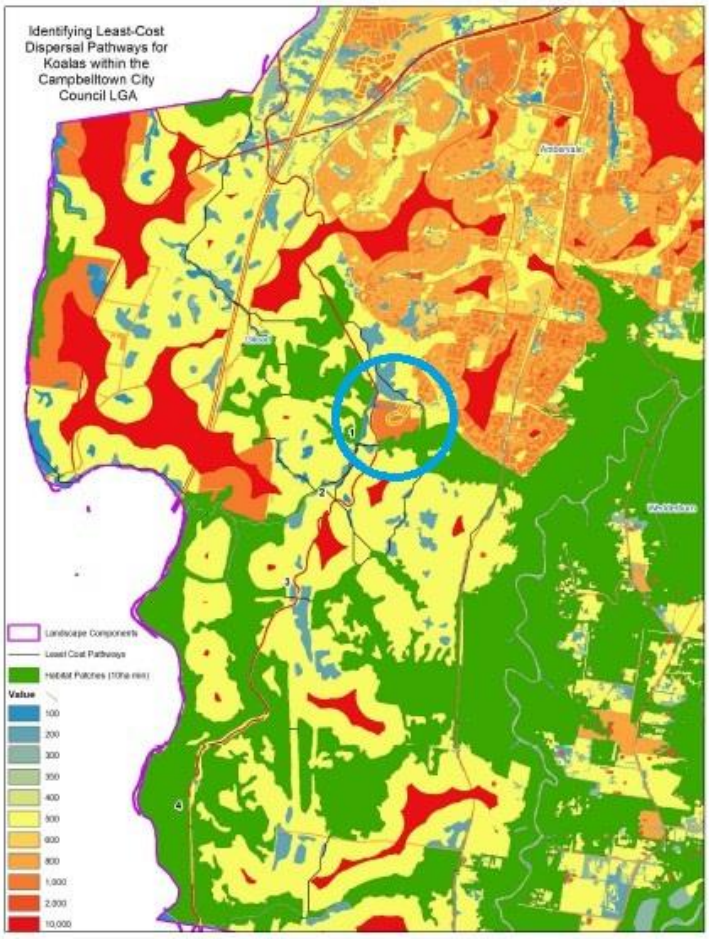

Figure 5 Outputs from Biolink (2018b) GAP CLoSR showing the 'least-cost' dispersal pathways to the south and north of the site, respectively. Outputs also illustrate a 'higher-cost' areas for koalas in the general area.

Conclusion(s) and Recommendation(s)

Given the preceding reviews and available information, we generally agree with the premise preferred by the KMP that *Potential Koala Habitat* exists on site, and that there is little in the way of evidence to indicate the presence of *Core Koala Habitat* as defined by the SEPP 44. It also appears clear that connectivity values for koalas across the landscape are primarily concentrated in areas adjacent to the site (*e.g*. Menangle Creek riparian zone), rather than including the site itself.

We note provisions within the KMP that additional fencing should be incorporated, with the aim to keep koalas out of the developed landscape and maintain use of the retained SLA habitat areas that provide more suitable and safer linkages. While this is notionally acceptable in principle, 100% exclusion is unlikely to be realised because of the existing entrance infrastructure. Notwithstanding that the risks associated with koalas could likely be managed on site without exclusion fencing[4], if fencing is the chosen approach, we would advocate the installation of one-way koala 'bridges' every 200 m around the perimeter so as to enable any koalas who inadvertently get caught inside the fencing to safely exit the site.

As compensation for the loss of a single forest red gum as part of the proposed extension, the importance of maintaining connectivity across the landscape should be acknowledged by way of 50 compensatory koala food trees to be offset to the south of the site in the Menangle Creek riparian zone. This number is an increase on the required 1:20 listed in the Campbelltown draft CKPoM; however, will provide a positive outcome for koalas in the future.

Please don't hesitate to contact the undersigned if you require any further information.

Yours Sincerely,

Dr. Grant Brearley
Senior Ecologist

[4] Including (but not limited to) vehicle speed limits, domestic dog restrictions.

Appendix 4

Biolink

Compliance with the Campbelltown Comprehensive Koala Plan of Management (June 2021)

Compliance with the Campbelltown Comprehensive Koala Plan of Management: proposed development on Lot 21/1000643, Gilead

Report to Travers Bushfire and Ecology

November 2021

biolink Ecological Consultants

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Table of Contents

Abbreviations

Abbreviation	Description
APZ	Asset Protection Zone
CCC	Campbelltown City Council
CC	Construction Certificate
CU	Compensation Units
CKPoM	Comprehensive Koala Plan of Management
DA	Development Application
DPIE	NSW Department of Planning, Industry and Environment
EP&A Act	Environmental Planning and Assessment Act, 1979
GP	Generational Persistence
GPS	Global Positioning Service
KAAR	Koala Activity Assessment Report
LGA	Local Government Area
NPWS	National Parks and Wildlife Services
NSW	New South Wales
PCT	Plant Community Type
PKFT	Preferred Koala Food Tree
SEPP44	State Environmental Planning Policy No. 44 (Koala Habitat Protection)
SLA	Strategic Linkage Area
VAR	Vegetation Assessment Report

Biolink

Supervising Ecologist Amanda Lane
Conservation Analyst Kirsty Wallis

Acknowledgements and Citation

We thank John Travers of John Travers Bushfire and Ecology.

This document should be cited as:

Biolink Ecological Consultants. (2021). Compliance with Campbelltown Comprehensive Koala Plan of Management: proposed development on Lot 21/1000643 in Gilead. Prepared for Travers Bushfire and Ecology. Biolink Ecological Consultants, Pottsville, NSW.

Summary

The Campbelltown Local Government Area (LGA) supports one of the last known koala (*Phascolarctos cinereus*) populations inhabiting the Sydney region. In accord with the stated goals of the State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP44), the Campbelltown Comprehensive Koala Plan of Management (CKPoM) provides a strategic approach to the protection, management and restoration of koala habitat for the entire LGA. Compliance with the CKPoM therefore constitutes compliance with the provisions of SEPP44. This document outlines the requirements for compliance with the Campbelltown CKPoM for a proposed development on Lot 21/1000643 and partial Lot 3/1007066 in Gilead, south west Campbelltown. These requirements include the preparation of a Vegetation Assessment Report (VAR), a Koala Activity Assessment Report (KAAR) and addressing the obligation for compensation and offsetting arising from the loss of Preferred Koala Food Trees (PKFTs). Collectively, the outcomes of the VAR and KAAR indicate that Lot 21/1000643 supports a mix of core koala habitat (with contemporaneous koala occupancy) and potential koala habitat, as defined by the Campbelltown CKPoM. The concept development footprint, as it is currently proposed, falls outside of core koala habitat and is situated entirely in potential koala habitat. Given its proximity to core koala habitat which is adjacently located within the same land parcel, as well as mapped to the south-east according the CKPoM, the proponent will need to follow development controls for core koala habitat, as it pertains to the retention of PKFTs, swimming pools, domestic dogs, fencing, road design and protection of koalas from disturbance. The most effective way of achieving this outcome is likely to be the enclaving of the proposed development. Compensatory requirements arising from the loss of PKFTs, as mapped in the VAR, are intended to be met via a monetary contribution to the Koala Habitat Rehabilitation Program, as outlined in Part 7 of the CKPoM. Adhering to the measures set out in this document will be an effective means of establishing compliance of the proposed development with the the Campbelltown CKPoM.

1. Introduction

The aim of State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP44) is to support the conservation and management of areas of natural vegetation that provide habitat for koalas (*Phascolarctos cinereus*) across New South Wales (NSW), to ensure the persistence of a permanent free-living population across the species' range. SEPP44 is a prescribed consideration under the NSW Environmental Planning and Assessment Act, 1979 (EP&A Act) for all Development Applications (DA) that may impact koalas or their habitat. A path to achieving this is through the preparation of Koala Plans of Management, either for an entire Local Government Area (LGA) – known as a Comprehensive Koala Plan of Management (CKPoM) - or some portion therein. Campbelltown City Council (CCC) requires that developments seeking approval on lands which support native vegetation and / or are > 1 ha, be assessed for koala occupancy and habitat by following the guidelines in the approved Campbelltown CKPoM (Phillips 2018).

One way in which areas of native vegetation in the Campbelltown LGA are assessed for potential koala habitat is through the requirement for a Vegetation Assessment Report (VAR). In areas of potential koala habitat, this standardises the habitat assessment process to ensure that best practices are applied to identify core koala habitat. Identification of core koala habitat further relies on the CKPoMs requirement for a Koala Activity Assessment Report (KAAR) to delineate areas of habitat that are contemporaneously occupied by resident koalas. Through this process Council planners are provided with standardised data to inform the determination process for Development Applications (DA), among other matters. The Campbelltown CKPoM also identifies the location of Strategic Linkage Areas (SLA) – these being areas that support major movement corridors for koalas. Council cannot approve a DA that falls within a SLA unless it is satisfied that the proposal will not interfere with the movement of koalas.

1.1 Campbelltown CKPoM

The Campbelltown CKPoM was adopted by resolution of CCC at its Ordinary Meeting held 13 December 2016 and was subsequently approved by the Secretary of the DPIE July 2020. The area covered by the Campbelltown CKPoM equates with the Campbelltown LGA, excluding National Parks and Wildlife Services (NPWS) estate that is otherwise exempt from SEPP44. The Campbelltown CKPoM does not supersede approved Individual Koala Plans of Management (IKPoM) that have been prepared in accord with SEPP44 and which are currently in force, unless there is provision for ongoing amendment. The lead authority is CCC who are responsible for developing, implementing and enforcing planning controls that relate to the management of koala habitat, among other things.

1.2 Definitions of Koala Habitat

For the purposes of the Campbelltown CKPoM, the term 'potential koala habitat' is defined as;

" any area of native vegetation where trees of the types listed in Schedule 2 of SEPP44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component;

a) *as identified in Figure 5.1 of the Plan, or*
b) *b) any other land identified as such by other processes arising from the Plan (such as VAR)."*

The term 'core koala habitat' is defined as;

"any parcel of land that is either wholly or partly identified under SEPP44 to contain a resident population of koalas, evidenced by attributes such as breeding females (that is females with young) and recent sightings of and historical records of a population;

a) *as identified in Figure 5.1 of this Plan, or*
b) *any other land identified as such by other processes arising from the Plan (such as a VAR)."*

Strategic Linkage Areas (SLAs), as defined by the Campbelltown CKPoM, are illustrated in Figure 5.3 of that same document.

1.3 Purpose of this document

This document is designed to review the compliance of a proposed development on Lot 21/1000643 and part of Lot 3/1007066 (Gilead, NSW), against the requirements of the Campbelltown CKPoM, by following the development assessment process, as outlined below in **Figure 1**.

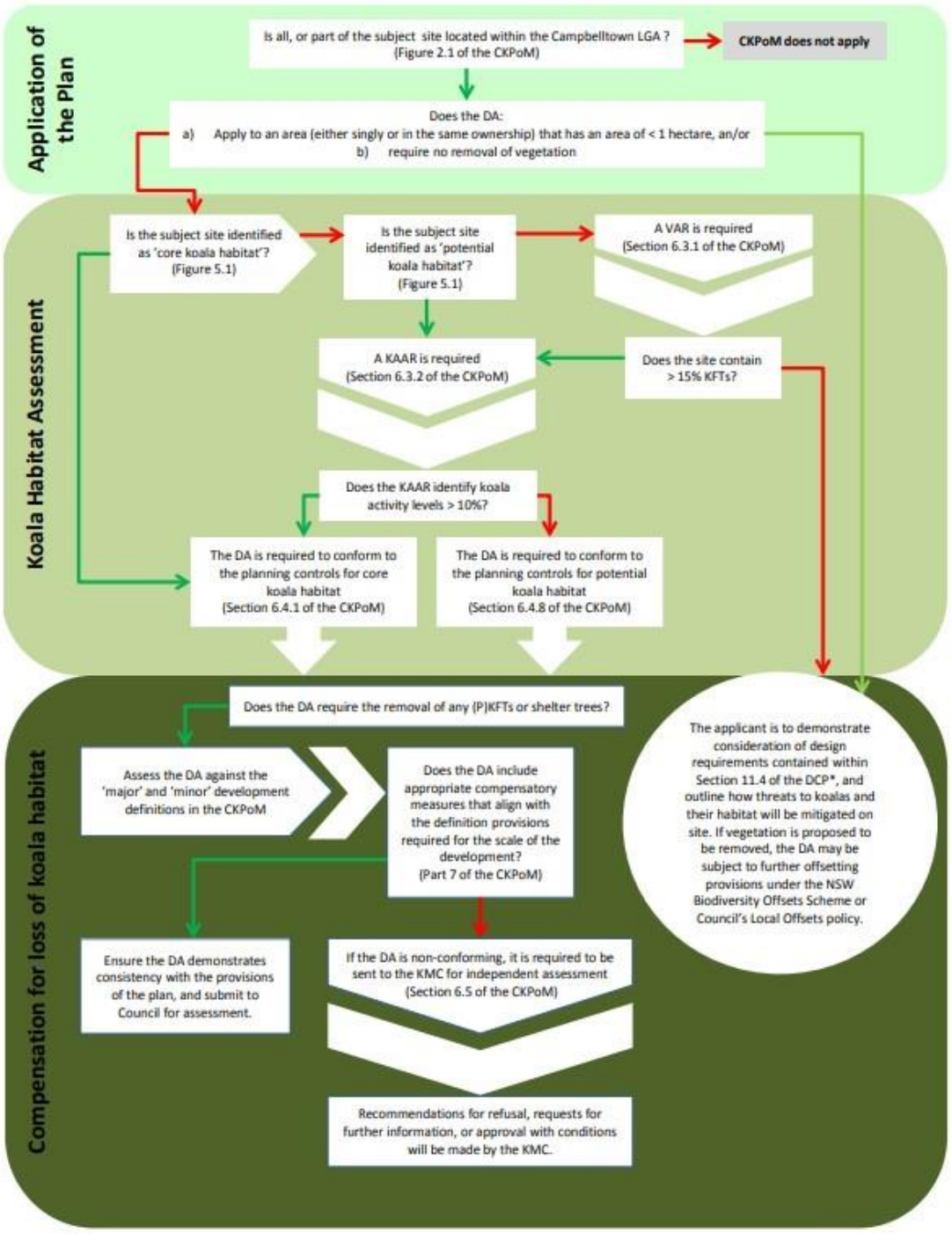

Figure 6.1: Development Assessment framework flowchart

Figure 1: Flowchart showing the assessment process for Development Applications (DA) according to the Campbelltown CKPoM. Taken from Figure 6.1 of that document.

2. Proposed development

The primary lot to which the proposed development applies (Lot 21/1000643) plus a small extension into Lot 3/1007066 which represents an Asset Protection Zone (APZ), all with a 20 m buffer is hereafter referred to as the study area, that being the area to which this compliance checklist pertains (7.80 ha in size). The land parcel is located at 70 Glendower Street, Gilead, NSW, 2560 and is situated directly north of the Estia Health Kilbride Retirement facility. The eastern border adjoins Rosemeadow and is in the south-west of Campbelltown LGA. The proposed development would represent an extension to the adjacent retirement facility, consisting of a combination of high rise residential, independent living and commercial premises. This is a proposed development, for which there is no current DA. A concept development footprint is shown in **Figure 2,** which also displays mapped vegetation.

2.1 Mapped vegetation

Using the Southern Sydney Vegetation Mapping layer, 4.02 ha (51.54%) of the study area is mapped as vegetation and comprises three Plant Community Types (PCTs); 849 Gum-topped/Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin (0.64 ha), 850 Grey Box-Forest Red Gum Grassy Woodland on Shale of the southern Cumberland, Sydney Basin (2.61 ha) and 1395 Narrow-leaved Ironbark-Broad-leaved Ironbark-Grey Gum Open Forest of the Edges of Cumberland Plain, Sydney Basin (0.77 ha) (**Figure 2**). All mapped vegetation within the study area is considered as potential koala habitat due to the presence of PKFTs within these PCTs and is mapped as potential koala habitat for the purposes of the Campbelltown CKPoM (**Figure 3**).

Figure 2: Concept design for a proposed retirement facility on Lot 21/1000643, Gilead, NSW, plus a small extension into Lot 3/1007066 to the north, which represents an Asset Protection Zone.

2.2 Site context

The study area is located directly adjacent to mapped core koala habitat to the east (**Figure 3**). The study area does not intersect any Strategic Linkage Areas (SLA) as mapped by the CKPoM, the nearest SLA being located to the south of the Estia Health Kilbride Retirement facility (**Figure 3**). As part of an analysis of koala records across the Campbelltown LGA, Biolink (2016), conducted a Generational Persistence (GP) Assessment, a process which examines historical koala records for evidence of koalas reoccurring in a localised area over sets of three consecutive koala generations[1]. The purpose of GP Assessment is to identify (where possible) the presence of resident source populations. This is determined using records from the BioNet Atlas;

(https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx),

[1] One koala generation is determined to be a period of six years (Phillips 2000)

with the presence of records from each relevant koala generation, within a 2 km grid cell, being the statistic of interest. Using this approach, cells of GP were found to adjoin the study area to the east at Rosemeadow (**Figure 4**). Whilst there are no koala records (BioNet Atlas) within the study area, there are 29 records within 1 km of the study area that are from the most recent koala generation (2015 – 2020) (**Figure 5**).

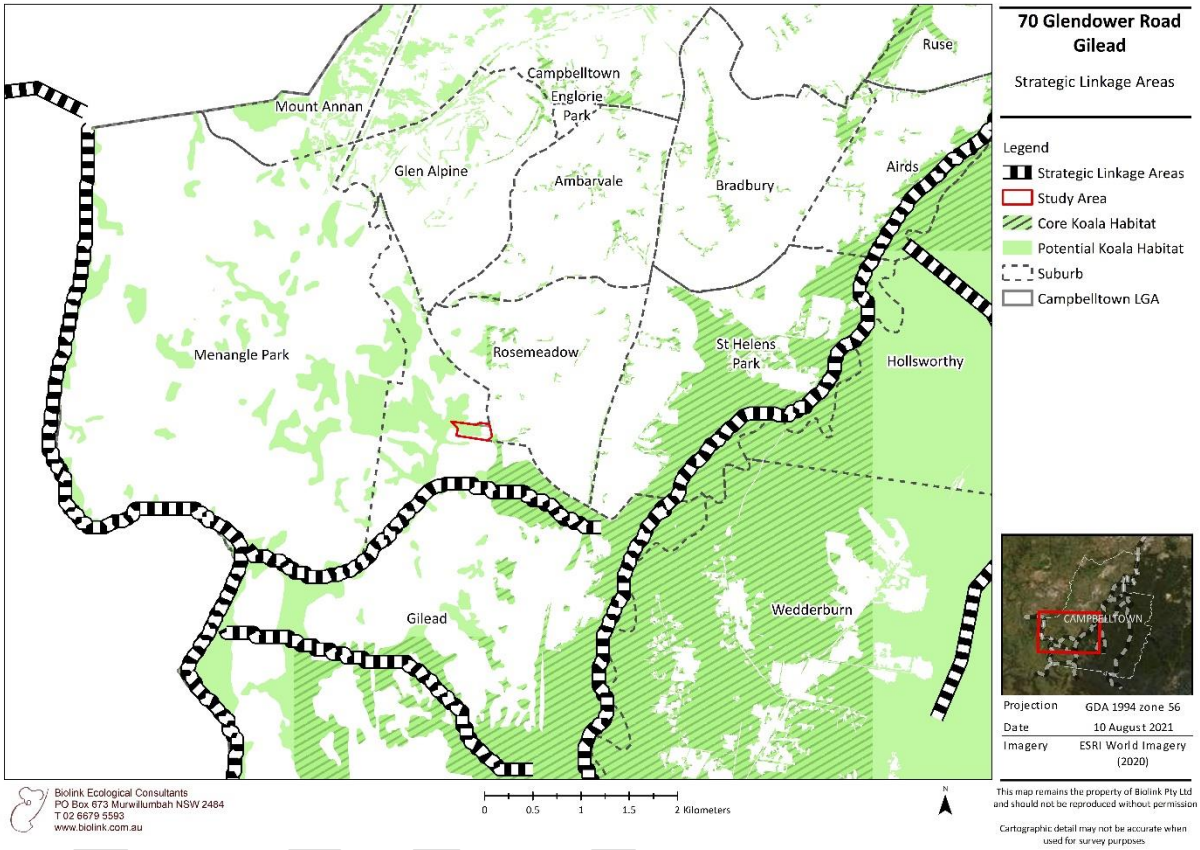

Figure 3: A close-up image, taken from of Figure 5.3 of the Campbelltown CKPoM, centred on the study area (red outline) which maps potential (green) and core (green hatched) koala habitat, as well as the location of Strategic Linkage Areas (SLA). The study area is shown to support potential koala habitat.

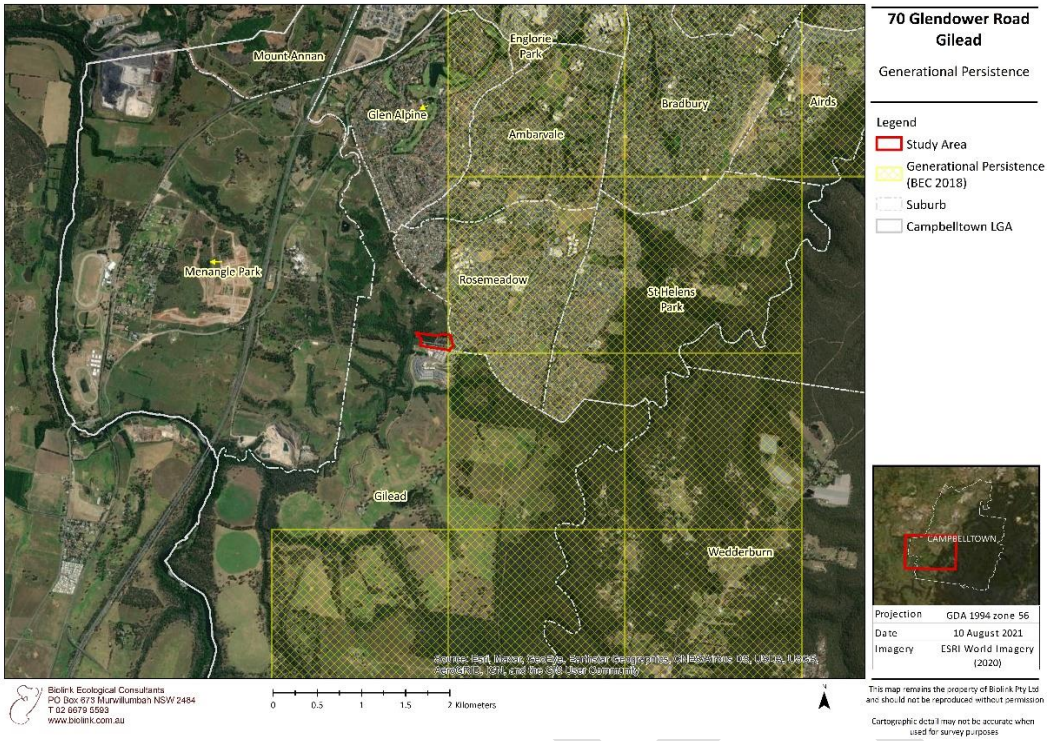

Figure 4: Areas of Generational Persistence (GP) (yellow cross hatch), located directly to the east of the study area (red outline).

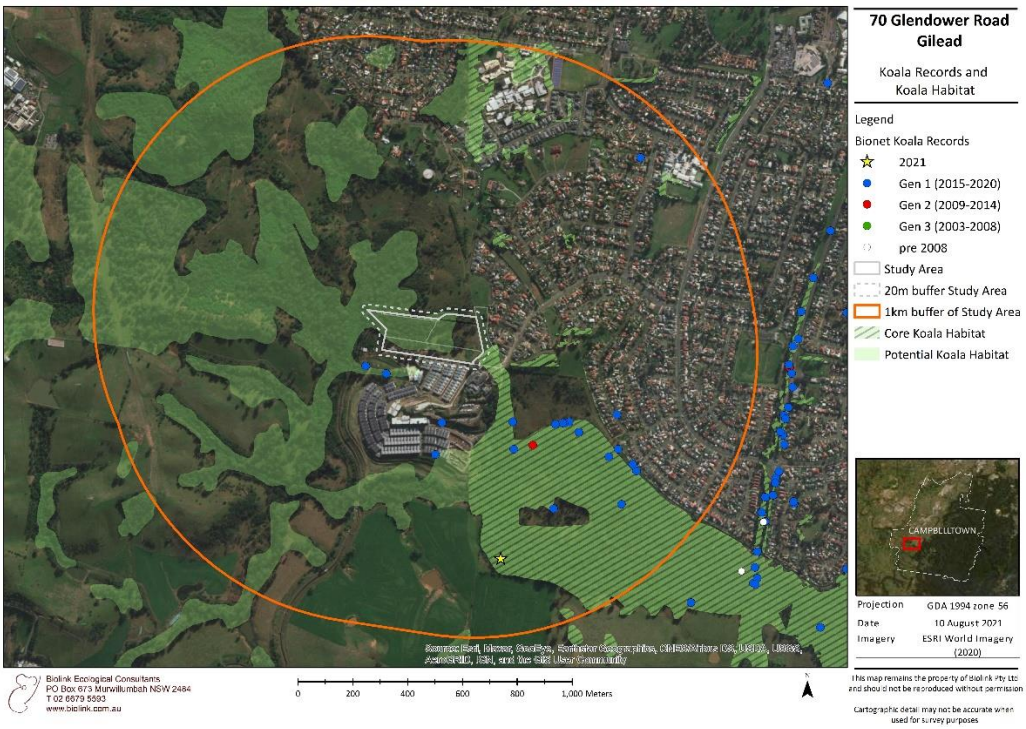

Figure 5: Koala records (BioNet) from the most recent koala generation (2015 – 2020), in relation to the study area (white outline) and a 1 km buffer (orange outline). There are no recent koala records within the study area and 29 recent records from within the 1 km buffer.

3. Development Application assessment flowchart

The following questions are taken from the flowchart outlining the assessment process for DAs in the Campbelltown CKPoM (Figure 6.1 of that document – see **Figure 1** of this report).

Is all, or part of the subject site located within the Campbelltown LGA? (Figure 2.1 of the CKPoM)

Yes – the subject site is Lot 21/1000643 and part of Lot 3/1007066, Gilead NSW.

Does the DA: Apply to an area (either singly or in the same ownership) that has an area of < 1 ha, and/or b) require no removal of vegetation.

No – see **Figure 2** and **Section 2** of this report.

Is the subject site identified as 'core koala habitat'? (Figure 5.1 of the CKPoM)

No – see **Figure 3** of this report.

Is the subject site identified as 'potential koala habitat'? (Figure 5.1 of the CKoPM)

Yes – see **Figure 3** of this report. In brief, the site is mapped in Figure 5.1 of the CKPoM as containing potential koala habitat across the majority, but not the entirety, of its area. A VAR was prepared by suitably qualified individuals[2] to ascertain the extent of potential koala habitat on the site, in accordance with the requirements of the CKPoM for sites with potential koala habitat mapped on site. The results of the VAR are presented in **Appendix 1, Section 3.2**. In brief, the results of the VAR confirm potential koala habitat as occurring broadly across the site, with an extension to the east where there is unmapped native vegetation consisting of several single-species stands of trees, set amongst scattered paddock trees and weedy ground cover. Du to the prevalence of *Eucalytpus tereticornis*, this unmapped vegetation meets the definition of potential koala habitat as outlined in the Campbelltown CKPoM. No koala shelter trees were recorded on the site.

[2] Suitably qualified individual, that being a person with post-graduate qualifications in koala ecology and/or demonstrable work experience that includes publication of works on koala ecology in peer-reviewed scientific literature and/or accreditation as a koala specialist by Council and/or a professional body such as the EIANZ. Authors of this compliance checklist also prepared the VAR and KAAR and their CVs can be found in Appendix 2.

A KAAR is required (Section 6.3.2 of the CKPoM). Does the KAAR identify koala activity levels > 10%

Yes - A KAAR was prepared by suitably qualified individuals[2] with the results presented in **Appendix 1, Section 3.3**. In brief, the results of the KAAR show that two of the five sites surveyed across the study area support significant koala activity (≥ 10%) and must therefore be regarded as supporting a resident koala population for the purposes of the Campbelltown CKPoM (Appendix B, page 58 of the CKPoM). Output from a splining process produced an activity contour model delineating the boundaries of core koala habitat and indicating that the western section of the study area is likely to support a portion of a single koala home range and it is probable that this home range extends further to the north-west. In this way, core koala habitat is present on the Lot to which the proposed DA will apply, but it does not intersect the proposed development footprint (as it is shown in **Figure 2**). Given the proximity of core koala habitat to the proposed development footprint and the existence of core koala habitat on the land parcel to which the proposed DA applies, the proponent will need to take a precautionary approach and conform to the planning controls for core koala habitat (Section 6.4.1 of the CKPoM). See **Section 4** of this report for more detail on how the proposed development can adhere to planning controls in core koala habitat.

Does the DA require the removal of any (P)KFTs or shelter trees?

Yes – see **Appendix 1, Figure 10** and **Table 3** for the intersection of the concept development footprint and PKFTs as mapped by the VAAR. There are no koala shelter trees, as defined in the CKPoM, mapped within the study area (see **Appendix 1, Section 3.2**).

Assess the DA against the 'major' and 'minor' development definitions in the CKPoM.

The proposed DA relates to a major development given that it relates to the subdivision of land into ≥ three lots, and/or requires the removal of three or more (P)KFTs for each ha of assessable land (see **Figure 2** and **Section 2** of this report). Where a proponent chooses to seek the removal of PKFTs or shelter trees in accordance with a DA, provision must be made to compensate for the loss of associated habitat.

Does the DA include appropriate compensatory measures that align with the definition provisions required for the scale of the development? (Part 7 of the CKPoM)

The proponent will enter into a legally binding agreement with Council to make a monetary contribution towards the Koala Habitat Rehabilitation Program, as detailed in Part 8 of the Campbelltown CKPoM, to offset the loss of PKFT arising from the proposed development. The amount of the compensatory payment is based on the value of the required 'compensation units' (CU) (for every cm of DBH or part thereof) arising from the total number and size of PKFTs that will be removed. As a guide, at the commencement of the CKPoM, the value of a CU was $1, which was to be applied as follows;

Small (DBH < 100 mm)	8 CU / mm DBH
Medium (DBH > 100 < 300 mm	15 CU/ mm DBH
Large (DBH > 300 mm)	25 CU / mm DBH

To give some meaning to these numbers in the context of the potential DA which is the subject of this document, **Appendix 1, Table 3** shows the numbers of PKFTs, organised by species and size class, which are located within the potential development footprint (taken from the georeferenced CAD drawing), the Asset Protection Zone (APZ) approved in 2018, and the study area more broadly. **Appendix 1, Figure 10** also shows the location and size class of PKFTs across the potential development footprint and Approved APZ.

4. Development controls in core koala habitat

Development controls in core koala habitat relate to all planning proposals, re-zonings and DA's that apply to an area with core koala habitat, as defined by the Campbelltown CKPoM and covers the retention of PKFTs and shelter trees, swimming pool design, the keeping of domestic dogs, appropriate fencing, road design and protection of koalas from disturbance.

4.1. Retention of PKFTs

According to Section 6.4.2 of the CKPoM, there shall be no removal PKFTs as a consequence of any new DA, beyond what is permissible under the definitions for major development. It is assumed that these permissions relate to removing PKFTs that are appropriately compensated for, which has been outlined in this report. The applicant must also demonstrate to the satisfaction of Council that the protection of all PKFTs are consistent with the requirements of AS 4970-2009 (Protection of Trees on Development Sites). Retained PKFTs that occur within residential allotments arising from the subdivision of land must be protected by a covenant or other effective restriction on the user on title of the land where appropriate.

4.2. Swimming pools

All new swimming pools must incorporate koala-friendly design features including a shallow ramp and/or stout rope to enable egress by koalas. Fencing must be of a type that prevents access by koalas, without contravening provisions of the *Swimming Pools Act 1992*.

4.3. Domestic dogs

The keeping of domestic dogs will either be prohibited by an effective restriction on the title of the land, or other planning measure, or subject to a covenant; imposing a legal requirement to install a dog-proof yard, whether the prospective owner has the immediate intention of owning a dog or not. Further detail is found in Section 6.4.4 of the CKPoM and these options must either be registered and/or in place prior to the issuing of a Construction Certificate (CC).

4.4. Fencing

Fencing must not impede the movement of koalas and fences not supported by the CKPoM include (but are not limited to);

- Colourbond panel fencing
- Barbed wire fencing
- Solid brock fencing (> 1 m high)
- Steel fencing (>30cm gas between rails)

4.5. Road design

Road design standards and/or approved vehicle calming devices must be incorporated on any new roads created through residential subdivision with a maximum speed of 40km/hr. Outside of residential subdivisions , where new roads or road upgrades are proposed that traverse areas of koala habitat and are predicted to accommodate in excess of 1,500 vehicle movements/day, rules apply as to the requirement for wildlife exclusion fencing, koala-grids at access points to the road corridor and connectivity structures such as under/overpasses should be at intervals of one structure per 250m or exclusion fencing. In areas where topographic or engineering constraints prevent the building of such structures, other solutions should be sought. Detailed design of the above must be prepared by a suitably qualified person.

4.6. Protection of koalas from disturbance

Clearing of native vegetation / earthworks must be temporarily suspended within a range of 25 m from any tree which is concurrently occupied by a koala and must not resume until the koala has moved from the tree of its own volition. No clearing can commence until the area proposed for clearing has been inspected for the presence of koalas by a suitably qualified person, and approval given in writing (approval is only valid for the day on which the inspection is undertaken). The individual implementing the inspection, or a nominated representative, must remain onsite during any approved clearing and if clearing operations on different sections of land are being undertaken concurrently, a suitably qualified person must be present in each section.

5. Ensuring development compliance

The land to which the proposed development on Lot 21/1000643 and partial Lot 3/1007066 in Gilead, south west Campbelltown, applies has followed the required development assessment process as outlined in **Figure 1**, including the preparation of a VAR and a KAAR. The outcomes of these studies demonstrate that the lands to which the proposed development applies supports a mix of potential and core koala habitat, with the concept development footprint falling outside of, but adjacent to, core koala habitat (mapped to the south-east in **Figure 3** and to the west as an outcome of the KAAR (**Appendix 1, Section 3.3**)).

The proposed development qualifies as a major development under the definitions of the Campbelltown CKPoM and involves the removal of PKFTs. This necessitates compensatory payments to the Koala Habitat Rehabilitation Program, with the amount of compensation subject to the exact number and size of PKFTs to be removed. This document does not present a number of exactly how many trees will be removed as a result of the proposed development, as the exact development footprint indicated in **Figure 2** may be subject to refinement and the associated APZs are not required to be completely cleared (they may instead be kept to a sparse woodland standard). This is likely to be an on-going conversation between the proponent and Council, of which this document represents the first step in establishing a final compensatory amount.

We acknowledge uncertainty around whether the application of development controls for new subdivisions should apply to the proposed development as it is not a sub-division proper, but does represent the construction of a large number of residential dwellings and associated increases in traffic, among other factors. The most effective way to address the required development controls for core koala habitat, as outlined in **Sections 4.2 – 4.5** above, and in-keeping with the spirit of the CKPoM, may be the enclaving of the development. Enclaving is considered an effective means of permanently

excluding koalas from the development by way of fencing, koala-grids and gateways that do not allow koalas to enter. While the proposed development does not fall within a SLA, the option to enclave should be considered in conjunction with an assessment of impacts on koala habitat connectivity, particularly in light of the hard boundary to koala movement presented by the aqueduct to the west of the study area.

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Appendix 1

Assessment of Lot 21/1000643 Campbelltown: koala occupancy and habitat

Report to Travers Bushfire and Ecology

June 2021

Table of Contents

Abbreviations

Abbreviation	Description
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CU	Compensation Units
CKPoM	Comprehensive Koala Plan of Management
DA	Development Application
DBH	Diameter at Breast Height
DPIE	NSW Department of Planning, Industry and Environment
GPS	Global Positioning Service
KAAR	Koala Activity Assessment Report
LGA	Local Government Area
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PKFT	Preferred Koala Food Tree
PKH	Preferred Koala Habitat
SAT	Spot Assessment Technique
SEPP44	State Environmental Planning Policy No. 44 (Koala Habitat Protection)
SLA	Strategic Linkage Area
VAR	Vegetation Assessment Report

Biolink

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Conservation Analyst	Kirsty Wallis
Advising Consultant	Stephen Phillips
Field Survey	Kirsty Wallis, Amanda Lane

Acknowledgements

We thank John Travers of John Travers Bushfire and Ecology.

Summary

In accord with the requirements of the Campbelltown Comprehensive Koala Plan of Management (CKPoM), this report describes fieldwork which resulted in a Vegetation Assessment Report (VAR) and a Koala Activity Assessment Report (KAAR) for a proposed development on Lot 21/1000643 and partial Lot 3/1007066 in Gilead, south west Campbelltown. The VAR included a stadia-metric survey of native trees over 50 mm Diameter at Breast Height (DBH) within the defined study area, that being the primary lot to which the proposed development applies and a small extension into adjoining lot 3/1007066, plus a 20 m buffer. The five most encountered native species were *Eucalyptus tereticornis*, *E. moluccana*, *Acacia implexa*, *E. crebra* and *Corymbia maculata*. Preferred Koala Food Tree (PKFT) species, as defined by the CKPoM (*E. tereticornis*, *E. moluccana* and *E. punctata*), accounted for 78.56% of the tree species present within the study area. The highest density of PKFTs were mapped in the central-north of the study area which supports a large consolidated stand of *E. tereticornis* and *E. moluccana*, the majority of these trees falling into the small (< 100 mm) and medium (> 100 mm < 300 mm) categorisations of the CKPoM. No species which are defined by the CKPoM as koala shelter trees were identified within the study area.

Current vegetation mapping for the site is generally congruent with field survey. Of the three Plant Community Types (PCTs) previously mapped within the study area, one (PCT code 1395) does not match the tallest stratum species composition at this location and may be better described as an extension of one of the other two PCTs (849 or 850) according to underlying soil / topography. There is unmapped native vegetation in the eastern portion of the study area consisting of several single-species stands of trees, set amongst scattered paddock trees and weedy ground cover. Due to the prevalence of *E. tereticornis*, this unmapped vegetation meets the definition of potential koala habitat as outlined in the Campbelltown CKPoM. A gully runs through the central portion of the study area from the west, supporting some disturbed rainforest elements with several large trees (> 1 m DBH) also located therein. It is our understanding that this riparian area is not part of the intended development footprint, but is included within the study area for context.

Spot Assessment Technique (SAT) assessments were undertaken at five survey sites, two of which were found to support high koala activity. Output from a splining process performed with the spatial analyst extension in ArcGIS 10.5 produced an activity contour model delineating the boundaries of core koala habitat. These activity contours indicate that the western section of the study area supports parts of at least one koala home range area that likely extends further to the north and west.

Collectively, the outcomes of the VAR and KAAR indicate that the study area supports a mix of core koala habitat (with contemporaneous koala occupancy) and potential koala habitat, as defined by the Campbelltown CKPoM. The results of this report provide an overlay of ecological data which can work to inform any potential development footprint.

6. Introduction

Koalas (*Phascolarctos cinereus*) inhabiting the Campbelltown Local Government Area (LGA) have long been the focus of scientific and community interest, with available data indicating that the population has undergone a measure of recovery over the last 20 – 30 years (Phillips 2016). The most recent LGA-wide population monitoring indicated an estimated population size of 236 ± 60 (95% CI) koalas, with contemporary range extensions to the north, near the boundary with Liverpool LGA, and in the south-west with koalas now occurring on both sides of Appin Road and the Hume Highway (Biolink 2021). Campbelltown City Council (CCC) requires that developments seeking approval on lands which support native vegetation and / or are > 1 ha, be assessed for koala occupancy and habitat by following the guidelines in the recently approved Campbelltown Comprehensive Koala Plan of Management (CKPoM) (Phillips 2016).

The Campbelltown CKPoM maps core and potential koala habitat and identifies the location of Strategic Linkage Areas (SLA) – these being areas that support major movement corridors for koalas. Council cannot approve a DA that falls within a SLA unless it is satisfied that the proposal will not interfere with the movement of koalas. In addition to this, the requirements for assessment of koala habitat as it pertains to a DA are the establishment of whether the subject land contains any potential koala habitat by way of a Vegetation Assessment Report (VAR). As a minimum this VAR must include:

- A description of the tallest stratum cover and details of species composition of each vegetation community.
- A checklist of native vegetation species occurring in each vegetation patch, including any isolated paddock trees on partially cleared lands.
- A stadia-metric survey that identifies the precise location, taxonomic identity and Diameter at Breast Height (DBH) of all native vegetation proposed to be removed and / or within 20 m of the proposed development footprint, including any proposed infrastructure, easements and Asset Protection Zones.
- A map of where koala food and shelter trees were recorded[3].

[3] The Campbelltown CKPoM is not bound by SEPP44 definitions of Preferred Koala Food Trees (PKFTs). To this end and based on published studies and resource documents, Preferred Koala Food Tree species for koalas in Campbelltown have been identified as Forest red gum (*Eucalyptus tereticornis*), Ribbon gum (*E. viminalis*), Woollybutt (*E. longifolia*), Gum-topped (Grey) box (*E. moluccana*) and Grey gum (*E. punctata*). Shelter trees are those species which are known to be preferentially used by koalas in the Campbelltown LGA for roosting and thermoregulatory purposes and are defined in the CKPoM as Turpentine (*Syncarpia glomulifera*) and Brush box (*Lophostemon confertus*).

If the land which is the subject of the DA is determined to be potential koala habitat, then a DA must include a Koala Activity Assessment Report (KAAR) for that land. Council may also require a KAAR to be prepared for any development within mapped core koala habitat where detailed information on the distribution of koala activity and movement is required to assist in the evaluation of development design. The appropriate methodological approach for the preparation of a KAAR is outlined in Appendix B of the Campbelltown CKPoM. With regard to the potential development on Lot 21/1000643, this involves following Regularised Grid-based SAT (RG-bSAT) sampling protocols at 250 m intervals (initial sampling intensity) or 125 m intervals (high sampling intensity) for DA lands < 15 ha. If High[4] koala activity is recorded at any of the initial sampling sites, then the surrounding high sampling intensity sites are also to be assessed.

The current project was initiated to assess Lot 21/1000643 and part of Lot 3/1007066 (Gilead, Campbelltown, NSW) for the possible occurrence of koalas and koala habitat in accord with the Campbelltown CKPoM, and so provide information of relevance to a potential Development Application (DA).

[4] As defined for East Coast Low Density populations by Table 2 in Phillips and Callaghan (2011)

7. Methodology

The primary lot to which the proposed development applies (Lot 21/1000643) plus a small extension into Lot 3/1007066 which represents an asset protection zone, all with a 20 m buffer, is hereafter referred to as the study area.

7.1. Vegetation Assessment Report

7.1.1. Stadia-metric tree survey

Across the study area, all native trees with a DBH greater than 50 mm were measured[5] and identified to species level (where possible), and their location recorded using a hand-held GPS. Each tree was then classified as either a Preferred Koala Food Tree (PKFT), shelter tree or other native species as prescribed by Phillips (2016). PKFTs were grouped into size classes in accordance with the Campbelltown CKPoM categorisations of small (DBH < 100 mm), medium (DBH > 100 < 300 mm) and large (DBH > 300 mm) (Phillips 2016).

7.1.2. Vegetation communities / species composition

The tallest stratum cover and details of species composition were recorded for each vegetation community present in the study area. A checklist of native vegetation species, including any isolated paddock trees on partially cleared lands, was generated.

7.2. Koala Activity Assessment Report

7.2.1. Field Survey

The study area was overlain with a 125 m grid with grid-cell intersections becoming potential survey points where they occurred in areas of native vegetation, *as per* the high sampling intensity requirement prescribed in the Campbelltown CKPoM. Sites could be moved up to 12 m if they did not intersect with the vegetation of ESRI Basemap satellite imagery. Universal Transverse Mercator coordinates were determined for each corresponding point and uploaded into hand-held Global Positioning System (GPS) to enable location in the field. Koala activity at each field site was assessed using the Spot Assessment Technique (SAT) of Phillips & Callaghan (2011).

The study area, and Gilead more broadly, has a widespread occurrence of grey gums and gum-topped (grey) box, species which are indicative of low nutrient soils and hence low koala carrying capacity

[5] 50 mm DBH is the minimum size class for a 'tree' when implementing the Biodiversity Assessment Method (OEH 2018).

landscapes. In accord with this, koala activity across the site was interpreted in terms of the east coast (low) as defined by Phillips & Callaghan (2011). **Table 1** details the koala activity threshold parameters that are applicable, with medium (normal) use and high use sites indicative of the presence of resident animals (*i.e.*, Core Koala Habitat).

Table 1. Categorisations of koala activity based on use of mean activity level ± 99% confidence intervals. Activity levels in the medium (normal) and high use range for east coast (low) activity categories indicates occupancy levels by resident koala populations (Source: modified from Table 2 in Phillips and Callaghan 2011).

Activity category	Low use	Medium (normal) use	High use
East Coast (low)	< 9.97%[1]	≥ 9.97% but ≤ 12.59%	> 12.59%

[1] Koala activity (%) is determined based on the number of trees with faecal pellets and the number of trees sampled at each site. For example, three positive trees of 30 trees would yield a 10% activity level.

7.2.2. Data analysis

Using the satellite imagery from ESRI Basemap World Imagery (2020) the locations of null sites were designated at 62.5 m intervals along dispersal barriers (*e.g.,* the aqueduct) and regularly spaced within large expanses of land devoid of trees. Null sites and koala activity data from all surveyed sites were then interpolated using regularised, thin-plate splining techniques using the spatial analyst extension in ArcGIS 10.5. Output from the splining process was utilised to produce an activity contour model to delineate areas occupied by resident koala populations by identifying contours with the 10% and 13% significant activity thresholds as previously detailed in **Table 1**. Lower activity contours were included in the activity model to assist with interpretation of connectivity. This process produces a meta-population model (or contour map) that delineates important 'source' areas supporting established resident koala populations.

8. Results

8.1. Study area

The study area totals 7.80 ha and consists of the primary lot to which the proposed development potentially applies (Lot 21/1000643) plus a small extension into Lot 3/1007066 which represents an asset protection zone, all with a 20 m buffer. The land parcel is located at 70 Glendower Street, Gilead, NSW, 2560 and is situated directly north of the Estia Health Kilbride Retirement facility. The eastern border adjoins Rosemeadow and is in the south-west of Campbelltown LGA. Using the Southern Sydney Vegetation Mapping layer, 4.02 ha (51.54%) is mapped as vegetation and comprises three Plant Community Types (PCTs); 849 Gum-topped/Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin (0.64 ha), 850 Grey Box-Forest Red Gum Grassy Woodland on Shale of the southern Cumberland, Sydney Basin (2.61 ha) and 1395 Narrow-leaved Ironbark-Broad-leaved Ironbark-Grey Gum Open Forest of the Edges of Cumberland Plain, Sydney Basin (0.77 ha) (**Figure 1**). All mapped vegetation within the study area is considered as potential koala habitat due to the presence of PKFTs within these PCTs and is mapped as potential koala habitat for the purposes of the Campbelltown CKPoM. The study area is located directly adjacent to mapped core koala habitat to the east. The study area does not intersect any Strategic Linkage Areas (SLA) as mapped by the CKPoM, the nearest SLA being located to the south of the Estia Health Kilbride Retirement facility (**Figure 2**).

Figure 1. The study area, inclusive of lot 21/1000643 and a small part of lot 3/1007066 (grey line) plus a 20 m buffer (dashed grey line). Three mapped vegetation communities are within the study area and two are outside. For descriptions of Plant Community Type (PCT) codes, refer to Section 3.1 above.

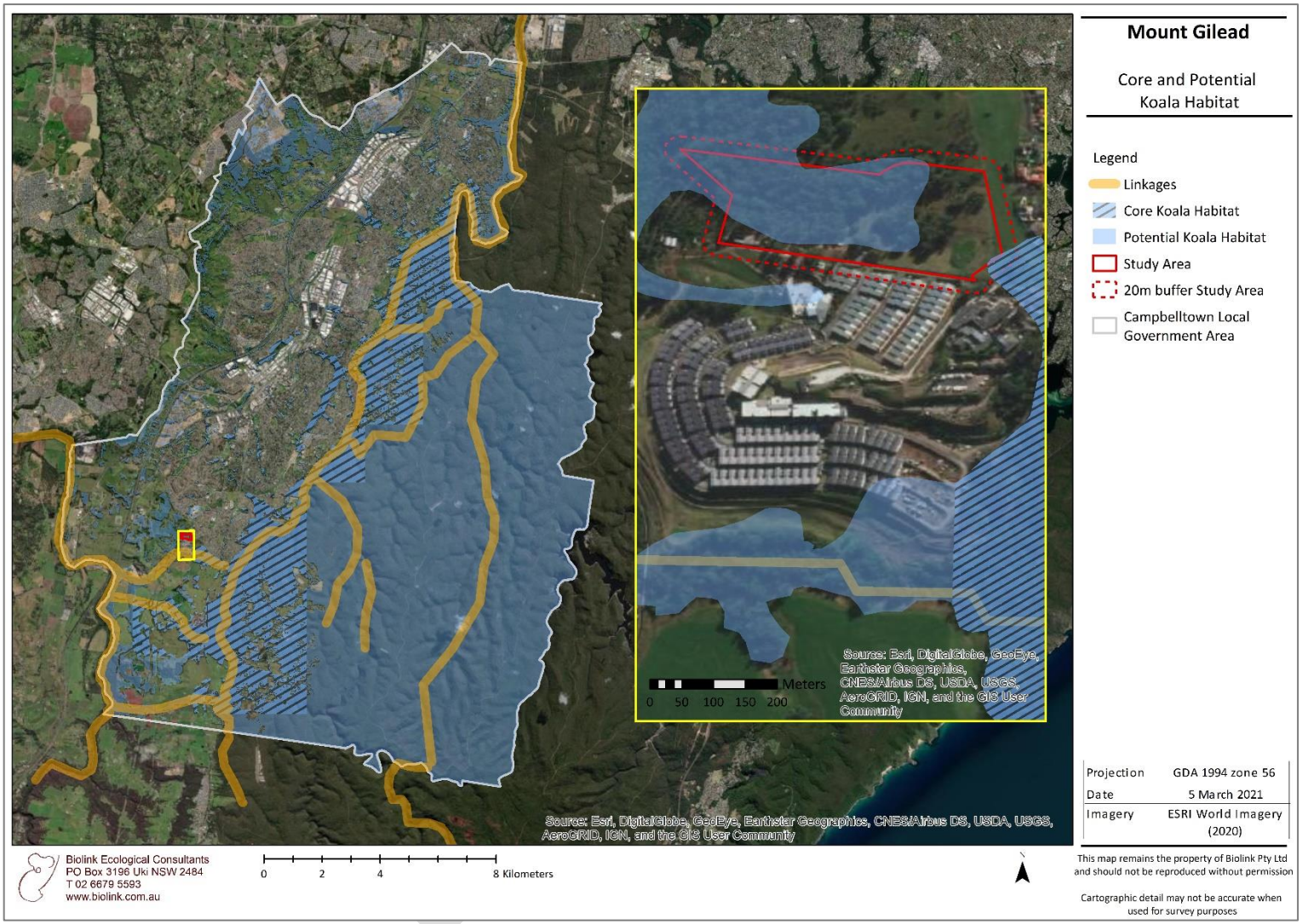

Figure 2. Core and potential koala habitat, and Strategic Linkage Areas (SLAs) as mapped for the Campbelltown LGA by the Campbelltown CKPoM, intersected with the study area. Inset shows more detail of the study area.

8.2. Vegetation Assessment Report

8.2.1. Stadia-metric tree survey

The stadia-metric survey of native trees ≥ 50 mm DBH was undertaken 21st – 23rd February 2021, during which time 1,814 trees were identified, measured, and mapped (**Figure 3**). Of these 1,814 trees, 78.56% were species identified as PKFTs by the CKPoM (*n* = 1,425). This consisted of three species; *E. tereticornis* (*n* = 1,077), *E. moluccana* (*n* = 343) and *E. punctata* (*n* = 5) (**Appendix A**). *Eucalyptus tereticornis* was widely distributed across the study area with the highest density in the north west (**Figure 4**). *Eucalyptus moluccana* was restricted to the western two-thirds of the study area (**Figure 5**). *Eucalyptus punctata* was restricted to a localised small stand in the central portion of the study area, directly north of the Estia Retirement Village swimming pool (**Figure 6**). The remaining trees (*n* = 389) were classified as 'Other' and consisted of *Acacia decurrens* (*n* = 6), *A. implexa* (*n* = 191), *Allocasurina littoralis* (*n* = 1), *Corymbia gummifera* (*n* = 4), *C. maculata* (*n* = 41), *E. crebra* (*n* = 141), *E. pilularis* (*n* = 1), *Melaleuca* sp. (*n* = 3) and *Ficus* sp. (*n* = 1) (**Figure 3**, **Appendix A**). There were no shelter trees (*Syncarpia glomulifera, Lophostemon confertus*) identified within the study area.

Considering only PKFTs, approximately 30.03% of the trees sampled fall into the CKPoM categorisation for small (< 100 mm DBH), 55.30% are categorised as medium (> 100 mm < 300 mm DBH) and 14.67% are categorised as large (> 300 mm DBH). A break-down of this by species is presented in **Table 2**.

Table 2. The number of PKFTs, grouped by the small, medium and large categories as prescribed by the Campbelltown CKPoM.

	E. tereticornis	*E. moluccana*	*E. punctata*
Small (< 100 mm DBH)	301	129	1
Medium (> 100 mm < 300 mm DBH)	608	176	4
Large (> 300 mm)	168	38	0

Figure 3. Distribution of 1,184 native trees over the study site with PKFTs (orange) and Other trees (blue). Tree size category (DBH) is indicated by circle size.

Figure 4. The distribution of 1, 077 *E. tereticornis* across the study area with size class defined by small (light green small circles), medium (green medium circles) and large (dark green large circles).

Figure 5. The distribution of 343 *E. moluccana* across the study area with size class defined by small (light red small circles), medium (red medium circles) and large (dark red large circles).

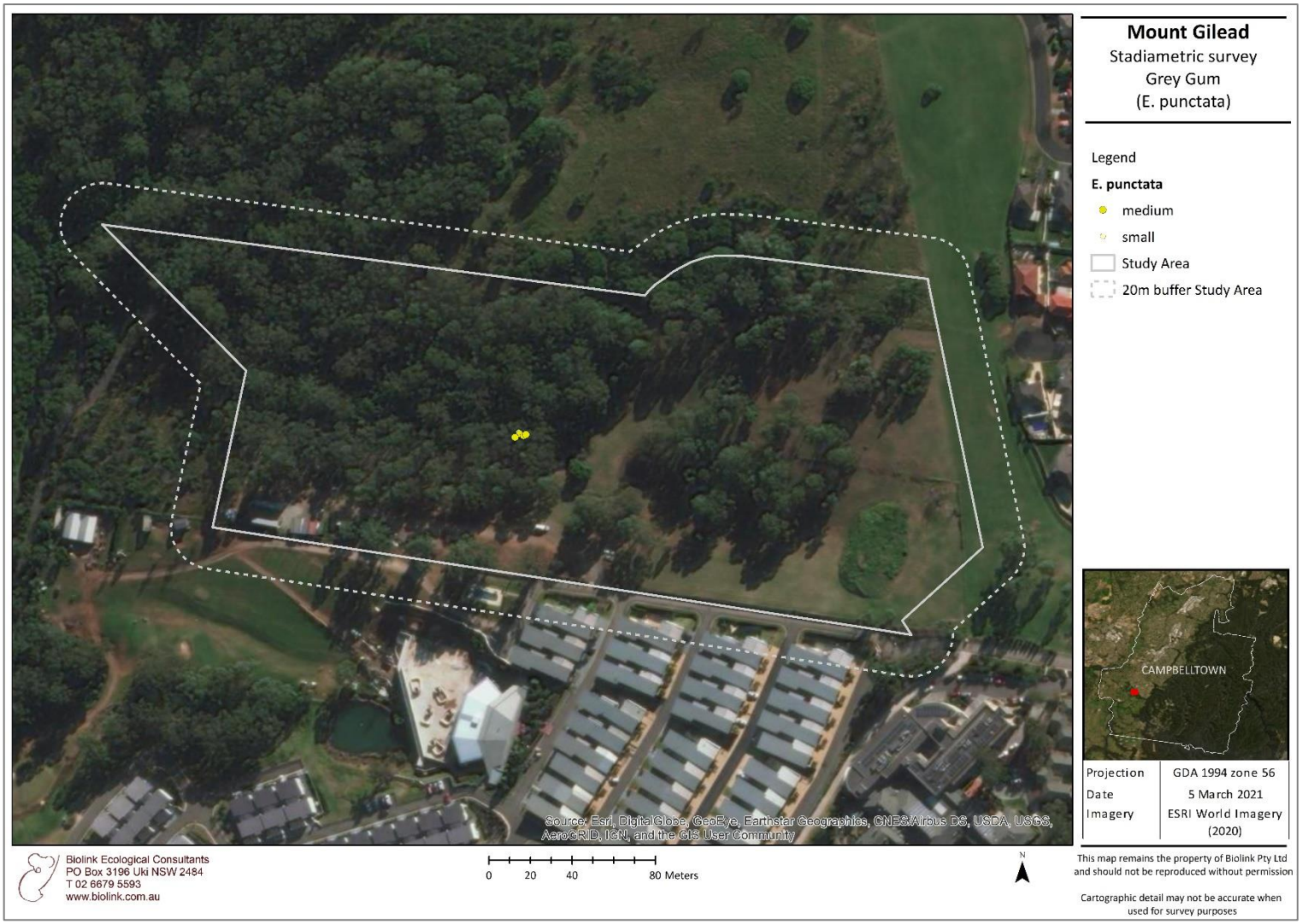

Figure 6. The distribution of five *E. punctata* across the study area with size class defined by small (light yellow small circles) and medium (yellow medium circles).

8.2.2. Vegetation communities / species composition

The mapped PCTs as presented in **Figure 1** are broadly reflective of the species composition across the study area, with some caveats. PCTs 849 (*Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin*) and 850 (*Grey Box-Forest Red Gum Grassy Woodland on Shale of the southern Cumberland, Sydney Basin*) have attributes in common, including substantial overlap in their tallest stratum composition of *E. moluccana, E. tereticornis* and *E. crebra*, with PCT 849 also typically supporting *E. eugeniodes* and *E. fibrosa*, neither of which were recorded during by this survey. The mapped distribution of tallest stratum species across the study area shows dominance of *E. moluccana* and *E. tereticornis*, with a lesser number of *E. crebra* across both PCT 849 and 850 (**Figure 7**). PCTs 849 and 850 are also typified by smaller trees, *A. implexa* and in the case of PCT 849, *A. decurrens*. This was generally reflected in data from the stadia-metric survey with *A. implexa* mapped in PCT 850, but not PCT 849 (**Figure 7**). The only *A. decurrens* mapped across the study area were outside these two PCTs. Shrub cover of *Bursaria spinosa* was widespread across lands mapped as PCT 849 and 850 and indeed across the entire study area. Additional native species noted across the lands mapped as PCT 849 and 850 were *Glycine tabacina*, *Dichondra repens, Entolasia stricta* and *Oxalis* sp. Widespread infestations of African olive (*Olea europaea*) and broad-leaved privet (*Ligustrum lucidum*) occurred across these PCTs, as did many ground-cover weed species.

Not reflected in the current vegetation mapping is a change in species composition surrounding a riparian area which originates in the west and runs centrally through the study area (**Figure 7**). It is our understanding that this area is to be excluded from any development footprint but is documented in this report to give context. This gully area was heavily infested with broad-leaved privet, likely shading out native species - a notion supported by a lack of recent recruitment with only large native trees present. Rainforest elements present in this area include common maidenhair (*Adiantum aethiopicum*) and wombat berry (*Eustrephus latifolius*) as well as previously listed *T. tabacina* and *D. repens* and a non-native vine common on rainforest margins (*Anredera cordifolia*).

Mapped in the north-western corner of the study area is a third PCT 1395 - *Narrow-leaved Ironbark-Broad-leaved Ironbark-Grey Gum Open Forest of the Edges of Cumberland Plain, Sydney Basin*. This PCT is typified by a tallest stratum of *E. crebra*, *E. fibrosa* and *E. punctata*, however stadia-metric survey revealed no *E. fibrosa* or *E. punctata* within the bounds of this mapped area. A single *E. crebra* was present, with larger numbers of *E. tereticornis* and *E. moluccana* (**Figure 7**). The lands mapped as PCT 1395 may be better described as an extension of one of the other two PCTs, either 849 or 850, depending on the underlying soil / topography.

Vegetation on the eastern third of the study area is currently unmapped, with no PCT designation. A substantial portion of this area is cleared / devoid of trees, however there are several single-species stands, with five stands of *A. implexa*, two stands of *A. decurrens*, one stand of *C. maculata* and one dispersed stand of *E. tereticornis* associated with *A. implexa* and *E. crebra* (**Figure 8**). Scattered paddock trees, primarily *E. tereticornis* and to a lesser extent *E. crebra*, are set amongst grassy ground cover, highly infested with weeds including scotch thistle (*Onopordum acanthium*), dallis grass (*Paspalum dilatatum*) and farmers friend (*Bidens pilosa*).

A check-list of native species documented across the study area is in **Appendix B**.

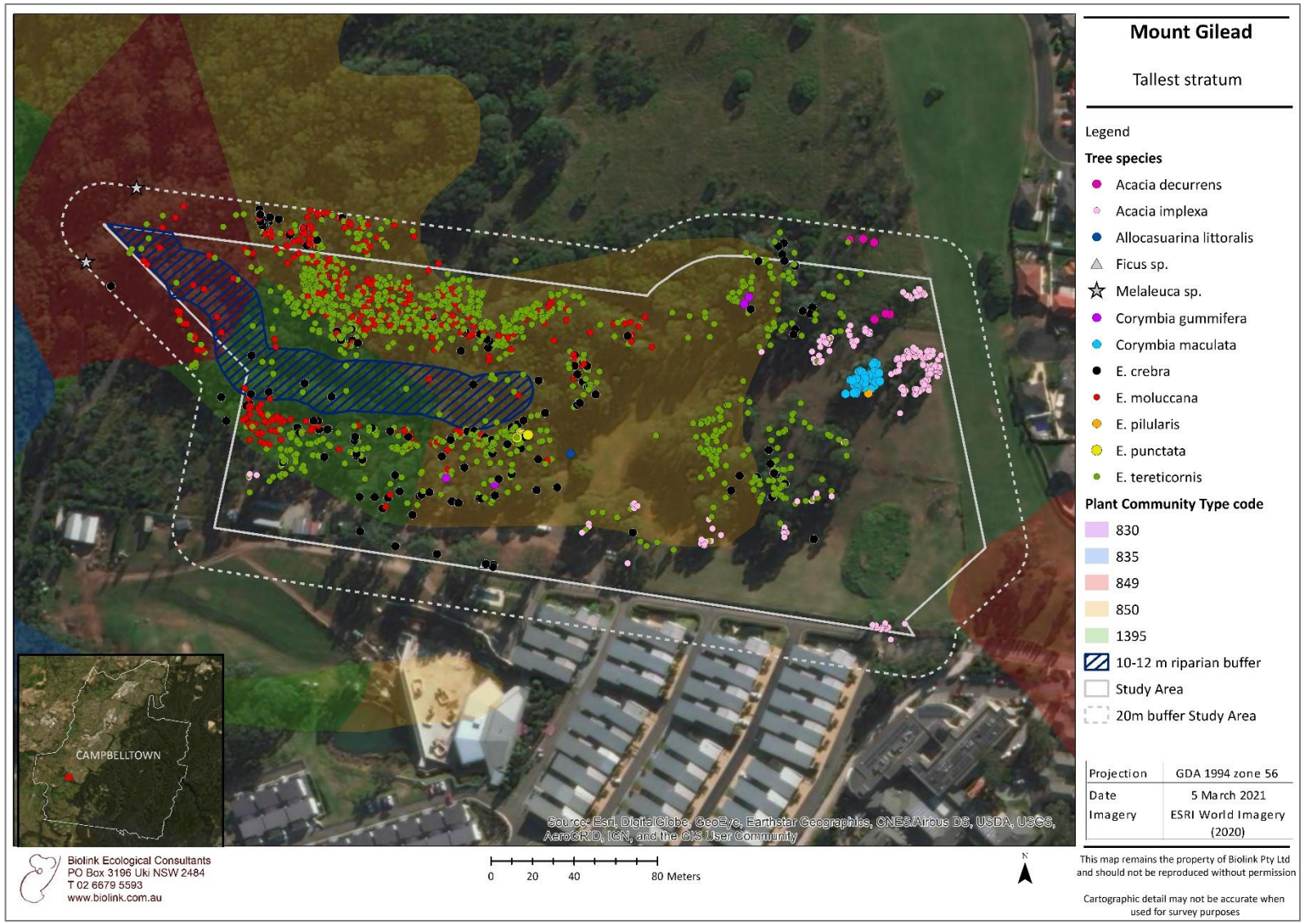

Figure 7. Tallest stratum tree species cover across the study area, overlaid on Plant Community Type (PCT) mapping. Riparian area shown in blue hatch.

Figure 8. Higher resolution of unmapped vegetation in the eastern portion of the study area, showing tallest stratum tree species.

8.3. Koala Activity Assessment Report

8.3.1. Field survey

Spot Assessment Technique (SAT) field survey assessments were undertaken on the 21st February 2021, resulting in five SAT sites being assessed. The distribution of these sites is illustrated in **Figure 9**, with a summary of associated data supplied in **Appendix C**. Evidence of koalas in the form of diagnostic faecal pellets was recorded at three of the five sampled field sites resulting in a habitat utilisation estimate of approximately 60% of the otherwise available habitat. Of the three active sites, two returned significant koala activity levels > 10% (see **Appendix C**, **Figure 9**). The activity contour analysis shows that the study area is likely to support a portion of a single koala home range area, and it is probable that this home range extends to the north-west.

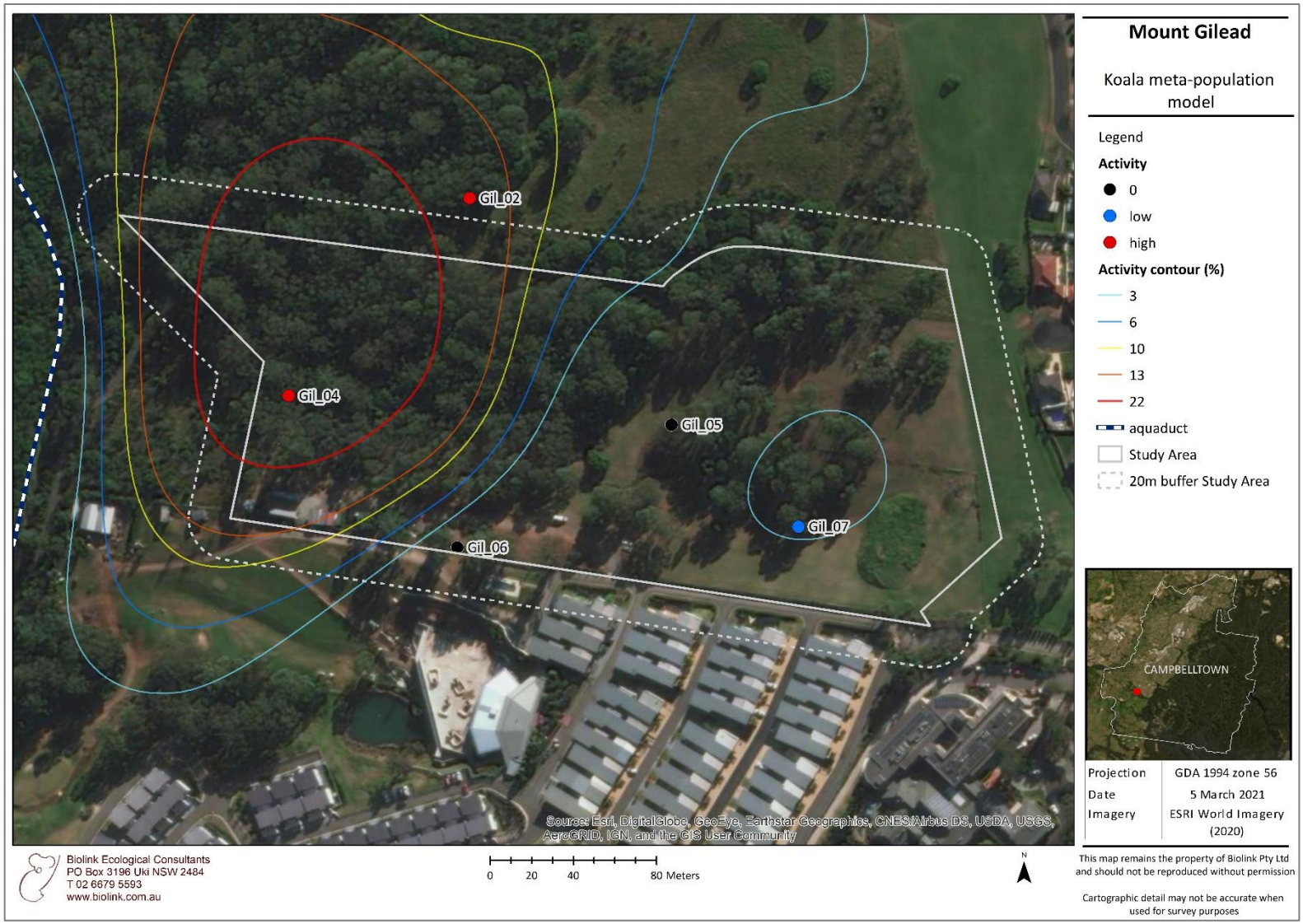

Figure 9. Koala activity model illustrating distribution of significant koala activity (yellow, orange and red lines) resulting from a five-site assessment.

9. Discussion

The outcomes of the VAR confirmed the current mapping of the study area by Campbelltown CKPoM as potential koala habitat. Vegetation in the eastern portion of the study area is currently unmapped but represents an extension of potential koala habitat by virtue of the numbers of *E. tereticornis* that are present. The presence of potential koala habitat necessitated the preparation of a KAAR, which identified koala activity levels > 10% at two of the five SAT sites which were assessed. The study area is therefore considered to currently support a mix of core and potential koala habitat, the boundaries of which were delineated by way of a splining process in the spatial analyst extension of ArcGIS 10.5 (**Figure 10).**

Development controls in core koala habitat depend on whether the DA is considered to represent a 'minor' or 'major' development. Minor development is a DA that relates to the construction of a single residential dwelling and / or the subdivision of land into ≤ two lots and / or requires the removal or no more than two PKFTs for each hectare of assessable land to which the DA relates. Without knowing the precise details of the proposed DA which is the subject of this report, it is probable that it warrants assessment as a major development, that being a DA that relates to the subdivision of a single lot of land into ≥ three lots, and / or requires the removal of ≥ three PKFTs for each hectare of assessable land to which the DA relates. Development controls in core koala habitat relate to the retention of PKFTs and shelter trees, swimming pool design, the keeping of domestic dogs, appropriate fencing, road design and protection of koalas from disturbance. In areas of potential koala habitat, Council may exercise discretion subject to the DA demonstrating that retention of PKFTs $\geq$ 200 mm DBH has been maximised and that the proposed tree removal will not prejudice the overall vision, aims and objectives of the CKPoM.

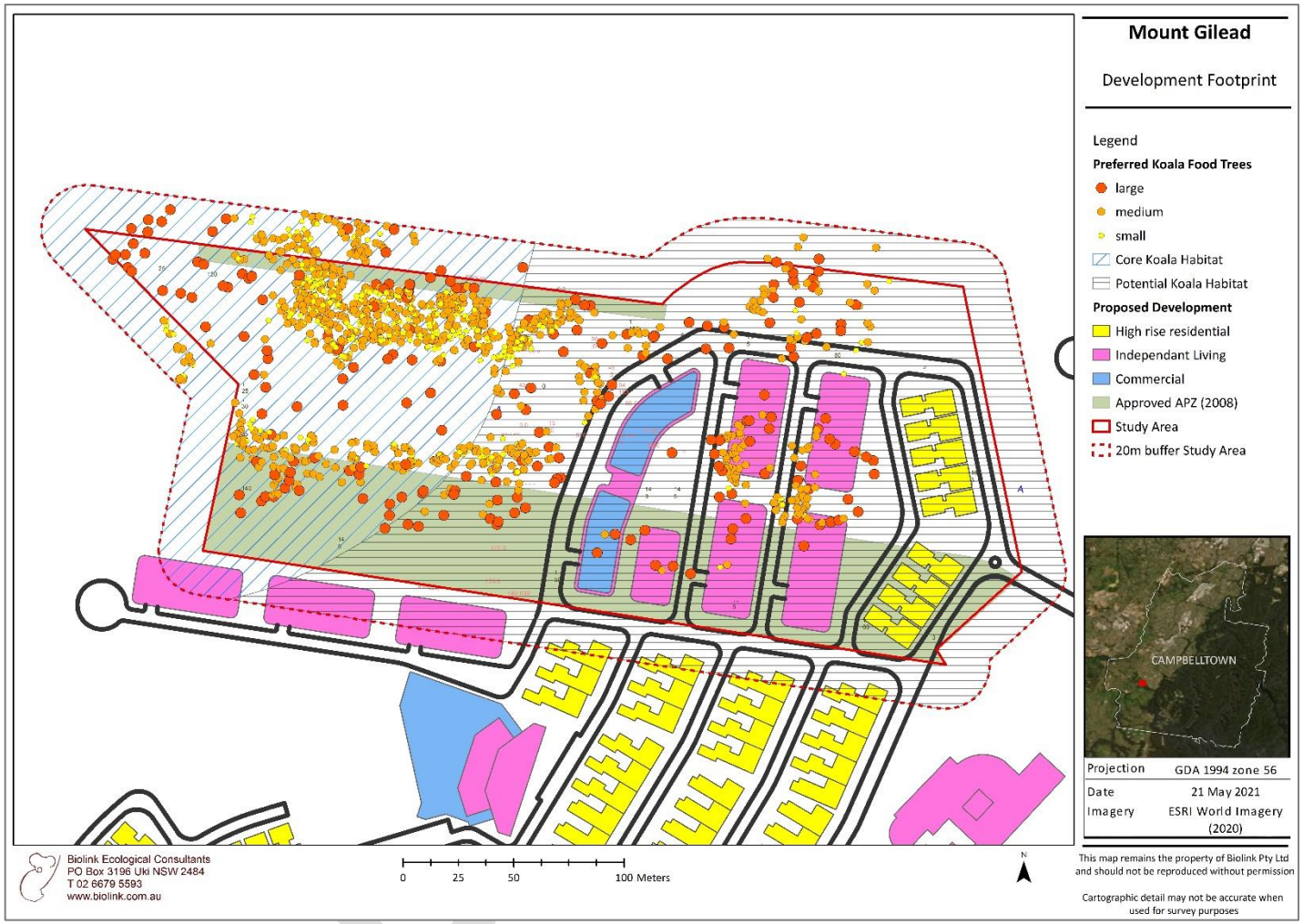

Figure 10. The study area, showing delineation of core (blue diagonal lines) *versus* potential (black horizontal lines) koala habitat, as calculated by activity contour analysis based on the outcomes of SAT survey. A potential development footprint (CAD drawing), and previously approved APZs (green). Note: the footprint was georeferenced from a pdf document and consequently there may be some slight discrepancies in its true intended size / location. The location of PKTFs is shown, categorised by size classes; small (yellow), medium (orange) and large (dark orange).

Where the proponent chooses to seek the removal of PKFTs in accordance with a major development, provision must be made to compensate for the loss of associated habitat as outlined in Part 7 of the Campbelltown CKPoM. In brief, the proponent must enter into a legally binding agreement with Council to either a) make a monetary contribution towards the Koala Habitat Rehabilitation Program (Part 8, CKPoM), or b) undertake rehabilitation works in areas identified by the Koala Rehabilitation Program (Part 8, CKPoM), including the payment of a Compensation Guarantee. The amount of money referred to in both a) and b) above, is based on the value of the required Compensation Units (CU), which is enumerated according to the number and size of PKFTs that will be removed. As a guide, at the commencement of the CKPoM, the value of a CU was $1, which was to be applied as follows;

Small (DBH < 100 mm)	8 CU / mm DBH
Medium (DBH > 100 < 300 mm	15 CU/ mm DBH
Large (DBH > 300 mm)	25 CU / mm DBH

To give some meaning to these numbers in the context of the potential DA which is the subject of this report, **Table 3** shows the numbers of PKFTs, organised by species and size class, which are located within the potential development footprint (taken from the georeferenced CAD drawing), the Asset Protection Zone (APZ) approved in 2018, and the study area more broadly. **Figure 10** also shows the location and size class of PKFTs across the potential development footprint and Approved APZ.

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Table 3. The number and size class classifications of Preferred Koala Food Trees that fall within an indicative development footprint, Approved APZ (top), Approved APZ (bottom), and the remainder of the study area.

		Development footprint		Approved APZ bottom		Approved APZ top		Remainder of study area	
Tree species	Tree size	Core	Potential	Core	Potential	Core	Potential	Core	Potential
E. moluccana	large		2	2	1	1		24	8
	medium		5	8	1	15		133	14
	small			2		5		111	11
E. punctata	large								
	medium								4
	small								1
E. tereticornis	large		61	20	22	7	3	39	16
	medium		118	31	9	19	4	316	111
	small		14	3	1	10		220	53
Total			**200**	**66**	**34**	**57**	**7**	**843**	**218**

This report does not present a figure of exactly how many trees will be removed as a result of the development, as the exact development footprint indicated in **Figure 10** may be subject to refinement and the associated APZs are not required to be completely cleared (they may instead be kept to a sparse woodland standard). Instead, we provide information on where PKFTs are currently located in the landscape and allow the Client to specify which of these will be removed once the footprint is finalised. In terms of calculating the compensatory requirements for any associated tree removal, in accordance with Parts 7 and 8 of the Campbelltown CKPoM, the Client has indicated interest in undertaking rehabilitation works.

To our knowledge there are no areas currently identified by the Koala Rehabilitation Program which might be the subject lands of such activities. In the absence of such defined areas, we suggest that the site directly to the north of the development would be an appropriate location for such activities, given its proximity to the trees which will be removed and the fact that the koala activity contours identified by this study extend into this site. Rehabilitation works on this site may therefore act to ameliorate the impacts on koala habitat connectivity resulting from the development itself. We also note that nothing in the CKPoM prohibits the proponent from undertaking rehabilitation measures on lands being the subject of the DA. The exact nature of these rehabilitation works will be subject to Council's discretion as the compensatory planting obligations outlined in the Campbelltown CKPoM apply only to minor developments.

Lastly, we note that if a DA does not conform to the defined compensatory measures set out by the CKPoM, it can be sent to the Koala Management Committee for independent assessment. A non-conforming DA may be considered and subsequently modified by Council such that the development does not compromise long-term koala management objectives. This may involve enclaving of developments in non-core koala habitat. Alternatively, the applicant may opt to prepare an Independent Koala Plan of Management under the provisions of SEPP44.

9.1. Recommendations

- In the absence of any areas currently identified by the Koala Rehabilitation Program as a site for compensatory activities, the proponent should consider rehabilitation works undertaken on the site directly to the north of the development site, assuming that these lands have secure conservation tenure.
- If the aforementioned site is deemed suitable by Council it should be formerly identified as lands with a program of habitat restoration and / or rehabilitation being undertaken as a

consequence of Part 8 of the CKPoM and listed by the Register of Development, and thereafter provided to the Koala Management Committee.

- A Vegetation Management Plan that meets the requirements set out in Council's VMP Guidelines (2016) and is formally approved by Council, should be used to guide compensatory plantings and other rehabilitation works, inclusive of supervision to ensure that any compensatory plantings succeed over time. As a guide, compensatory plantings of PKFTs should reflect locally abundant PKFT species.
- A Compensation Guarantee be paid according to the exact number of PKFTs removed as a result of this development, this number feeding into the calculation provided on page 25 of this report. This will be released once the required works have been implemented and in accord with a legally binding agreement with Council.
- Given the proximity of the development footprint to at least one koala home range and evidence of transitory PKFT use within the development footprint, the recommendations for protection of koalas from disturbance, as outlined in Part 6 of the Campbelltown CKPoM, should be considered.
- Enclaving should be considered as a means of permanently excluding koalas from the development by way of fencing, koala-grids and gateways that do not allow koalas to enter.

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Appendix A

Due to the large file size, the results of stadia-metric tree survey can be provided in a separate PDF by request.

Appendix B

Check list of native species documented across the study area.

Trees

Corymbia gummifera

C. maculata

Eucalyptus crebra

E. molucanna

E. pilularis

E. punctata

E. tereticornis

Ficus sp.

Melaleuca sp.

Small trees

Acacia decurrens

A. implexa

Allocasurina littoralis

Shrubs

Bursaria spinosa

Ground covers

Dichondra repens

Entolasia stricta

Oxalis sp

Adiantum aethiopicum

Vines and Climbers

Glycine tabacina

Eustrephus latifolius

Appendix C

Location of SAT sites.

Site	Date	Easting	Northing	Activity	Location notes
Gil_02	21/02/2021	295557	6223553	16.67	
Gil_04	21/02/2021	295470	6223458	30.00	
Gil_05	21/02/2021	295654	6223444	0	Half of site is paddock trees, other half is olive forest.
Gil_06	21/02/2021	295551	6223385	0	Edge of development site/fencing onto shared residential swimming pool. Disturbed / weedy
Gil_07	21/02/2021	295715	6223395	3.33	Disturbed / weedy.

Appendix 2

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Curriculum Vitae

Dr. Amanda Lane (Supervising Ecologist)

Mobile: 0434 537 465 **| Landline:** 02 6679 5523 **| Email:** Amanda.lane@biolink.com.au

Qualifications: Bachelor of Arts – University of Queensland

Bachelor of Science (Honours) – University of Queensland

Doctor of Philosophy (Science) – University of Sydney

Select recent key projects:

- Review of the conservation status of the Queensland population of the koala, leading up to and including the 2019 fire events (WWF-Australia)
- Review of the conservation status of NSW populations of the koala, leading up to an including part of the 2019/20 fire event (International Fund for Animal Welfare)
- Areas of Regional Koala Significance (ARKS): methodological review and recommendations for refinement (DPIE)
- Koala habitat connectivity across the Cumberland Plains, NSW (Greening Australia)
- Ecological assessments for koala habitat conservation agreements in Ballina/Lismore and Port Macquarie (Biodiversity Conservation Trust).
- Bonny Hills corridor connectivity assessment (Port Macquarie-Hastings Council).
- Field survey and records analysis including koala vehicle-strike, identification of koala black spots (Lismore Council).
- GAP CLoSR connectivity analyses and prioritisation program for koala conservation (Port Stephens).
- Review connectivity options across Macarthur and Wilton SE priority growth areas (Campbelltown City Council / Office of Environment and Heritage).
- Historical analysis and population assessments to guide koala conservation in South Grafton (Clarence Valley Council).
- Redlands koalas LGA wide assessment (Redlands City Council).
- Gold Coast koalas city-wide monitoring and historical records analysis (City of Gold Coast).

Areas of expertise:

Amanda has over 15 years' experience advising universities, private industry, government bodies and NGO's. She is a former lecturer at the University of Sydney with professional interests in wildlife ecology, botany, conservation and genetics. Prior to joining Biolink, Amanda spent a period of time researching the current conservation and genetic challenges of Tasmanian Devils, work that was undertaken in association with the Save the Tasmanian Devil Program. As a collaborator with the International Union for the Conservation of Nature (IUCN), Amanda is also involved with monitoring the global conservation status of sea snakes which allows her to continue contemplating the marine reptiles she researched during her Ph.D.

In recent times, Amanda has been involved in the preparation of reports and associated koala plans of management, and has utilised GIS-based software (i.e. GAP CLoSR) to examine koala linkages / habitat connectivity issues, and the development of GIS procedures for examining population distribution and threatening processes at both local and regional scales. Amanda performs specialist flora and fauna surveys using a variety of techniques including BAM (Biodiversity Assessment Method) and Rapid VI (Vegetation Integrity), most recently to assess priority areas for koala habitat conservation in both Ballina and Port Macquarie, in association with the Biodiversity Conservation Trust. Peer reviewed scientific papers by Amanda have been published in national and international journals including *Conservation Biology, Australian Journal of Zoology, Molecular Ecology, Austral Ecology, Biological Conservation, Animal Behaviour, Functional Ecology and Molecular Phylogenetics and Evolution*.

Peer Reviewed Publications

Phillip, S., Wallis, K., **Lane, A.** (2021). Quantifying the impacts of bushfire on population of wild koalas (Phascolarctos cinereus): Insights from the 2019/20 fire season. *Ecological Management and Restoration* 22: 80 – 88.

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Russell, T., Lane, **A.M.** … Madsen, T. (2018). MHC diversity and female age underpin reproductive success in an Australian icon; the Tasmanian Devil. *Scientific Reports* 8: 4175.

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Eifes, C.T., **Lane, A.M**. … Murphy, J. (2013). Fascinating and forgotten: the conservation status of marine elapid snakes. *Herpetological Conservation and Biology* 8: 37-52.

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McMeniman, C.J., **Lane, A.M.** … O'Neill, S. (2008). Host adaptation of a Wolbachia strain after long-erm serial passage in mosquito cell lines. *Applied and Environmental Microbiology* 74: 6963-6969.

Lane, A.M., Oldroyd, B.P. and Shine, R. (2008). Microsatellite loci for laticaudine sea kraits. *Molecular Ecology Resources* 8: 1161-1163.

Unsworth, N., **Lane, A.M**. … Nissen, M.D. (2007). Flinders Island spotted fever rickettsioses caused by "marmionii" strain of *Rickettsia honei*, Eastern Australia. *Emerging Infectious Diseases* 13: 566-573.

Shine, R., Webb, J.K., **Lane, A.M**. and Mason, R.T. (2006). Flexible mate choice: a male snake's preference for larger females is modified by the sizes of the female encountered. *Animal Behaviour* 71: 203-209.

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Shine, R., Webb, J.K., **Lane, A.** and Mason, R.T. (2005). Mate location tactics in garter snakes: effects of rival males, interrupted trails and non-pheromonal cues. *Functional Ecology* 19: 1017-1024.

Lane, A.M., Shaw, M.D., McGraw, E.A. and O'Neill, S. (2005). Evidence of a spotted fever-like Rickettsia and a potential new vector from north-eastern Australia. *Journal of Medical Entomology* 42: 918-921.

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Curriculum Vitae

Kirsty Wallis (Conservation Analyst)

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Qualifications: Bachelor of Science

Masters in Wildlife, Health and Population Management

Select recent key projects:

- Koala Baseline Surveys & Analyses – Koala Likelihood Model (NSW Office of Environment and Heritage).
- The Kiwarrak and Khappinghat ARKS: Aspects of distribution and abundance of koalas (MidCoast Council).
- Historical analysis and population assessments to guide koala conservation in South Grafton (Clarence Valley Council).
- Save our Species Report: Managing koala populations for the future (Port Stephens LGA).
- Koala habitat assessments, utilisation and mapping (South Gippsland Landcare Network).
- Historical records analysis and koala hub assessments (Port Stephens Council).
- Redlands LGA wide assessment (Redlands City Council).
- Gold Coast city-wide monitoring and historical records analysis (City of Gold Coast).

Areas of expertise:

Kirsty has over 10 years of experience working with State-based conservation agencies and in the environmental industry. Coming to Biolink from koala-focused work with a State-based conservation agency, Kirsty has designed and manages Koala-SAT database and oversees the spatial analysis / GIS side of our work, as well as engaging in field work wAhen the opportunity arises.

Kirsty's experience with Biolink includes unravelling the complexities of the NSW Government's Koala Likelihood Modelling (KLM) project and working on the creation of a koala habitat model for the South Gippsland area of Victoria. Most recently, Kirsty's expertise assisted in the development of the Rapid-SAT methodology and novel mathematical and spatial analysis techniques to identify koala black-spots in the Lismore LGA.

Compliance with the Campbelltown Comprehensive Koala Plan of Management: proposed development on Lot 21/1000643, Gilead

Report to Travers Bushfire and Ecology

November 2021

biolink Ecological Consultants

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Table of Contents

Abbreviations

Abbreviation	Description
APZ	Asset Protection Zone
CCC	Campbelltown City Council
CC	Construction Certificate
CU	Compensation Units
CKPoM	Comprehensive Koala Plan of Management
DA	Development Application
DPIE	NSW Department of Planning, Industry and Environment
EP&A Act	Environmental Planning and Assessment Act, 1979
GP	Generational Persistence
GPS	Global Positioning Service
KAAR	Koala Activity Assessment Report
LGA	Local Government Area
NPWS	National Parks and Wildlife Services
NSW	New South Wales
PCT	Plant Community Type
PKFT	Preferred Koala Food Tree
SEPP44	State Environmental Planning Policy No. 44 (Koala Habitat Protection)
SLA	Strategic Linkage Area
VAR	Vegetation Assessment Report

Biolink

Supervising Ecologist Amanda Lane
Conservation Analyst Kirsty Wallis

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Summary

The Campbelltown Local Government Area (LGA) supports one of the last known koala (*Phascolarctos cinereus*) populations inhabiting the Sydney region. In accord with the stated goals of the State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP44), the Campbelltown Comprehensive Koala Plan of Management (CKPoM) provides a strategic approach to the protection, management and restoration of koala habitat for the entire LGA. Compliance with the CKPoM therefore constitutes compliance with the provisions of SEPP44. This document outlines the requirements for compliance with the Campbelltown CKPoM for a proposed development on Lot 21/1000643 and partial Lot 3/1007066 in Gilead, south west Campbelltown. These requirements include the preparation of a Vegetation Assessment Report (VAR), a Koala Activity Assessment Report (KAAR) and addressing the obligation for compensation and offsetting arising from the loss of Preferred Koala Food Trees (PKFTs). Collectively, the outcomes of the VAR and KAAR indicate that Lot 21/1000643 supports a mix of core koala habitat (with contemporaneous koala occupancy) and potential koala habitat, as defined by the Campbelltown CKPoM. The concept development footprint, as it is currently proposed, falls outside of core koala habitat and is situated entirely in potential koala habitat. Given its proximity to core koala habitat which is adjacently located within the same land parcel, as well as mapped to the south-east according the CKPoM, the proponent will need to follow development controls for core koala habitat, as it pertains to the retention of PKFTs, swimming pools, domestic dogs, fencing, road design and protection of koalas from disturbance. The most effective way of achieving this outcome is likely to be the enclaving of the proposed development. Compensatory requirements arising from the loss of PKFTs, as mapped in the VAR, are intended to be met via a monetary contribution to the Koala Habitat Rehabilitation Program, as outlined in Part 7 of the CKPoM. Adhering to the measures set out in this document will be an effective means of establishing compliance of the proposed development with the the Campbelltown CKPoM.

1. Introduction

The aim of State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP44) is to support the conservation and management of areas of natural vegetation that provide habitat for koalas (*Phascolarctos cinereus*) across New South Wales (NSW), to ensure the persistence of a permanent free-living population across the species' range. SEPP44 is a prescribed consideration under the NSW Environmental Planning and Assessment Act, 1979 (EP&A Act) for all Development Applications (DA) that may impact koalas or their habitat. A path to achieving this is through the preparation of Koala Plans of Management, either for an entire Local Government Area (LGA) – known as a Comprehensive Koala Plan of Management (CKPoM) - or some portion therein. Campbelltown City Council (CCC) requires that developments seeking approval on lands which support native vegetation and / or are > 1 ha, be assessed for koala occupancy and habitat by following the guidelines in the approved Campbelltown CKPoM (Phillips 2018).

One way in which areas of native vegetation in the Campbelltown LGA are assessed for potential koala habitat is through the requirement for a Vegetation Assessment Report (VAR). In areas of potential koala habitat, this standardises the habitat assessment process to ensure that best practices are applied to identify core koala habitat. Identification of core koala habitat further relies on the CKPoMs requirement for a Koala Activity Assessment Report (KAAR) to delineate areas of habitat that are contemporaneously occupied by resident koalas. Through this process Council planners are provided with standardised data to inform the determination process for Development Applications (DA), among other matters. The Campbelltown CKPoM also identifies the location of Strategic Linkage Areas (SLA) – these being areas that support major movement corridors for koalas. Council cannot approve a DA that falls within a SLA unless it is satisfied that the proposal will not interfere with the movement of koalas.

1.1 Campbelltown CKPoM

The Campbelltown CKPoM was adopted by resolution of CCC at its Ordinary Meeting held 13 December 2016 and was subsequently approved by the Secretary of the DPIE July 2020. The area covered by the Campbelltown CKPoM equates with the Campbelltown LGA, excluding National Parks and Wildlife Services (NPWS) estate that is otherwise exempt from SEPP44. The Campbelltown CKPoM does not supersede approved Individual Koala Plans of Management (IKPoM) that have been prepared in accord with SEPP44 and which are currently in force, unless there is provision for ongoing amendment. The lead authority is CCC who are responsible for developing, implementing and enforcing planning controls that relate to the management of koala habitat, among other things.

1.2 Definitions of Koala Habitat

For the purposes of the Campbelltown CKPoM, the term 'potential koala habitat' is defined as;

" any area of native vegetation where trees of the types listed in Schedule 2 of SEPP44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component;

a) *as identified in Figure 5.1 of the Plan, or*
b) *b) any other land identified as such by other processes arising from the Plan (such as VAR)."*

The term 'core koala habitat' is defined as;

"any parcel of land that is either wholly or partly identified under SEPP44 to contain a resident population of koalas, evidenced by attributes such as breeding females (that is females with young) and recent sightings of and historical records of a population;

a) *as identified in Figure 5.1 of this Plan, or*
b) *any other land identified as such by other processes arising from the Plan (such as a VAR)."*

Strategic Linkage Areas (SLAs), as defined by the Campbelltown CKPoM, are illustrated in Figure 5.3 of that same document.

1.3 Purpose of this document

This document is designed to review the compliance of a proposed development on Lot 21/1000643 and part of Lot 3/1007066 (Gilead, NSW), against the requirements of the Campbelltown CKPoM, by following the development assessment process, as outlined below in **Figure 1**.

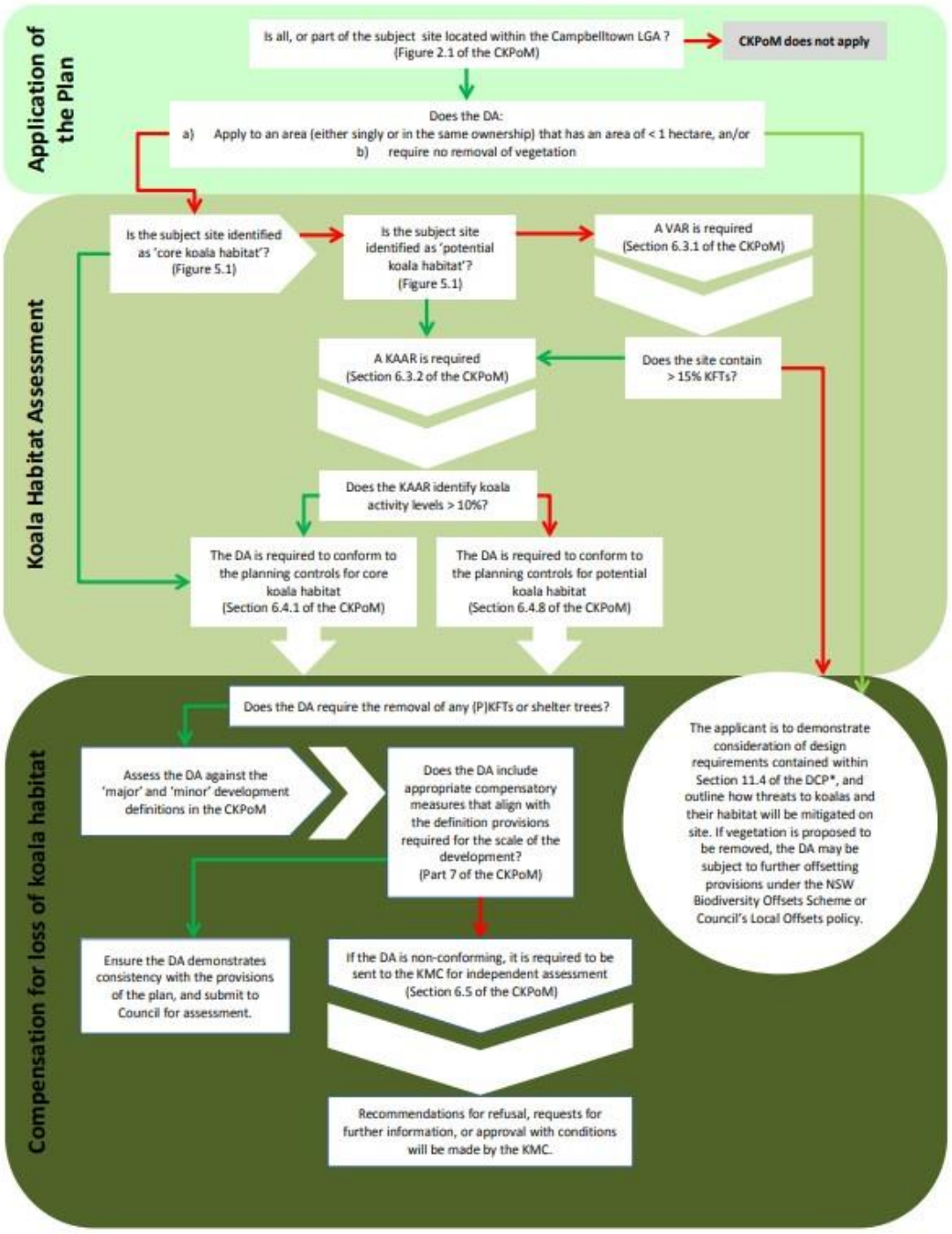

Figure 6.1: Development Assessment framework flowchart

Figure 1: Flowchart showing the assessment process for Development Applications (DA) according to the Campbelltown CKPoM. Taken from Figure 6.1 of that document.

2. Proposed development

The primary lot to which the proposed development applies (Lot 21/1000643) plus a small extension into Lot 3/1007066 which represents an Asset Protection Zone (APZ), all with a 20 m buffer is hereafter referred to as the study area, that being the area to which this compliance checklist pertains (7.80 ha in size). The land parcel is located at 70 Glendower Street, Gilead, NSW, 2560 and is situated directly north of the Estia Health Kilbride Retirement facility. The eastern border adjoins Rosemeadow and is in the south-west of Campbelltown LGA. The proposed development would represent an extension to the adjacent retirement facility, consisting of a combination of high rise residential, independent living and commercial premises. This is a proposed development, for which there is no current DA. A concept development footprint is shown in **Figure 2,** which also displays mapped vegetation.

2.1 Mapped vegetation

Using the Southern Sydney Vegetation Mapping layer, 4.02 ha (51.54%) of the study area is mapped as vegetation and comprises three Plant Community Types (PCTs); 849 Gum-topped/Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin (0.64 ha), 850 Grey Box-Forest Red Gum Grassy Woodland on Shale of the southern Cumberland, Sydney Basin (2.61 ha) and 1395 Narrow-leaved Ironbark-Broad-leaved Ironbark-Grey Gum Open Forest of the Edges of Cumberland Plain, Sydney Basin (0.77 ha) (**Figure 2**). All mapped vegetation within the study area is considered as potential koala habitat due to the presence of PKFTs within these PCTs and is mapped as potential koala habitat for the purposes of the Campbelltown CKPoM (**Figure 3**).

Figure 2: Concept design for a proposed retirement facility on Lot 21/1000643, Gilead, NSW, plus a small extension into Lot 3/1007066 to the north, which represents an Asset Protection Zone.

2.2 Site context

The study area is located directly adjacent to mapped core koala habitat to the east (**Figure 3**). The study area does not intersect any Strategic Linkage Areas (SLA) as mapped by the CKPoM, the nearest SLA being located to the south of the Estia Health Kilbride Retirement facility (**Figure 3**). As part of an analysis of koala records across the Campbelltown LGA, Biolink (2016), conducted a Generational Persistence (GP) Assessment, a process which examines historical koala records for evidence of koalas reoccurring in a localised area over sets of three consecutive koala generations[1]. The purpose of GP Assessment is to identify (where possible) the presence of resident source populations. This is determined using records from the BioNet Atlas;

(https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx),

[1] One koala generation is determined to be a period of six years (Phillips 2000)

with the presence of records from each relevant koala generation, within a 2 km grid cell, being the statistic of interest. Using this approach, cells of GP were found to adjoin the study area to the east at Rosemeadow (**Figure 4**). Whilst there are no koala records (BioNet Atlas) within the study area, there are 29 records within 1 km of the study area that are from the most recent koala generation (2015 – 2020) (**Figure 5**).

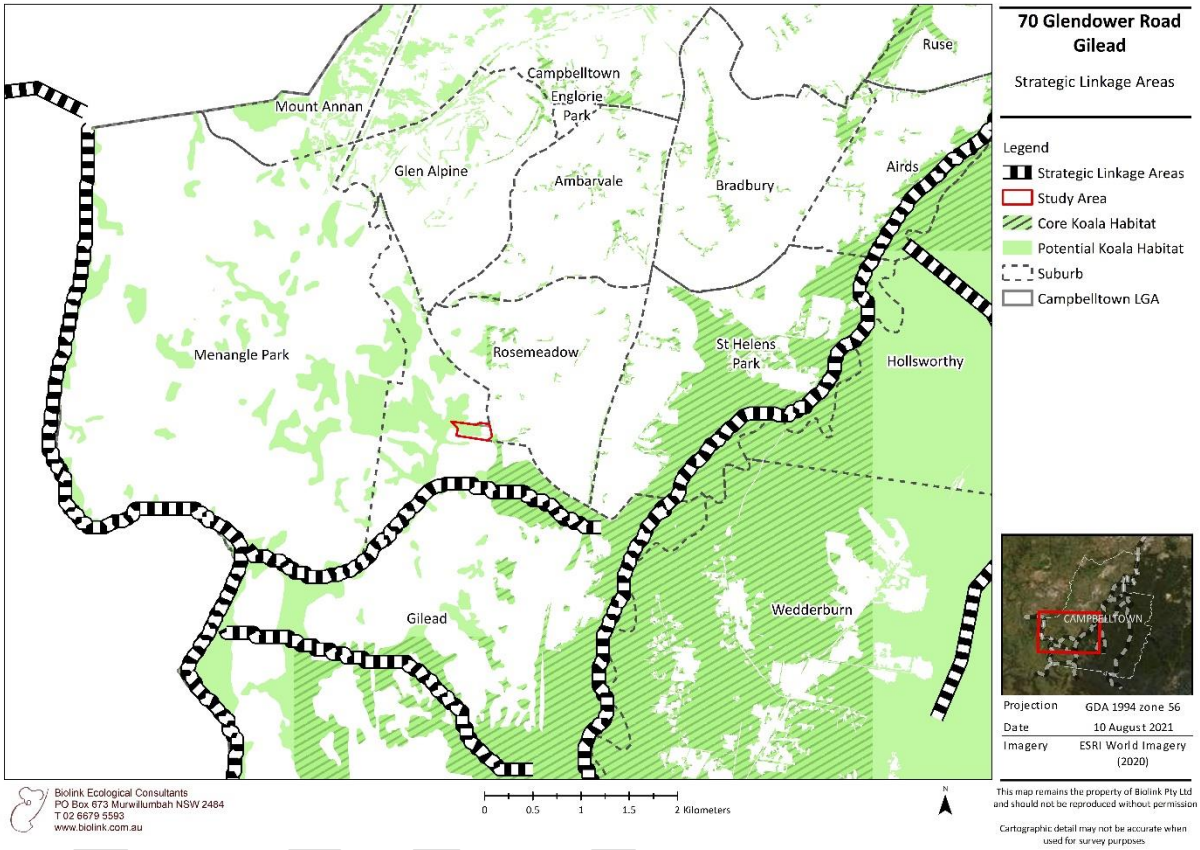

Figure 3: A close-up image, taken from of Figure 5.3 of the Campbelltown CKPoM, centred on the study area (red outline) which maps potential (green) and core (green hatched) koala habitat, as well as the location of Strategic Linkage Areas (SLA). The study area is shown to support potential koala habitat.

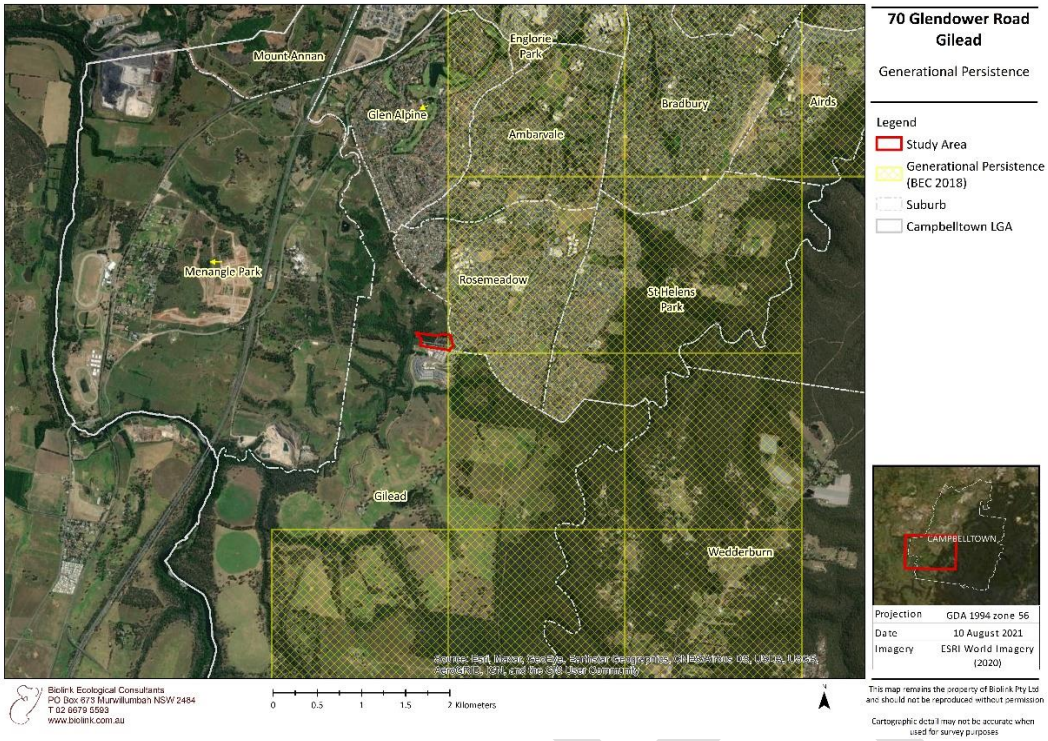

Figure 4: Areas of Generational Persistence (GP) (yellow cross hatch), located directly to the east of the study area (red outline).

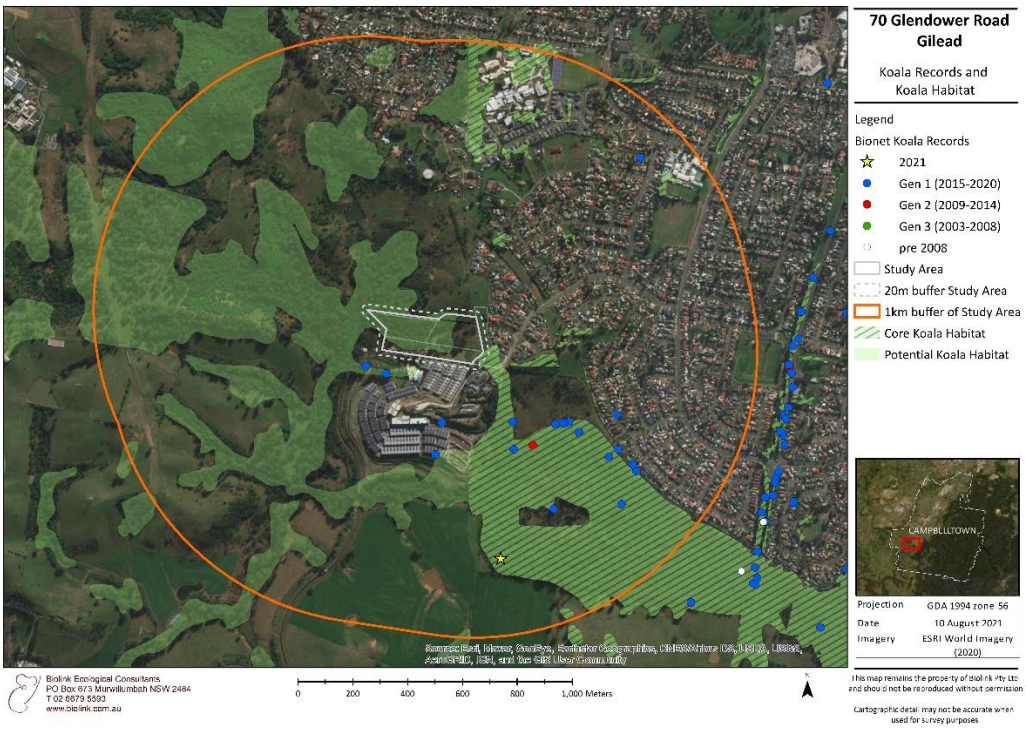

Figure 5: Koala records (BioNet) from the most recent koala generation (2015 – 2020), in relation to the study area (white outline) and a 1 km buffer (orange outline). There are no recent koala records within the study area and 29 recent records from within the 1 km buffer.

3. Development Application assessment flowchart

The following questions are taken from the flowchart outlining the assessment process for DAs in the Campbelltown CKPoM (Figure 6.1 of that document – see **Figure 1** of this report).

Is all, or part of the subject site located within the Campbelltown LGA? (Figure 2.1 of the CKPoM)

Yes – the subject site is Lot 21/1000643 and part of Lot 3/1007066, Gilead NSW.

Does the DA: Apply to an area (either singly or in the same ownership) that has an area of < 1 ha, and/or b) require no removal of vegetation.

No – see **Figure 2** and **Section 2** of this report.

Is the subject site identified as 'core koala habitat'? (Figure 5.1 of the CKPoM)

No – see **Figure 3** of this report.

Is the subject site identified as 'potential koala habitat'? (Figure 5.1 of the CKoPM)

Yes – see **Figure 3** of this report. In brief, the site is mapped in Figure 5.1 of the CKPoM as containing potential koala habitat across the majority, but not the entirety, of its area. A VAR was prepared by suitably qualified individuals[2] to ascertain the extent of potential koala habitat on the site, in accordance with the requirements of the CKPoM for sites with potential koala habitat mapped on site. The results of the VAR are presented in **Appendix 1, Section 3.2**. In brief, the results of the VAR confirm potential koala habitat as occurring broadly across the site, with an extension to the east where there is unmapped native vegetation consisting of several single-species stands of trees, set amongst scattered paddock trees and weedy ground cover. Du to the prevalence of *Eucalytpus tereticornis*, this unmapped vegetation meets the definition of potential koala habitat as outlined in the Campbelltown CKPoM. No koala shelter trees were recorded on the site.

[2] Suitably qualified individual, that being a person with post-graduate qualifications in koala ecology and/or demonstrable work experience that includes publication of works on koala ecology in peer-reviewed scientific literature and/or accreditation as a koala specialist by Council and/or a professional body such as the EIANZ. Authors of this compliance checklist also prepared the VAR and KAAR and their CVs can be found in Appendix 2.

A KAAR is required (Section 6.3.2 of the CKPoM). Does the KAAR identify koala activity levels > 10%

Yes - A KAAR was prepared by suitably qualified individuals[2] with the results presented in **Appendix 1, Section 3.3**. In brief, the results of the KAAR show that two of the five sites surveyed across the study area support significant koala activity (≥ 10%) and must therefore be regarded as supporting a resident koala population for the purposes of the Campbelltown CKPoM (Appendix B, page 58 of the CKPoM). Output from a splining process produced an activity contour model delineating the boundaries of core koala habitat and indicating that the western section of the study area is likely to support a portion of a single koala home range and it is probable that this home range extends further to the north-west. In this way, core koala habitat is present on the Lot to which the proposed DA will apply, but it does not intersect the proposed development footprint (as it is shown in **Figure 2**). Given the proximity of core koala habitat to the proposed development footprint and the existence of core koala habitat on the land parcel to which the proposed DA applies, the proponent will need to take a precautionary approach and conform to the planning controls for core koala habitat (Section 6.4.1 of the CKPoM). See **Section 4** of this report for more detail on how the proposed development can adhere to planning controls in core koala habitat.

Does the DA require the removal of any (P)KFTs or shelter trees?

Yes – see **Appendix 1, Figure 10** and **Table 3** for the intersection of the concept development footprint and PKFTs as mapped by the VAAR. There are no koala shelter trees, as defined in the CKPoM, mapped within the study area (see **Appendix 1, Section 3.2**).

Assess the DA against the 'major' and 'minor' development definitions in the CKPoM.

The proposed DA relates to a major development given that it relates to the subdivision of land into ≥ three lots, and/or requires the removal of three or more (P)KFTs for each ha of assessable land (see **Figure 2** and **Section 2** of this report). Where a proponent chooses to seek the removal of PKFTs or shelter trees in accordance with a DA, provision must be made to compensate for the loss of associated habitat.

Does the DA include appropriate compensatory measures that align with the definition provisions required for the scale of the development? (Part 7 of the CKPoM)

The proponent will enter into a legally binding agreement with Council to make a monetary contribution towards the Koala Habitat Rehabilitation Program, as detailed in Part 8 of the Campbelltown CKPoM, to offset the loss of PKFT arising from the proposed development. The amount of the compensatory payment is based on the value of the required 'compensation units' (CU) (for every cm of DBH or part thereof) arising from the total number and size of PKFTs that will be removed. As a guide, at the commencement of the CKPoM, the value of a CU was $1, which was to be applied as follows;

Small (DBH < 100 mm)	8 CU / mm DBH
Medium (DBH > 100 < 300 mm	15 CU/ mm DBH
Large (DBH > 300 mm)	25 CU / mm DBH

To give some meaning to these numbers in the context of the potential DA which is the subject of this document, **Appendix 1, Table 3** shows the numbers of PKFTs, organised by species and size class, which are located within the potential development footprint (taken from the georeferenced CAD drawing), the Asset Protection Zone (APZ) approved in 2018, and the study area more broadly. **Appendix 1, Figure 10** also shows the location and size class of PKFTs across the potential development footprint and Approved APZ.

4. Development controls in core koala habitat

Development controls in core koala habitat relate to all planning proposals, re-zonings and DA's that apply to an area with core koala habitat, as defined by the Campbelltown CKPoM and covers the retention of PKFTs and shelter trees, swimming pool design, the keeping of domestic dogs, appropriate fencing, road design and protection of koalas from disturbance.

4.1. Retention of PKFTs

According to Section 6.4.2 of the CKPoM, there shall be no removal PKFTs as a consequence of any new DA, beyond what is permissible under the definitions for major development. It is assumed that these permissions relate to removing PKFTs that are appropriately compensated for, which has been outlined in this report. The applicant must also demonstrate to the satisfaction of Council that the protection of all PKFTs are consistent with the requirements of AS 4970-2009 (Protection of Trees on Development Sites). Retained PKFTs that occur within residential allotments arising from the subdivision of land must be protected by a covenant or other effective restriction on the user on title of the land where appropriate.

4.2. Swimming pools

All new swimming pools must incorporate koala-friendly design features including a shallow ramp and/or stout rope to enable egress by koalas. Fencing must be of a type that prevents access by koalas, without contravening provisions of the *Swimming Pools Act 1992*.

4.3. Domestic dogs

The keeping of domestic dogs will either be prohibited by an effective restriction on the title of the land, or other planning measure, or subject to a covenant; imposing a legal requirement to install a dog-proof yard, whether the prospective owner has the immediate intention of owning a dog or not. Further detail is found in Section 6.4.4 of the CKPoM and these options must either be registered and/or in place prior to the issuing of a Construction Certificate (CC).

4.4. Fencing

Fencing must not impede the movement of koalas and fences not supported by the CKPoM include (but are not limited to);

- Colourbond panel fencing
- Barbed wire fencing
- Solid brock fencing (> 1 m high)
- Steel fencing (>30cm gas between rails)

4.5. Road design

Road design standards and/or approved vehicle calming devices must be incorporated on any new roads created through residential subdivision with a maximum speed of 40km/hr. Outside of residential subdivisions , where new roads or road upgrades are proposed that traverse areas of koala habitat and are predicted to accommodate in excess of 1,500 vehicle movements/day, rules apply as to the requirement for wildlife exclusion fencing, koala-grids at access points to the road corridor and connectivity structures such as under/overpasses should be at intervals of one structure per 250m or exclusion fencing. In areas where topographic or engineering constraints prevent the building of such structures, other solutions should be sought. Detailed design of the above must be prepared by a suitably qualified person.

4.6. Protection of koalas from disturbance

Clearing of native vegetation / earthworks must be temporarily suspended within a range of 25 m from any tree which is concurrently occupied by a koala and must not resume until the koala has moved from the tree of its own volition. No clearing can commence until the area proposed for clearing has been inspected for the presence of koalas by a suitably qualified person, and approval given in writing (approval is only valid for the day on which the inspection is undertaken). The individual implementing the inspection, or a nominated representative, must remain onsite during any approved clearing and if clearing operations on different sections of land are being undertaken concurrently, a suitably qualified person must be present in each section.

5. Ensuring development compliance

The land to which the proposed development on Lot 21/1000643 and partial Lot 3/1007066 in Gilead, south west Campbelltown, applies has followed the required development assessment process as outlined in **Figure 1**, including the preparation of a VAR and a KAAR. The outcomes of these studies demonstrate that the lands to which the proposed development applies supports a mix of potential and core koala habitat, with the concept development footprint falling outside of, but adjacent to, core koala habitat (mapped to the south-east in **Figure 3** and to the west as an outcome of the KAAR (**Appendix 1, Section 3.3**)).

The proposed development qualifies as a major development under the definitions of the Campbelltown CKPoM and involves the removal of PKFTs. This necessitates compensatory payments to the Koala Habitat Rehabilitation Program, with the amount of compensation subject to the exact number and size of PKFTs to be removed. This document does not present a number of exactly how many trees will be removed as a result of the proposed development, as the exact development footprint indicated in **Figure 2** may be subject to refinement and the associated APZs are not required to be completely cleared (they may instead be kept to a sparse woodland standard). This is likely to be an on-going conversation between the proponent and Council, of which this document represents the first step in establishing a final compensatory amount.

We acknowledge uncertainty around whether the application of development controls for new subdivisions should apply to the proposed development as it is not a sub-division proper, but does represent the construction of a large number of residential dwellings and associated increases in traffic, among other factors. The most effective way to address the required development controls for core koala habitat, as outlined in **Sections 4.2 – 4.5** above, and in-keeping with the spirit of the CKPoM, may be the enclaving of the development. Enclaving is considered an effective means of permanently

excluding koalas from the development by way of fencing, koala-grids and gateways that do not allow koalas to enter. While the proposed development does not fall within a SLA, the option to enclave should be considered in conjunction with an assessment of impacts on koala habitat connectivity, particularly in light of the hard boundary to koala movement presented by the aqueduct to the west of the study area.

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Appendix 1

Assessment of Lot 21/1000643 Campbelltown: koala occupancy and habitat

Report to Travers Bushfire and Ecology

June 2021

Table of Contents

Abbreviations

Abbreviation	Description
APZ	Asset Protection Zone
CCC	Campbelltown City Council
CU	Compensation Units
CKPoM	Comprehensive Koala Plan of Management
DA	Development Application
DBH	Diameter at Breast Height
DPIE	NSW Department of Planning, Industry and Environment
GPS	Global Positioning Service
KAAR	Koala Activity Assessment Report
LGA	Local Government Area
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PKFT	Preferred Koala Food Tree
PKH	Preferred Koala Habitat
SAT	Spot Assessment Technique
SEPP44	State Environmental Planning Policy No. 44 (Koala Habitat Protection)
SLA	Strategic Linkage Area
VAR	Vegetation Assessment Report

Biolink

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Field Survey	Kirsty Wallis, Amanda Lane

Acknowledgements

We thank John Travers of John Travers Bushfire and Ecology.

Summary

In accord with the requirements of the Campbelltown Comprehensive Koala Plan of Management (CKPoM), this report describes fieldwork which resulted in a Vegetation Assessment Report (VAR) and a Koala Activity Assessment Report (KAAR) for a proposed development on Lot 21/1000643 and partial Lot 3/1007066 in Gilead, south west Campbelltown. The VAR included a stadia-metric survey of native trees over 50 mm Diameter at Breast Height (DBH) within the defined study area, that being the primary lot to which the proposed development applies and a small extension into adjoining lot 3/1007066, plus a 20 m buffer. The five most encountered native species were *Eucalyptus tereticornis*, *E. moluccana*, *Acacia implexa*, *E. crebra* and *Corymbia maculata*. Preferred Koala Food Tree (PKFT) species, as defined by the CKPoM (*E. tereticornis*, *E. moluccana* and *E. punctata*), accounted for 78.56% of the tree species present within the study area. The highest density of PKFTs were mapped in the central-north of the study area which supports a large consolidated stand of *E. tereticornis* and *E. moluccana*, the majority of these trees falling into the small (< 100 mm) and medium (> 100 mm < 300 mm) categorisations of the CKPoM. No species which are defined by the CKPoM as koala shelter trees were identified within the study area.

Current vegetation mapping for the site is generally congruent with field survey. Of the three Plant Community Types (PCTs) previously mapped within the study area, one (PCT code 1395) does not match the tallest stratum species composition at this location and may be better described as an extension of one of the other two PCTs (849 or 850) according to underlying soil / topography. There is unmapped native vegetation in the eastern portion of the study area consisting of several single-species stands of trees, set amongst scattered paddock trees and weedy ground cover. Due to the prevalence of *E. tereticornis*, this unmapped vegetation meets the definition of potential koala habitat as outlined in the Campbelltown CKPoM. A gully runs through the central portion of the study area from the west, supporting some disturbed rainforest elements with several large trees (> 1 m DBH) also located therein. It is our understanding that this riparian area is not part of the intended development footprint, but is included within the study area for context.

Spot Assessment Technique (SAT) assessments were undertaken at five survey sites, two of which were found to support high koala activity. Output from a splining process performed with the spatial analyst extension in ArcGIS 10.5 produced an activity contour model delineating the boundaries of core koala habitat. These activity contours indicate that the western section of the study area supports parts of at least one koala home range area that likely extends further to the north and west.

Collectively, the outcomes of the VAR and KAAR indicate that the study area supports a mix of core koala habitat (with contemporaneous koala occupancy) and potential koala habitat, as defined by the Campbelltown CKPoM. The results of this report provide an overlay of ecological data which can work to inform any potential development footprint.

6. Introduction

Koalas (*Phascolarctos cinereus*) inhabiting the Campbelltown Local Government Area (LGA) have long been the focus of scientific and community interest, with available data indicating that the population has undergone a measure of recovery over the last 20 – 30 years (Phillips 2016). The most recent LGA-wide population monitoring indicated an estimated population size of 236 ± 60 (95% CI) koalas, with contemporary range extensions to the north, near the boundary with Liverpool LGA, and in the south-west with koalas now occurring on both sides of Appin Road and the Hume Highway (Biolink 2021). Campbelltown City Council (CCC) requires that developments seeking approval on lands which support native vegetation and / or are > 1 ha, be assessed for koala occupancy and habitat by following the guidelines in the recently approved Campbelltown Comprehensive Koala Plan of Management (CKPoM) (Phillips 2016).

The Campbelltown CKPoM maps core and potential koala habitat and identifies the location of Strategic Linkage Areas (SLA) – these being areas that support major movement corridors for koalas. Council cannot approve a DA that falls within a SLA unless it is satisfied that the proposal will not interfere with the movement of koalas. In addition to this, the requirements for assessment of koala habitat as it pertains to a DA are the establishment of whether the subject land contains any potential koala habitat by way of a Vegetation Assessment Report (VAR). As a minimum this VAR must include:

- A description of the tallest stratum cover and details of species composition of each vegetation community.
- A checklist of native vegetation species occurring in each vegetation patch, including any isolated paddock trees on partially cleared lands.
- A stadia-metric survey that identifies the precise location, taxonomic identity and Diameter at Breast Height (DBH) of all native vegetation proposed to be removed and / or within 20 m of the proposed development footprint, including any proposed infrastructure, easements and Asset Protection Zones.
- A map of where koala food and shelter trees were recorded[3].

[3] The Campbelltown CKPoM is not bound by SEPP44 definitions of Preferred Koala Food Trees (PKFTs). To this end and based on published studies and resource documents, Preferred Koala Food Tree species for koalas in Campbelltown have been identified as Forest red gum (*Eucalyptus tereticornis*), Ribbon gum (*E. viminalis*), Woollybutt (*E. longifolia*), Gum-topped (Grey) box (*E. moluccana*) and Grey gum (*E. punctata*). Shelter trees are those species which are known to be preferentially used by koalas in the Campbelltown LGA for roosting and thermoregulatory purposes and are defined in the CKPoM as Turpentine (*Syncarpia glomulifera*) and Brush box (*Lophostemon confertus*).

If the land which is the subject of the DA is determined to be potential koala habitat, then a DA must include a Koala Activity Assessment Report (KAAR) for that land. Council may also require a KAAR to be prepared for any development within mapped core koala habitat where detailed information on the distribution of koala activity and movement is required to assist in the evaluation of development design. The appropriate methodological approach for the preparation of a KAAR is outlined in Appendix B of the Campbelltown CKPoM. With regard to the potential development on Lot 21/1000643, this involves following Regularised Grid-based SAT (RG-bSAT) sampling protocols at 250 m intervals (initial sampling intensity) or 125 m intervals (high sampling intensity) for DA lands < 15 ha. If High[4] koala activity is recorded at any of the initial sampling sites, then the surrounding high sampling intensity sites are also to be assessed.

The current project was initiated to assess Lot 21/1000643 and part of Lot 3/1007066 (Gilead, Campbelltown, NSW) for the possible occurrence of koalas and koala habitat in accord with the Campbelltown CKPoM, and so provide information of relevance to a potential Development Application (DA).

[4] As defined for East Coast Low Density populations by Table 2 in Phillips and Callaghan (2011)

7. Methodology

The primary lot to which the proposed development applies (Lot 21/1000643) plus a small extension into Lot 3/1007066 which represents an asset protection zone, all with a 20 m buffer, is hereafter referred to as the study area.

7.1. Vegetation Assessment Report

7.1.1. Stadia-metric tree survey

Across the study area, all native trees with a DBH greater than 50 mm were measured[5] and identified to species level (where possible), and their location recorded using a hand-held GPS. Each tree was then classified as either a Preferred Koala Food Tree (PKFT), shelter tree or other native species as prescribed by Phillips (2016). PKFTs were grouped into size classes in accordance with the Campbelltown CKPoM categorisations of small (DBH < 100 mm), medium (DBH > 100 < 300 mm) and large (DBH > 300 mm) (Phillips 2016).

7.1.2. Vegetation communities / species composition

The tallest stratum cover and details of species composition were recorded for each vegetation community present in the study area. A checklist of native vegetation species, including any isolated paddock trees on partially cleared lands, was generated.

7.2. Koala Activity Assessment Report

7.2.1. Field Survey

The study area was overlain with a 125 m grid with grid-cell intersections becoming potential survey points where they occurred in areas of native vegetation, *as per* the high sampling intensity requirement prescribed in the Campbelltown CKPoM. Sites could be moved up to 12 m if they did not intersect with the vegetation of ESRI Basemap satellite imagery. Universal Transverse Mercator coordinates were determined for each corresponding point and uploaded into hand-held Global Positioning System (GPS) to enable location in the field. Koala activity at each field site was assessed using the Spot Assessment Technique (SAT) of Phillips & Callaghan (2011).

The study area, and Gilead more broadly, has a widespread occurrence of grey gums and gum-topped (grey) box, species which are indicative of low nutrient soils and hence low koala carrying capacity

[5] 50 mm DBH is the minimum size class for a 'tree' when implementing the Biodiversity Assessment Method (OEH 2018).

landscapes. In accord with this, koala activity across the site was interpreted in terms of the east coast (low) as defined by Phillips & Callaghan (2011). **Table 1** details the koala activity threshold parameters that are applicable, with medium (normal) use and high use sites indicative of the presence of resident animals (*i.e.*, Core Koala Habitat).

Table 1. Categorisations of koala activity based on use of mean activity level ± 99% confidence intervals. Activity levels in the medium (normal) and high use range for east coast (low) activity categories indicates occupancy levels by resident koala populations (Source: modified from Table 2 in Phillips and Callaghan 2011).

Activity category	Low use	Medium (normal) use	High use
East Coast (low)	< 9.97%[1]	≥ 9.97% but ≤ 12.59%	> 12.59%

[1] Koala activity (%) is determined based on the number of trees with faecal pellets and the number of trees sampled at each site. For example, three positive trees of 30 trees would yield a 10% activity level.

7.2.2. Data analysis

Using the satellite imagery from ESRI Basemap World Imagery (2020) the locations of null sites were designated at 62.5 m intervals along dispersal barriers (*e.g.,* the aqueduct) and regularly spaced within large expanses of land devoid of trees. Null sites and koala activity data from all surveyed sites were then interpolated using regularised, thin-plate splining techniques using the spatial analyst extension in ArcGIS 10.5. Output from the splining process was utilised to produce an activity contour model to delineate areas occupied by resident koala populations by identifying contours with the 10% and 13% significant activity thresholds as previously detailed in **Table 1**. Lower activity contours were included in the activity model to assist with interpretation of connectivity. This process produces a meta-population model (or contour map) that delineates important 'source' areas supporting established resident koala populations.

8. Results

8.1. Study area

The study area totals 7.80 ha and consists of the primary lot to which the proposed development potentially applies (Lot 21/1000643) plus a small extension into Lot 3/1007066 which represents an asset protection zone, all with a 20 m buffer. The land parcel is located at 70 Glendower Street, Gilead, NSW, 2560 and is situated directly north of the Estia Health Kilbride Retirement facility. The eastern border adjoins Rosemeadow and is in the south-west of Campbelltown LGA. Using the Southern Sydney Vegetation Mapping layer, 4.02 ha (51.54%) is mapped as vegetation and comprises three Plant Community Types (PCTs); 849 Gum-topped/Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin (0.64 ha), 850 Grey Box-Forest Red Gum Grassy Woodland on Shale of the southern Cumberland, Sydney Basin (2.61 ha) and 1395 Narrow-leaved Ironbark-Broad-leaved Ironbark-Grey Gum Open Forest of the Edges of Cumberland Plain, Sydney Basin (0.77 ha) (**Figure 1**). All mapped vegetation within the study area is considered as potential koala habitat due to the presence of PKFTs within these PCTs and is mapped as potential koala habitat for the purposes of the Campbelltown CKPoM. The study area is located directly adjacent to mapped core koala habitat to the east. The study area does not intersect any Strategic Linkage Areas (SLA) as mapped by the CKPoM, the nearest SLA being located to the south of the Estia Health Kilbride Retirement facility (**Figure 2**).

Figure 1. The study area, inclusive of lot 21/1000643 and a small part of lot 3/1007066 (grey line) plus a 20 m buffer (dashed grey line). Three mapped vegetation communities are within the study area and two are outside. For descriptions of Plant Community Type (PCT) codes, refer to Section 3.1 above.

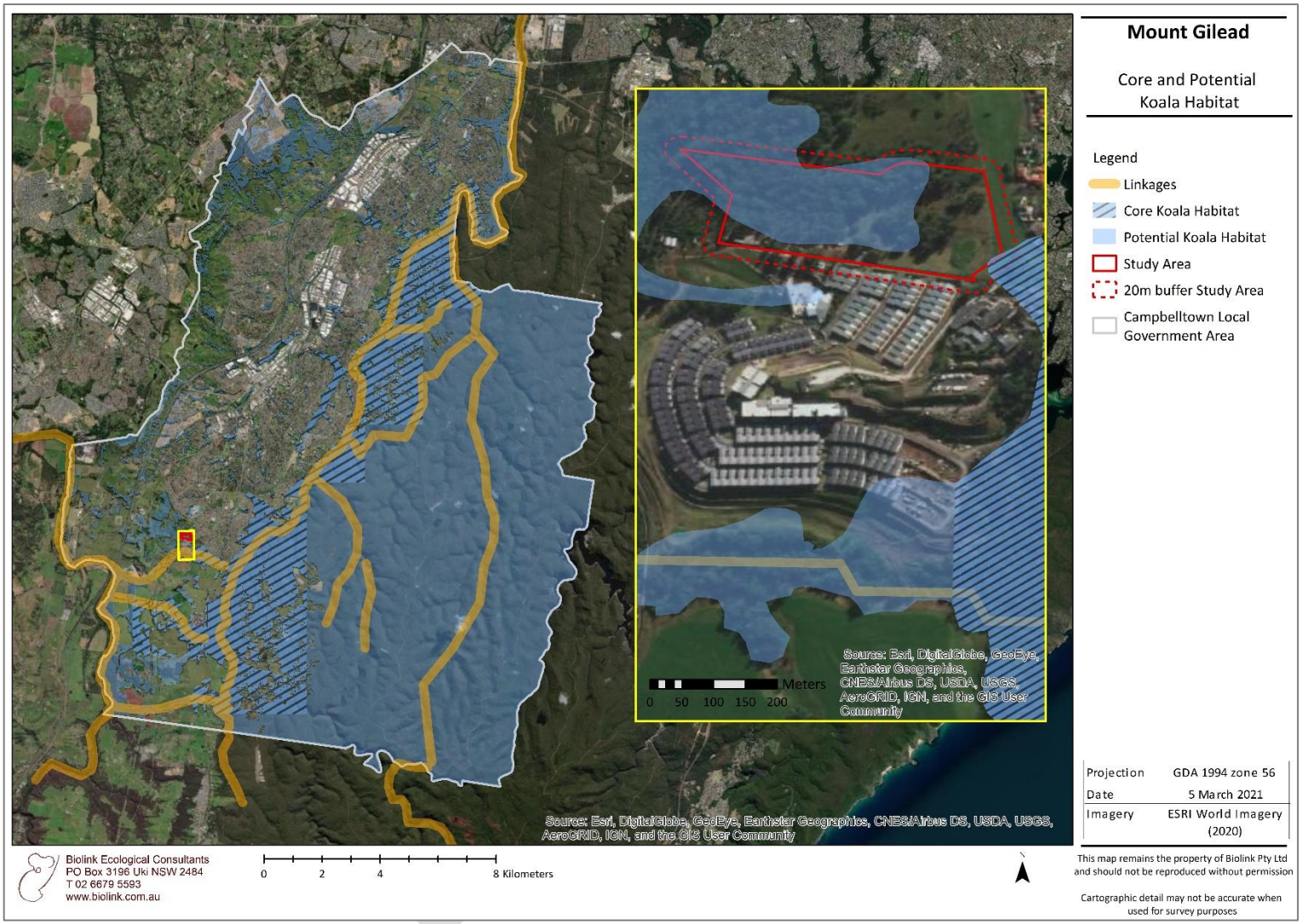

Figure 2. Core and potential koala habitat, and Strategic Linkage Areas (SLAs) as mapped for the Campbelltown LGA by the Campbelltown CKPoM, intersected with the study area. Inset shows more detail of the study area.

8.2. Vegetation Assessment Report

8.2.1. Stadia-metric tree survey

The stadia-metric survey of native trees ≥ 50 mm DBH was undertaken 21st – 23rd February 2021, during which time 1,814 trees were identified, measured, and mapped (**Figure 3**). Of these 1,814 trees, 78.56% were species identified as PKFTs by the CKPoM (*n* = 1,425). This consisted of three species; *E. tereticornis* (*n* = 1,077), *E. moluccana* (*n* = 343) and *E. punctata* (*n* = 5) (**Appendix A**). *Eucalyptus tereticornis* was widely distributed across the study area with the highest density in the north west (**Figure 4**). *Eucalyptus moluccana* was restricted to the western two-thirds of the study area (**Figure 5**). *Eucalyptus punctata* was restricted to a localised small stand in the central portion of the study area, directly north of the Estia Retirement Village swimming pool (**Figure 6**). The remaining trees (*n* = 389) were classified as 'Other' and consisted of *Acacia decurrens* (*n* = 6), *A. implexa* (*n* = 191), *Allocasurina littoralis* (*n* = 1), *Corymbia gummifera* (*n* = 4), *C. maculata* (*n* = 41), *E. crebra* (*n* = 141), *E. pilularis* (*n* = 1), *Melaleuca* sp. (*n* = 3) and *Ficus* sp. (*n* = 1) (**Figure 3**, **Appendix A**). There were no shelter trees (*Syncarpia glomulifera, Lophostemon confertus*) identified within the study area.

Considering only PKFTs, approximately 30.03% of the trees sampled fall into the CKPoM categorisation for small (< 100 mm DBH), 55.30% are categorised as medium (> 100 mm < 300 mm DBH) and 14.67% are categorised as large (> 300 mm DBH). A break-down of this by species is presented in **Table 2**.

Table 2. The number of PKFTs, grouped by the small, medium and large categories as prescribed by the Campbelltown CKPoM.

	E. tereticornis	*E. moluccana*	*E. punctata*
Small (< 100 mm DBH)	301	129	1
Medium (> 100 mm < 300 mm DBH)	608	176	4
Large (> 300 mm)	168	38	0

Figure 3. Distribution of 1,184 native trees over the study site with PKFTs (orange) and Other trees (blue). Tree size category (DBH) is indicated by circle size.

Figure 4. The distribution of 1, 077 *E. tereticornis* across the study area with size class defined by small (light green small circles), medium (green medium circles) and large (dark green large circles).

Figure 5. The distribution of 343 *E. moluccana* across the study area with size class defined by small (light red small circles), medium (red medium circles) and large (dark red large circles).

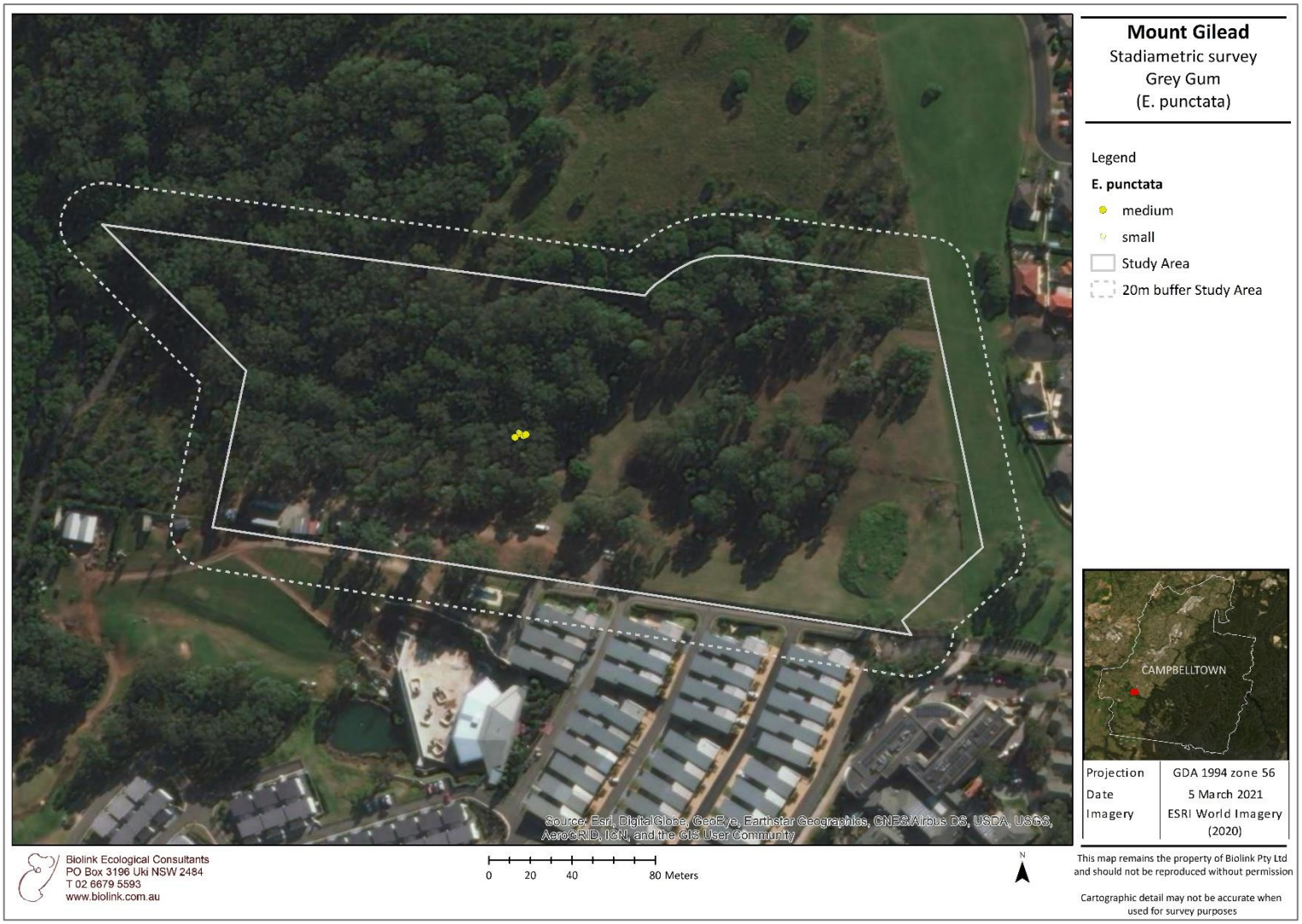

Figure 6. The distribution of five *E. punctata* across the study area with size class defined by small (light yellow small circles) and medium (yellow medium circles).

8.2.2. Vegetation communities / species composition

The mapped PCTs as presented in **Figure 1** are broadly reflective of the species composition across the study area, with some caveats. PCTs 849 (*Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin*) and 850 (*Grey Box-Forest Red Gum Grassy Woodland on Shale of the southern Cumberland, Sydney Basin*) have attributes in common, including substantial overlap in their tallest stratum composition of *E. moluccana, E. tereticornis* and *E. crebra*, with PCT 849 also typically supporting *E. eugeniodes* and *E. fibrosa*, neither of which were recorded during by this survey. The mapped distribution of tallest stratum species across the study area shows dominance of *E. moluccana* and *E. tereticornis*, with a lesser number of *E. crebra* across both PCT 849 and 850 (**Figure 7**). PCTs 849 and 850 are also typified by smaller trees, *A. implexa* and in the case of PCT 849, *A. decurrens*. This was generally reflected in data from the stadia-metric survey with *A. implexa* mapped in PCT 850, but not PCT 849 (**Figure 7**). The only *A. decurrens* mapped across the study area were outside these two PCTs. Shrub cover of *Bursaria spinosa* was widespread across lands mapped as PCT 849 and 850 and indeed across the entire study area. Additional native species noted across the lands mapped as PCT 849 and 850 were *Glycine tabacina*, *Dichondra repens, Entolasia stricta* and *Oxalis* sp. Widespread infestations of African olive (*Olea europaea*) and broad-leaved privet (*Ligustrum lucidum*) occurred across these PCTs, as did many ground-cover weed species.

Not reflected in the current vegetation mapping is a change in species composition surrounding a riparian area which originates in the west and runs centrally through the study area (**Figure 7**). It is our understanding that this area is to be excluded from any development footprint but is documented in this report to give context. This gully area was heavily infested with broad-leaved privet, likely shading out native species - a notion supported by a lack of recent recruitment with only large native trees present. Rainforest elements present in this area include common maidenhair (*Adiantum aethiopicum*) and wombat berry (*Eustrephus latifolius*) as well as previously listed *T. tabacina* and *D. repens* and a non-native vine common on rainforest margins (*Anredera cordifolia*).

Mapped in the north-western corner of the study area is a third PCT 1395 - *Narrow-leaved Ironbark-Broad-leaved Ironbark-Grey Gum Open Forest of the Edges of Cumberland Plain, Sydney Basin*. This PCT is typified by a tallest stratum of *E. crebra*, *E. fibrosa* and *E. punctata*, however stadia-metric survey revealed no *E. fibrosa* or *E. punctata* within the bounds of this mapped area. A single *E. crebra* was present, with larger numbers of *E. tereticornis* and *E. moluccana* (**Figure 7**). The lands mapped as PCT 1395 may be better described as an extension of one of the other two PCTs, either 849 or 850, depending on the underlying soil / topography.

Vegetation on the eastern third of the study area is currently unmapped, with no PCT designation. A substantial portion of this area is cleared / devoid of trees, however there are several single-species stands, with five stands of *A. implexa*, two stands of *A. decurrens*, one stand of *C. maculata* and one dispersed stand of *E. tereticornis* associated with *A. implexa* and *E. crebra* (**Figure 8**). Scattered paddock trees, primarily *E. tereticornis* and to a lesser extent *E. crebra*, are set amongst grassy ground cover, highly infested with weeds including scotch thistle (*Onopordum acanthium*), dallis grass (*Paspalum dilatatum*) and farmers friend (*Bidens pilosa*).

A check-list of native species documented across the study area is in **Appendix B**.

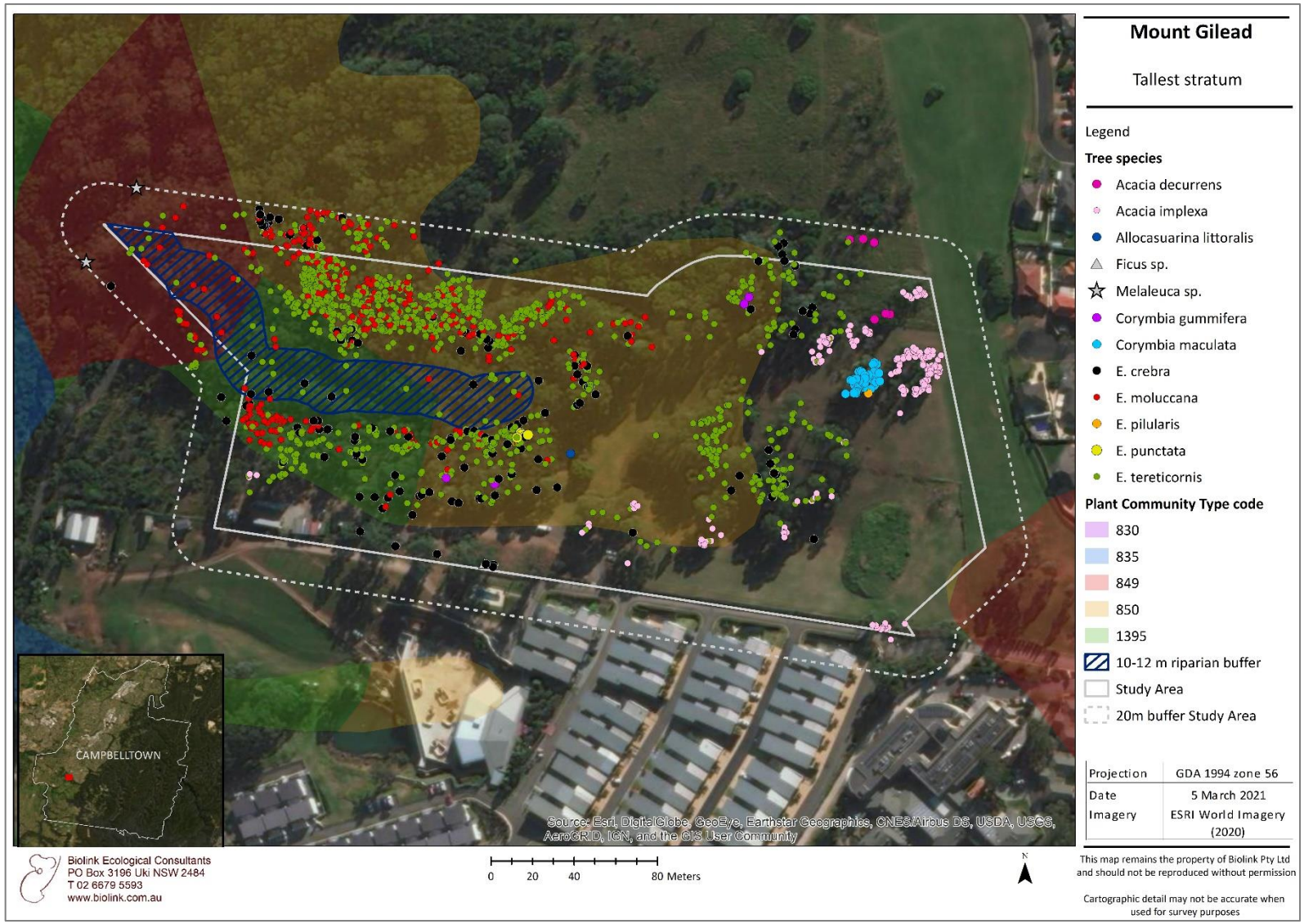

Figure 7. Tallest stratum tree species cover across the study area, overlaid on Plant Community Type (PCT) mapping. Riparian area shown in blue hatch.

Figure 8. Higher resolution of unmapped vegetation in the eastern portion of the study area, showing tallest stratum tree species.

8.3. Koala Activity Assessment Report

8.3.1. Field survey

Spot Assessment Technique (SAT) field survey assessments were undertaken on the 21st February 2021, resulting in five SAT sites being assessed. The distribution of these sites is illustrated in **Figure 9**, with a summary of associated data supplied in **Appendix C**. Evidence of koalas in the form of diagnostic faecal pellets was recorded at three of the five sampled field sites resulting in a habitat utilisation estimate of approximately 60% of the otherwise available habitat. Of the three active sites, two returned significant koala activity levels > 10% (see **Appendix C**, **Figure 9**). The activity contour analysis shows that the study area is likely to support a portion of a single koala home range area, and it is probable that this home range extends to the north-west.

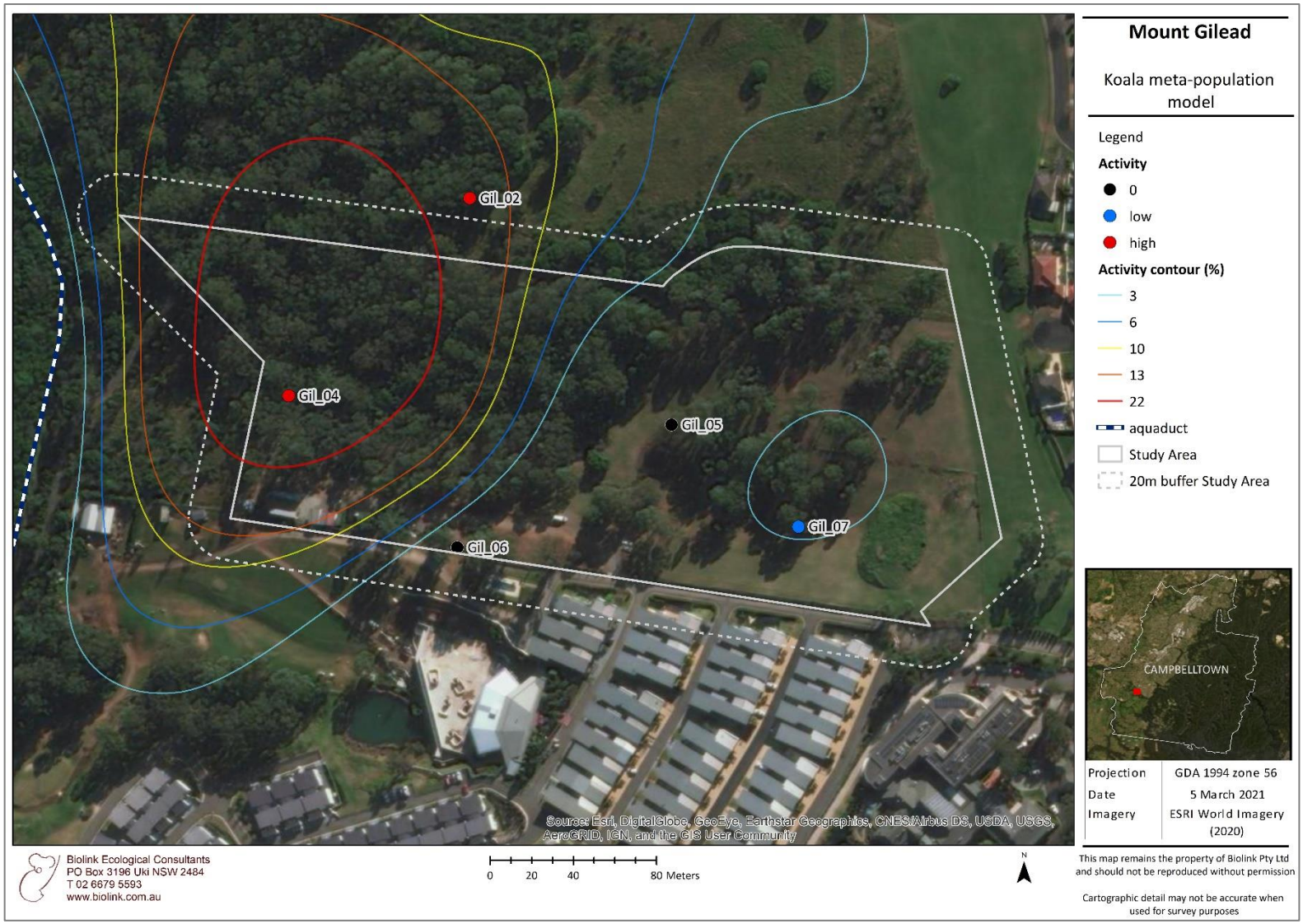

Figure 9. Koala activity model illustrating distribution of significant koala activity (yellow, orange and red lines) resulting from a five-site assessment.

9. Discussion

The outcomes of the VAR confirmed the current mapping of the study area by Campbelltown CKPoM as potential koala habitat. Vegetation in the eastern portion of the study area is currently unmapped but represents an extension of potential koala habitat by virtue of the numbers of *E. tereticornis* that are present. The presence of potential koala habitat necessitated the preparation of a KAAR, which identified koala activity levels > 10% at two of the five SAT sites which were assessed. The study area is therefore considered to currently support a mix of core and potential koala habitat, the boundaries of which were delineated by way of a splining process in the spatial analyst extension of ArcGIS 10.5 (**Figure 10).**

Development controls in core koala habitat depend on whether the DA is considered to represent a 'minor' or 'major' development. Minor development is a DA that relates to the construction of a single residential dwelling and / or the subdivision of land into ≤ two lots and / or requires the removal or no more than two PKFTs for each hectare of assessable land to which the DA relates. Without knowing the precise details of the proposed DA which is the subject of this report, it is probable that it warrants assessment as a major development, that being a DA that relates to the subdivision of a single lot of land into ≥ three lots, and / or requires the removal of ≥ three PKFTs for each hectare of assessable land to which the DA relates. Development controls in core koala habitat relate to the retention of PKFTs and shelter trees, swimming pool design, the keeping of domestic dogs, appropriate fencing, road design and protection of koalas from disturbance. In areas of potential koala habitat, Council may exercise discretion subject to the DA demonstrating that retention of PKFTs $\geq$ 200 mm DBH has been maximised and that the proposed tree removal will not prejudice the overall vision, aims and objectives of the CKPoM.

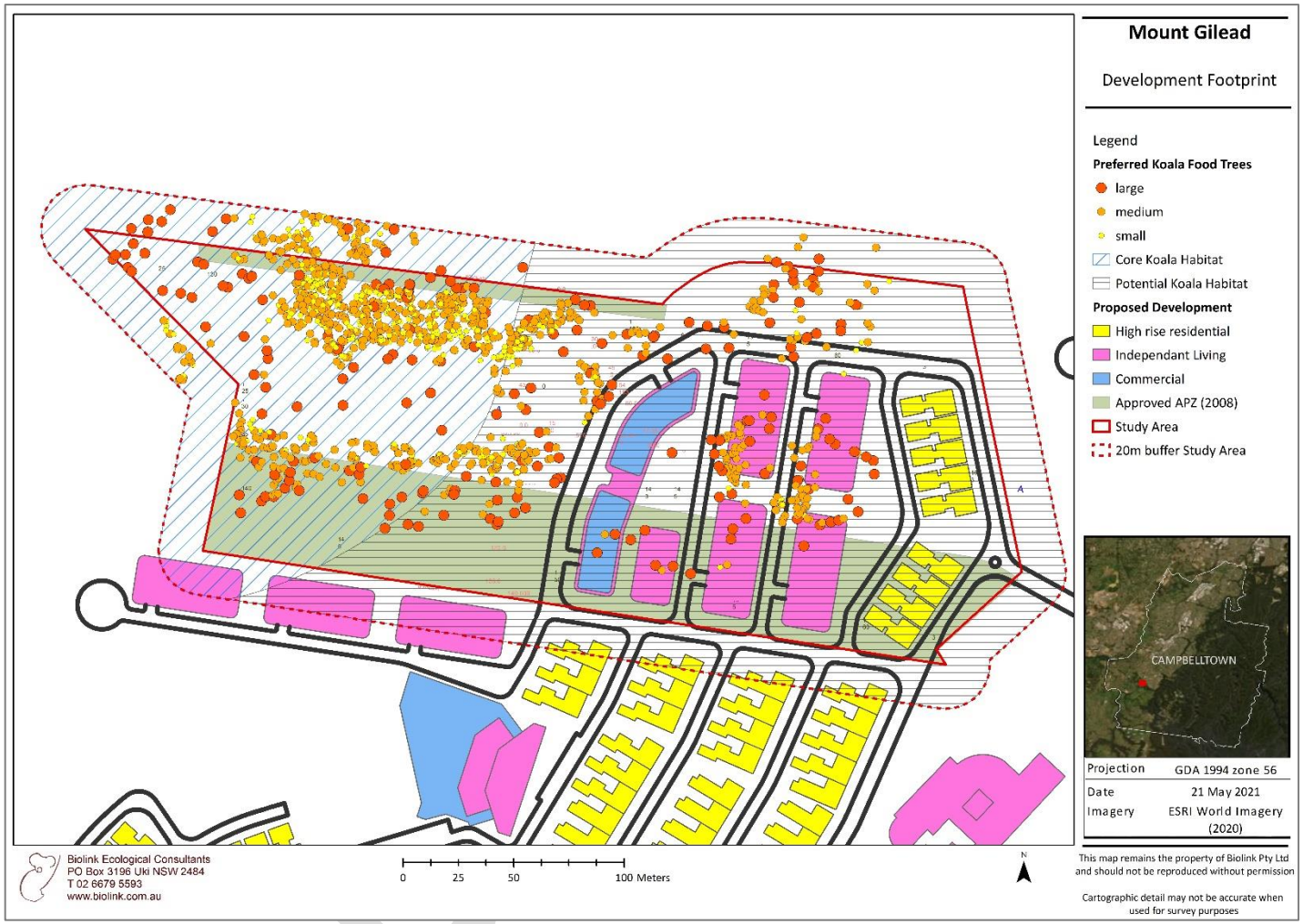

Figure 10. The study area, showing delineation of core (blue diagonal lines) *versus* potential (black horizontal lines) koala habitat, as calculated by activity contour analysis based on the outcomes of SAT survey. A potential development footprint (CAD drawing), and previously approved APZs (green). Note: the footprint was georeferenced from a pdf document and consequently there may be some slight discrepancies in its true intended size / location. The location of PKTFs is shown, categorised by size classes; small (yellow), medium (orange) and large (dark orange).

Where the proponent chooses to seek the removal of PKFTs in accordance with a major development, provision must be made to compensate for the loss of associated habitat as outlined in Part 7 of the Campbelltown CKPoM. In brief, the proponent must enter into a legally binding agreement with Council to either a) make a monetary contribution towards the Koala Habitat Rehabilitation Program (Part 8, CKPoM), or b) undertake rehabilitation works in areas identified by the Koala Rehabilitation Program (Part 8, CKPoM), including the payment of a Compensation Guarantee. The amount of money referred to in both a) and b) above, is based on the value of the required Compensation Units (CU), which is enumerated according to the number and size of PKFTs that will be removed. As a guide, at the commencement of the CKPoM, the value of a CU was $1, which was to be applied as follows;

Small (DBH < 100 mm)	8 CU / mm DBH
Medium (DBH > 100 < 300 mm	15 CU/ mm DBH
Large (DBH > 300 mm)	25 CU / mm DBH

To give some meaning to these numbers in the context of the potential DA which is the subject of this report, **Table 3** shows the numbers of PKFTs, organised by species and size class, which are located within the potential development footprint (taken from the georeferenced CAD drawing), the Asset Protection Zone (APZ) approved in 2018, and the study area more broadly. **Figure 10** also shows the location and size class of PKFTs across the potential development footprint and Approved APZ.

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Table 3. The number and size class classifications of Preferred Koala Food Trees that fall within an indicative development footprint, Approved APZ (top), Approved APZ (bottom), and the remainder of the study area.

		Development footprint		Approved APZ bottom		Approved APZ top		Remainder of study area	
Tree species	Tree size	Core	Potential	Core	Potential	Core	Potential	Core	Potential
E. moluccana	large		2	2	1	1		24	8
	medium		5	8	1	15		133	14
	small			2		5		111	11
E. punctata	large								
	medium								4
	small								1
E. tereticornis	large		61	20	22	7	3	39	16
	medium		118	31	9	19	4	316	111
	small		14	3	1	10		220	53
Total			**200**	**66**	**34**	**57**	**7**	**843**	**218**

This report does not present a figure of exactly how many trees will be removed as a result of the development, as the exact development footprint indicated in **Figure 10** may be subject to refinement and the associated APZs are not required to be completely cleared (they may instead be kept to a sparse woodland standard). Instead, we provide information on where PKFTs are currently located in the landscape and allow the Client to specify which of these will be removed once the footprint is finalised. In terms of calculating the compensatory requirements for any associated tree removal, in accordance with Parts 7 and 8 of the Campbelltown CKPoM, the Client has indicated interest in undertaking rehabilitation works.

To our knowledge there are no areas currently identified by the Koala Rehabilitation Program which might be the subject lands of such activities. In the absence of such defined areas, we suggest that the site directly to the north of the development would be an appropriate location for such activities, given its proximity to the trees which will be removed and the fact that the koala activity contours identified by this study extend into this site. Rehabilitation works on this site may therefore act to ameliorate the impacts on koala habitat connectivity resulting from the development itself. We also note that nothing in the CKPoM prohibits the proponent from undertaking rehabilitation measures on lands being the subject of the DA. The exact nature of these rehabilitation works will be subject to Council's discretion as the compensatory planting obligations outlined in the Campbelltown CKPoM apply only to minor developments.

Lastly, we note that if a DA does not conform to the defined compensatory measures set out by the CKPoM, it can be sent to the Koala Management Committee for independent assessment. A non-conforming DA may be considered and subsequently modified by Council such that the development does not compromise long-term koala management objectives. This may involve enclaving of developments in non-core koala habitat. Alternatively, the applicant may opt to prepare an Independent Koala Plan of Management under the provisions of SEPP44.

9.1. Recommendations

- In the absence of any areas currently identified by the Koala Rehabilitation Program as a site for compensatory activities, the proponent should consider rehabilitation works undertaken on the site directly to the north of the development site, assuming that these lands have secure conservation tenure.
- If the aforementioned site is deemed suitable by Council it should be formerly identified as lands with a program of habitat restoration and / or rehabilitation being undertaken as a

consequence of Part 8 of the CKPoM and listed by the Register of Development, and thereafter provided to the Koala Management Committee.

- A Vegetation Management Plan that meets the requirements set out in Council's VMP Guidelines (2016) and is formally approved by Council, should be used to guide compensatory plantings and other rehabilitation works, inclusive of supervision to ensure that any compensatory plantings succeed over time. As a guide, compensatory plantings of PKFTs should reflect locally abundant PKFT species.
- A Compensation Guarantee be paid according to the exact number of PKFTs removed as a result of this development, this number feeding into the calculation provided on page 25 of this report. This will be released once the required works have been implemented and in accord with a legally binding agreement with Council.
- Given the proximity of the development footprint to at least one koala home range and evidence of transitory PKFT use within the development footprint, the recommendations for protection of koalas from disturbance, as outlined in Part 6 of the Campbelltown CKPoM, should be considered.
- Enclaving should be considered as a means of permanently excluding koalas from the development by way of fencing, koala-grids and gateways that do not allow koalas to enter.

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Appendix A

Due to the large file size, the results of stadia-metric tree survey can be provided in a separate PDF by request.

Appendix B

Check list of native species documented across the study area.

Trees

Corymbia gummifera

C. maculata

Eucalyptus crebra

E. molucanna

E. pilularis

E. punctata

E. tereticornis

Ficus sp.

Melaleuca sp.

Small trees

Acacia decurrens

A. implexa

Allocasurina littoralis

Shrubs

Bursaria spinosa

Ground covers

Dichondra repens

Entolasia stricta

Oxalis sp

Adiantum aethiopicum

Vines and Climbers

Glycine tabacina

Eustrephus latifolius

Appendix C

Location of SAT sites.

Site	Date	Easting	Northing	Activity	Location notes
Gil_02	21/02/2021	295557	6223553	16.67	
Gil_04	21/02/2021	295470	6223458	30.00	
Gil_05	21/02/2021	295654	6223444	0	Half of site is paddock trees, other half is olive forest.
Gil_06	21/02/2021	295551	6223385	0	Edge of development site/fencing onto shared residential swimming pool. Disturbed / weedy
Gil_07	21/02/2021	295715	6223395	3.33	Disturbed / weedy.

Appendix 2

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Curriculum Vitae

Dr. Amanda Lane (Supervising Ecologist)

Mobile: 0434 537 465 **| Landline:** 02 6679 5523 **| Email:** Amanda.lane@biolink.com.au

Qualifications: Bachelor of Arts – University of Queensland

Bachelor of Science (Honours) – University of Queensland

Doctor of Philosophy (Science) – University of Sydney

Select recent key projects:

- Review of the conservation status of the Queensland population of the koala, leading up to and including the 2019 fire events (WWF-Australia)
- Review of the conservation status of NSW populations of the koala, leading up to an including part of the 2019/20 fire event (International Fund for Animal Welfare)
- Areas of Regional Koala Significance (ARKS): methodological review and recommendations for refinement (DPIE)
- Koala habitat connectivity across the Cumberland Plains, NSW (Greening Australia)
- Ecological assessments for koala habitat conservation agreements in Ballina/Lismore and Port Macquarie (Biodiversity Conservation Trust).
- Bonny Hills corridor connectivity assessment (Port Macquarie-Hastings Council).
- Field survey and records analysis including koala vehicle-strike, identification of koala black spots (Lismore Council).
- GAP CLoSR connectivity analyses and prioritisation program for koala conservation (Port Stephens).
- Review connectivity options across Macarthur and Wilton SE priority growth areas (Campbelltown City Council / Office of Environment and Heritage).
- Historical analysis and population assessments to guide koala conservation in South Grafton (Clarence Valley Council).
- Redlands koalas LGA wide assessment (Redlands City Council).
- Gold Coast koalas city-wide monitoring and historical records analysis (City of Gold Coast).

Areas of expertise:

Amanda has over 15 years' experience advising universities, private industry, government bodies and NGO's. She is a former lecturer at the University of Sydney with professional interests in wildlife ecology, botany, conservation and genetics. Prior to joining Biolink, Amanda spent a period of time researching the current conservation and genetic challenges of Tasmanian Devils, work that was undertaken in association with the Save the Tasmanian Devil Program. As a collaborator with the International Union for the Conservation of Nature (IUCN), Amanda is also involved with monitoring the global conservation status of sea snakes which allows her to continue contemplating the marine reptiles she researched during her Ph.D.

In recent times, Amanda has been involved in the preparation of reports and associated koala plans of management, and has utilised GIS-based software (i.e. GAP CLoSR) to examine koala linkages / habitat connectivity issues, and the development of GIS procedures for examining population distribution and threatening processes at both local and regional scales. Amanda performs specialist flora and fauna surveys using a variety of techniques including BAM (Biodiversity Assessment Method) and Rapid VI (Vegetation Integrity), most recently to assess priority areas for koala habitat conservation in both Ballina and Port Macquarie, in association with the Biodiversity Conservation Trust. Peer reviewed scientific papers by Amanda have been published in national and international journals including *Conservation Biology, Australian Journal of Zoology, Molecular Ecology, Austral Ecology, Biological Conservation, Animal Behaviour, Functional Ecology and Molecular Phylogenetics and Evolution*.

Peer Reviewed Publications

Phillip, S., Wallis, K., **Lane, A.** (2021). Quantifying the impacts of bushfire on population of wild koalas (Phascolarctos cinereus): Insights from the 2019/20 fire season. *Ecological Management and Restoration* 22: 80 – 88.

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McMeniman, C.J., **Lane, A.M.** … O'Neill, S. (2008). Host adaptation of a Wolbachia strain after long-erm serial passage in mosquito cell lines. *Applied and Environmental Microbiology* 74: 6963-6969.

Lane, A.M., Oldroyd, B.P. and Shine, R. (2008). Microsatellite loci for laticaudine sea kraits. *Molecular Ecology Resources* 8: 1161-1163.

Unsworth, N., **Lane, A.M**. … Nissen, M.D. (2007). Flinders Island spotted fever rickettsioses caused by "marmionii" strain of *Rickettsia honei*, Eastern Australia. *Emerging Infectious Diseases* 13: 566-573.

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Curriculum Vitae

Kirsty Wallis (Conservation Analyst)

Mobile: 0423 986 708 **| Landline:** 02 6679 5523 **| Email:** Kirsten.wallis@biolink.com.au

Qualifications: Bachelor of Science

Masters in Wildlife, Health and Population Management

Select recent key projects:

- Koala Baseline Surveys & Analyses – Koala Likelihood Model (NSW Office of Environment and Heritage).
- The Kiwarrak and Khappinghat ARKS: Aspects of distribution and abundance of koalas (MidCoast Council).
- Historical analysis and population assessments to guide koala conservation in South Grafton (Clarence Valley Council).
- Save our Species Report: Managing koala populations for the future (Port Stephens LGA).
- Koala habitat assessments, utilisation and mapping (South Gippsland Landcare Network).
- Historical records analysis and koala hub assessments (Port Stephens Council).
- Redlands LGA wide assessment (Redlands City Council).
- Gold Coast city-wide monitoring and historical records analysis (City of Gold Coast).

Areas of expertise:

Kirsty has over 10 years of experience working with State-based conservation agencies and in the environmental industry. Coming to Biolink from koala-focused work with a State-based conservation agency, Kirsty has designed and manages Koala-SAT database and oversees the spatial analysis / GIS side of our work, as well as engaging in field work wAhen the opportunity arises.

Kirsty's experience with Biolink includes unravelling the complexities of the NSW Government's Koala Likelihood Modelling (KLM) project and working on the creation of a koala habitat model for the South Gippsland area of Victoria. Most recently, Kirsty's expertise assisted in the development of the Rapid-SAT methodology and novel mathematical and spatial analysis techniques to identify koala black-spots in the Lismore LGA.

Appendix 5

Strategic Environmental and Engineering Consulting

Assessment of fluvial Geomorphology
Lot 21 Glendower St
Gilead
15th July 2020

SEEC

Strategic Environmental & Engineering Consulting

Assessment of Fluvial Geomorphology:

Lot 21 DP 1000643, Gilead

Prepared for HT Retirement Pty Ltd

Revision A

15 July 2020

SEEC

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this plan does not contain any incomplete or misleading information.

Andrew Macleod B.Sc (Hons) CPESC CPSS
Director and Principal Soil Conservationist
SEEC

15 July 2020

Version Register

Version	Date	Author	Reviewer	Notes	Other
Rev A	15/07/2020	AM	BJ	Draft issue for review	

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd were engaged by HT Retirement Pty Ltd to assess the fluvial geomorphology of the natural drainage features on Lot 21 DP 1000643, Gilead ("the site").

This report provides a summary of the findings of that assessment. The assessment was undertaken by Andrew Macleod from SEEC. A site inspection was conducted on 13 July 2020. A CV for Andrew Macleod is contained in Appendix A of this report.

1.2 Purpose and Limitations

The purpose of this assessment is to determine the fluvial geomorphological conditions within the various natural drainage features on Lot 21 DP 1000643, Gilead. This will aid HT Retirement Pty Ltd and their consultants in planning and allowing for appropriate riparian buffers around any drainage features that might be considered as "watercourses".

In conducting this assessment, SEEC have only investigated the fluvial geomorphology of the drainage features. We have not assessed the flora and fauna of the drainage features, and our assessment is limited to observations and investigations of soils, geology, and drainage features (e.g. banks, beds, pools etc.), as typically occur in watercourses (Landcom, 2004).

2 ASSESSMENT OF CONDITIONS

2.1 Mapped Hydrolines

Figure 1 shows the mapped position of various "blue lines" from the NSW Government Hydroline Spatial Data (NSW Government, 2020), which is available online. Figure 1 shows the contours across the site, along with the cadastral boundary.

For ease of reference, various points along the natural drainage features have been labelled to define three separate reaches:

- A to C as marked on Figure 1 and Figure 2;
- B to C as marked on Figure 1 and Figure 2; and
- C to D as marked on Figure 1 and Figure 2.

Figure 1 – Hydrolines from NSW Government online spatial portal. Site boundary is shown in yellow. Existing features and key locations are marked.

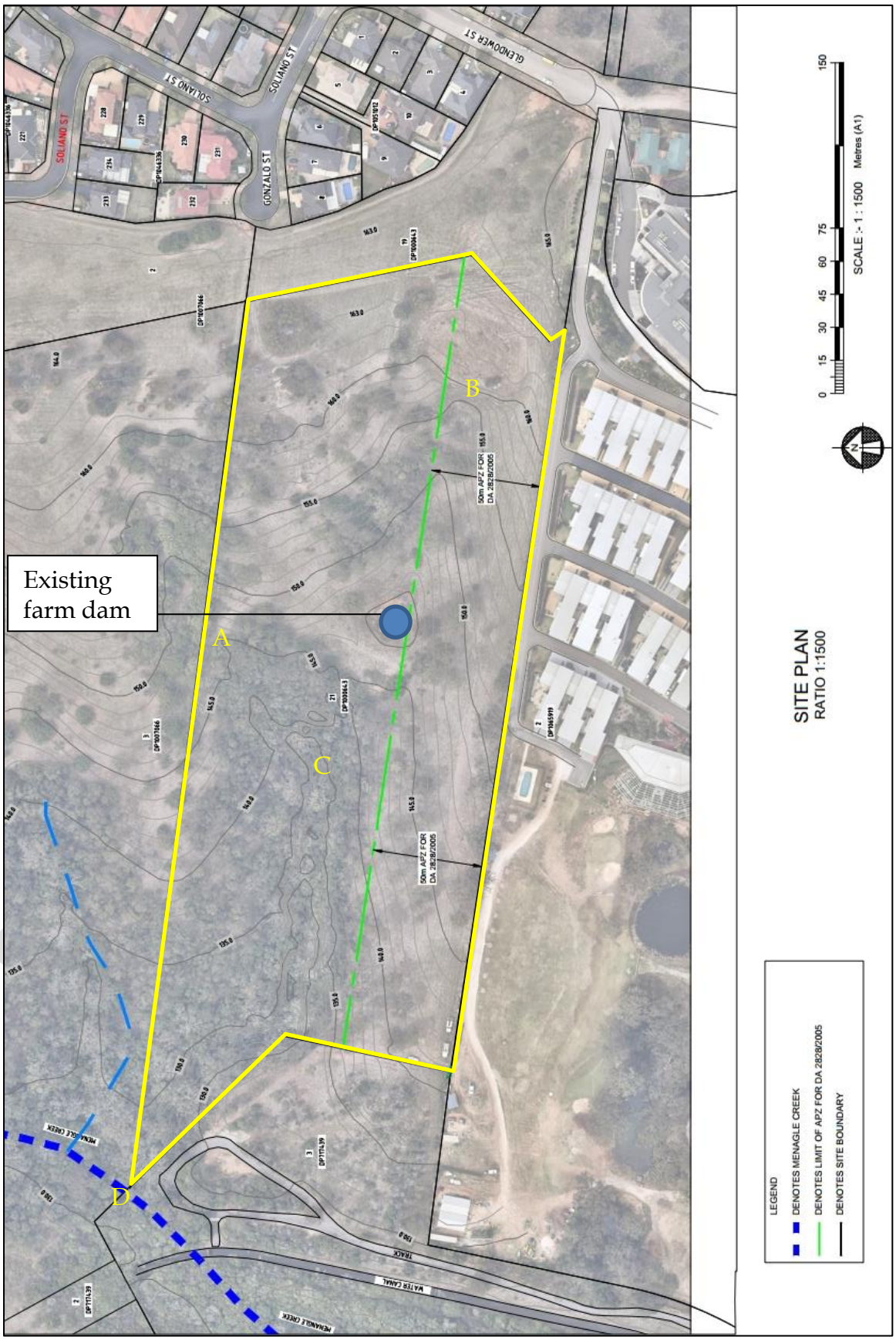

Figure 2 – Site plan, boundary and contours (provided by John M Daly & Associates). Existing features and key locations are marked

2.2 Fluvial Assessment

Table 1 contains a summary of the three reaches of the drainage features, as marked on Figure 1 and Figure 2. Included in Table 1 is an assessment of the fluvial geomorphological characteristics of each reach. Note that Menangle Creek is a named watercourse and is excluded from the assessment in Table 1.

Table 1 – Assessment of Fluvial Features.

Parameters	A to C	B to C	C to D
Description	Drainage depression, partly gullied.	Drainage depression. Farm dam at the location shown in Figure 1 and Figure 2. Gully erosion in section between the dam and Point C.	Drainage line. Deeply incised with obvious gully erosion. Steep-sided, V-shaped valley.
Stream Order*	1	1	2
Photo(s) of typical conditions			
			
			
Soil Landscape	Blacktown Soil Landscape (undulating low hills on Wianamatta Group shales)	Blacktown Soil Landscape (undulating low hills on Wianamatta Group shales)	Luddenham Soil Landscape (rolling hills on Wianamatta Group shales)

Parameters	A to C	B to C	C to D
Fluvial geomorphology	No channel development. No stream bed or banks. No pool/riffle sequence within the drainage depression. No evidence of sedimentation. Erosional feature only.	No channel development. No stream bed or banks. No pool/riffle sequence within the drainage depression. No evidence of sedimentation, other than in the farm dam. Erosional feature only.	Minor channel development is evident, with shallow (less than 200mm) outer bend channels. Little or no evidence of channel braids. No depositional stream banks. Near-level bed with variable width, average 2m wide. Evidence of deposition to form the stream bed. Occasional shallow pools evident although with little or no alluvial deposition. Sedimentation of coarse fragments within and adjacent to the primary flow channel to form part of the stream bed. Bedrock exposed only from gully erosion, not as part of a residual stream feature.
Assessment	This is not a watercourse because it lacks fluvial features. There is no defined channel, no stream bed, and no defined stream banks. This is a depression only, and has been scoured as a result of modified runoff patterns (primarily from urbanisation and land clearing upslope).	This is not a watercourse because it lacks fluvial features. There is no defined channel, no stream bed, and no defined stream banks. This is a depression only. The reach downslope of the farm dam has scoured as a result of overflows from the dam, which only occur during prolonged heavy rainfall.	First order stream. Basic fluvial features are evident such as a depositional stream bed, occasional shallow pools and a defined channel.

* (Based on Strahler System and NSW Government (2020) Hydrolines portal.

3 NRAR ASSESSMENT TOOL

The NSW Natural Resources Access Regulator (NRAR) is part of the NSW Department of Planning, Industry and Environment (DPIE). The NRAR has developed a Waterfront Land Tool (NRAR, 2020) to "help applicants to determine what is waterfront land under the controlled activity provisions of the Water Management Act 2000."

Table 2 provides a summary of the assessment of each reach of the drainage features based on the NRAR (2020) tool.

Table 2 – Results of assessment using NRAR waterfront land tool.

Question No.	Parameter	A to C	B to C	C to D
1	**Is the location exempt from Controlled Activity provisions?**	No	No	No
2a	**Is it a Blue Line on the Hydrolines portal?**	Yes	Yes	Yes
3	**What order stream is it**	1	1	2
4a	**Does it have a defined bed or banks?**	No	No	Yes
4b	**What type of watercourse is it?**	N/A	N/A	Type 1 – confined valley headwater
5a and 5c	**Watercourse features present?**	No	No	Yes
5b	**What features?**	N/A	N/A	Pools, erosion and deposition
8	**Locate the high bank for the type of watercourse**	N/A	N/A	Type 1 – confined valley headwater
9	**Works within 40m of high bank?**	N/A	N/A	Yes
12 and 14	**Controlled activity approval applies?**	No, not a watercourse	No, not a watercourse	Yes, controlled activity approval is required.

4 CONCLUSION

Table 1 contains a summary of the assessment of fluvial geomorphology in drainage features at Lot 21 DP 1000643, Gilead.

We have determined that there are no fluvial features in two of the mapped sections marked as "blue lines" from the NSW Government (2020) Hydrolines portal, and so these are not "watercourses" as understood by a fluvial geomorphologist .

As noted in Section 3, works within the sections from A to C and B to C (Figure 1) do not require Controlled Activity Approval.

5 REFERENCES

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OEH NSW Government eSpade web portal. www.espade.environment.nsw.gov.au

6 APPENDICES

6.1 CV for Andrew Macleod

Andrew Macleod
B.Sc (Hons.) CPSS CPESC

Director and Principal Scientist

SEEC
Strategic Environmental and Engineering Consulting

Andrew is an expert in all aspects of soil and water management. He is a recognised industry leader in construction-phase erosion and sediment control and conducts regular training, consulting and expert witness services in this field.

Andrew has worked on a wide range of sites including mines, gas projects, major infrastructure projects (road and rail), pipelines and subdivisions. He is also the current President of the International Erosion Control Association (IECA) in Australasia.

Andrew is a Director of SEEC and one of our Principal Environmental Scientists. He is a Certified Professional in Erosion and Sediment Control (CPESC) and a Certified Professional Soil Scientist (CPSS).

Qualifications

- Bachelor of Science (Applied Physical Geography) with Honours. UNSW (1999)
- Certified Professional in Erosion and Sediment Control (CPESC #3678)
- Director, International Erosion Control Association (IECA) Australasian Chapter 2011 to present
- Certified Professional Soil Scientist (CPSS # 1152)
- President, International Erosion Control Association (IECA) Australasian Chapter 2012 to 2018, and 2019 onwards
- Director, Bowral Cricket Club 2011 to 2019
- Member of the Australian Society of Soil Science Incorporated (ASSSI)
- Member of the International Erosion Control Association (IECA)

Awards

- Kevin Bennet Memorial award for the Best Paper: "MUSIC Calibration Based on Soil Conditions." Stormwater Industry Association (SIA) NSW and Qld Joint Annual Conference, 2008.
- Merit Commendation for Education or Innovation: SEEC Half-Day Erosion and Sediment Control Workshop, Stormwater Industry Association Awards, 2010.

Papers Presented

- "Working in and Around Watercourses – In-Stream Erosion and Sediment Control During Construction." IECA SIA Qld Joint Conference, Brisbane, 2017
- "50 Shade of Blue Book: Erosion and Sediment Control Compliance." IECA, SIA NSW, EA Joint Conference, Sydney, 2015
- "Watching the Grass Grow – A Field Study of Rehabilitation in Southern Queensland". IECA National Conference, Wellington, NZ 2014.
- "Erosion reductions using spray-on soil stabilisers." IECA National Conference, Gold Coast 2013, and IECA Environmental Connection Conference, Nashville, Tennessee, USA 2014.
- "CSG: Coal Seam Gas or Crops, Soils, Grasses. Lessons for Effective Rehabilitation on Gas Projects" IECA Mining Rehabilitation Conference, Hunter Valley 2013.

- "From Construction Phase to Completion: Sediment Pollution in Stormwater" SIA NSW and Vic Joint Annual Conference, Albury 2009.
- "MUSIC Calibration Based on Soil Conditions." SIA NSW and Qld Joint Annual Conference, Gold Coast 2008.

Areas of Technical Expertise

- Construction site erosion and sediment control
- Water sensitive urban design
- Soil survey/soil landscape/land capability mapping
- Water quality modelling and surface water management
- Site rehabilitation and revegetation
- Research projects and field trials
- Dryland salinity (rural and urban)
- Fluvial and landscape geomorphology
- Onsite wastewater management
- Environmental impact assessment
- Presentation of seminars/workshops on soil and water management
- Water treatment, sediment and nutrient control

Short Courses/Workshops Completed

- WorkCover Occupational Health and Safety General Induction for Construction Work (CGI01253136SEQ1)
- Rail Industry Safety Induction Certificate (NSW Railcorp - No 0010052440)
- GIQ – Coal Industry Surface Induction. January 2013
- MUSIC Version 2 and 3 Training, CRC for Catchment Hydrology (now eWater). March 2004 and May 2005
- Arrow Energy Induction. January 2013
- Microsoft Access Database Management and Design Training. March 2001
- ESRI ArcGIS 8 Training. September 2003
- Air Photo Interpretation Course. November 2000
- Advanced driver training. December 2010
- 4WD Safe Operations. June 2001

Career Highlights

Director, SEEC; August 2007 to present.

- Staff, client and business management.
- Recruitment and training.
- Budgeting and project management.
- Expert advice on erosion and sediment control and soils.
- Expert advice on water cycle management and water quality modelling issues.
- Preparation and delivery of teaching programs on erosion and sediment control and soils.

Environmental Scientist, Morse McVey & Associates; Jan 2004 to Aug 2007.

- Preparation of soil and water management studies and reports.
- Preparation of water quality modelling and management plans.
- Preparation of erosion and sediment control plans.
- Teaching workshops on erosion and sediment control on construction sites.

Spatial Analyst, NSW Department of Infrastructure, Planning and Natural Resources; March 2003 to Jan 2004.

- Soil landscape mapping
- Map analysis and derivation using GIS
- Derivative map development
- Spatial database maintenance and development.

Soil Surveyor and Technical Officer, NSW Department of Land and Water Conservation; Feb 2000 to March 2003.

- Development and maintenance of soil landscape database
- Field soil survey and mapping
- Soil conservation and land management
- Interpretation of laboratory results.

Recent Projects

- Expert erosion and sediment control specialist for major projects including Hume Hwy Tarcutta (NSW), Bruce Highway C2CA3 (Qld), Gateway Upgrade (Qld), South-West Rail Link (NSW), Southern Sydney Freight Link (NSW), North-West Rail Link (NSW), WestConnex 1b, 2 and 3b (NSW), Sydney Metro 2 (NSW), Kingsford Smith Drive upgrade (Brisbane), Pacific Highway Woolgoolga to Ballina, Snowy 2.0.
- Wet-season ESCPs for Ichthys Project, Darwin, plus wet season NT EPA auditing and certification of contractor works for Ichthys Project, Darwin.
- Expert witness in the NSW Land and Environment Court on erosion and sediment control and water quality issues, numerous projects. For NSW
- Teaching comprehensive 4-day workshops about erosion and sediment control on construction sites. Recent workshops run over four days have been conducted in Sydney and Brisbane.
- Preparation of planning-phase erosion and sediment control plans for major projects including Batemans Bay Bridge, M1 Princes Highway, Newcastle Inner City Bypass, Lachlan Valley Way, The Northern Road.
- Preparation of Surface Water and Soils Assessments for Dargues Gold Mine near Braidwood, NSW. Expert witness in the NSW Land and Environment Court for same project.
- Pipeline erosion management, Goulburn and Oberon,

Department of Planning and Environment.

- Coordination of rehabilitation trials, Dalby Qld (Surat Basin). For Arrow Energy.
- Preparation of Surface and Ground Water Management Plans, Nowra Brickworks Quarry, Dargues Reef Gold Mine, Rocla Green Valley Quarry, Tomingley Gold Project.
- Erosion and sediment control management for MCJV Narrows, Gladstone Qld.
- Preparation of demonstration erosion and sediment control drawings for inclusion in Technical Guides, Sunshine Coast City Council (SE Queensland).
- Preparation and delivery of half and full-day workshops on best-practice erosion and sediment control throughout NSW and Qld. Recent clients include Camden Council, MidCoast Council, Wyong Council, Burton Contractors, Gympie Shire Council, Hunter Water, Leighton Contractors, Fulton Hogan, Gold Coast City Council, Downer EDI, Transport for NSW, Railcorp, Lake Macquarie City Council and Arrow Energy.
- Develop and prepare template deemed-compliance Erosion and Sediment Control Plans (ESCPs) for Arrow Energy gathering network, Surat and Bowen Basins, Qld and for Santos, NSW Pilliga Gas Exploration.
- Preparation and delivery of erosion and sediment control workshops on main road and rail projects. For the Centre for Environmental Training (CET).
- Expert advice regarding erosion and sediment control for Sydney rail projects including Glenfield to Leppington Rail Line, Southern Sydney Freight Link, Glenfield Transport Interchange, North-west Rail Link, North Strathfield Rail Underpass.
- Expert advice and planning for soil and water management - proposed downhill mountain bike track, Hassans Walls (Lithgow).
- Pre-tender and design assessment of construction-phase soil and water management issues; proposed Nelligen Bridge, NSW, Bega Bypass, NSW, Burrill Lake Bridge, NSW, Kapooka Bridge realignment, Wagga Wagga, NSW, Batemans Bay Bridge, NSW.
- Review of river diversion geomorphology and stability, major zinc and lead mine, NT, Australia.
- Auditing of erosion and sediment controls, Bruce Highway C2C-C and Mackay Ring Road, Qld.

NSW (APA Group) and Moranbah (Arrow Energy).

- Preparation of Technical Guidance Manual for cross-formation drainage and erosion and sediment control during major road construction (for NSW RTA).
- Prepare and deliver toolbox training sessions for contractors on the commuter carparks program, Sydney Greater Metropolitan area; TfNSW.
- Preparation of numerous Water Cycle Management Studies and Surface Water Management Plans for various projects including:
    - Rural residential subdivision, Goulburn
    - Golf resort, Darkes Forest
    - Quarry and mine developments, Southern Highlands and Central West.
- Coordination of field trials of soil stabilisers to determine erosion reductions under rainfall, Toowoomba, Qld and Picton, NSW.
- Soil surveys to identify development constraints and opportunities for proposed bypass road, Orange.
- Fluvial geomorphology assessment of parts of the Nepean and Georges Rivers for proposed Sewage Treatment Plant discharge points (Sydney Water).
- Preparation of Onsite Wastewater Management Studies for numerous rural and rural residential developments; Southern Highlands, Hunter, Blue Mountains etc. Also for a commercial and tourist development at Darkes Forest, NSW.
- Preparation of Construction-phase Soil and Water Management Plans for various developments including:
    - Residential and industrial subdivisions, Southern Highlands
    - M4 Smart Motorways, Sydney
    - North-West Rail Link, Sydney.
- Assessment of water sensitive urban design principles for proposed redevelopment of Lawson Town Centre in the Blue Mountains.
- Preparation of water cycle modelling templates and input data for MUSIC modelling. Direct appointment tenders by the Sydney Catchment Authority (SCA).

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Appendix 6

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Proposed asset protection zones

Legend

Aerial source: Nearmap

- Lot boundary (source: CAD)
- Contour 1m (sourec: LiDAR)
- Creekline (source: LPI & CAD)
- 10-12m riparian buffer

Indicative Asset Protection Zone (APZ)

- APZ (1.70ha)
- Approved APZ (2006 (1.75ha)
- 3.2m Radiant Heat Barrier
- 4m Radiant Heat Barrier

Proposed development

- Independant Living Units (SFPP)
- High rise residential
- Internal road network

0 20 40 m

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

PROJECT & MXD REFERENCE	DATE & ISSUE NUMBER	SCALE & COORDINATE SYSTEM
Glendowner St, Gilead 19HOP02_BF001	21/12/2021 Issue 1 SC	1:1,500 @A3 GDA 1994 MGA Zone 56

TITLE

Proposed Development & APZ Area Lot 21

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