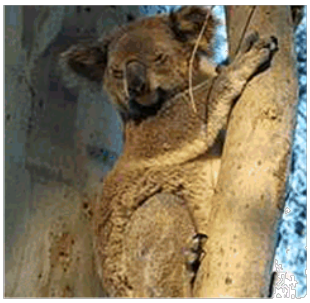
South Campbelltown Koala Habitat Connectivity Study


Report to Campbelltown City Council

December 2017

biolink pty ltd
ecological consultants
PO Box 3196 Uki NSW 2484
T 02 6679 5593
F 02 6679 5523
www.biolink.com.au

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Abbreviations

Abbreviation	Description
CCC	Campbelltown City Council
CKPoM	Comprehensive Koala Plan of Management
DBH	Diameter at Breast Height
GMPGA	Greater MacArthur Priority Growth Area
KMP	Koala Management Precinct
OEH	Office of Environment and Heritage
PKH	Preferred Koala Habitat
PKFT	Preferred Koala Food Tree
SLA	Strategic Linkage Area

Acknowledgements

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1 Introduction

The Campbelltown koala population remains one of the more studied in the Greater Sydney region. This population, now deemed to be recovering from near extinction 20 – 30 years ago, recently became the focus of a draft Comprehensive Koala Plan of Management (CKPoM) prepared in accord with *State Environmental Planning Policy* (SEPP) *No 44 – Koala Habitat Protection*. Under the umbrella of the draft CKPoM, several Strategic Linkage Areas (SLAs) were identified, the aspirational intent of which was to afford connectivity across the planning landscape to enable recolonization of formerly utilized habitat areas. **To this end, a key consideration relating to the designation of SLAs in the south of the Campbelltown City Council LGA (CCC LGA) was to enable the westward passage of koalas from the general area of the Wedderburn Plateau within the George's River catchment, to the adjoining Nepean River catchment within which koalas were also known to occur.**

This study was focused on a largely rural landscape located to the west - south-west of the Wedderburn Plateau. The focal area comprised the localities of Menangle Park and Gilead, and is part of the Greater MacArthur Priority Growth Area (GMPGA). As far as planning for conservation purposes is concerned, the aforementioned SLAs have been identified as:

- regional, sub-regional and local corridors under Campbelltown's draft Biodiversity strategy, and
- core areas and regional corridors under the Office of Environment and Heritage (OEH) Biodiversity Investment Opportunities Map (BioMap).

In addition to potential development outcomes arising from the GMPGA designation, a major upgrade of Appin Road from 2 to 6 lanes is also in the early planning stages. Appin Road is a high-traffic volume, arterial road that skirts a substantive body of occupied koala habitat to the east and so bisects the aforementioned SLAs that extend from this area to the west. There are increasing numbers of koala vehicle-strike along this road, many of which can be associated with the aforementioned SLAs.

Despite the relatively recent[1] history of vehicle-strikes and potential importance of the SLAs in the study area, there is a paucity of relevant koala assessments and data. This is not an oversight, but reflects the ongoing recovery and range expansion of koalas in the CCC LGA that were initially identified by biolink (2015), such that there are now regular koala sightings

[1] Majority of road-kill has occurred within last decade.

being reported from areas to the west of Appin Road. Concomitant with this recovery trend is the opportunity to facilitate the colonization of formerly unoccupied areas of suitable habitat so as to enhance long-term population resilience in the event of a catastrophic fire event in the southeast of the CCC LGA. Given this background, a primary question that requires addressing is how important are the SLAs for koalas and from that, should any upgrade of Appin Road within the CCC LGA facilitate or restrict connectivity?

To assist Campbelltown City Council (CCC) to make informed planning decisions for koala conservation, a koala connectivity study was implemented with a focus on the aforementioned SLAs and the associated vegetation communities therein. The aims of this project were as follows:

1. To investigate the current koala usage and occupancy of the SLAs,
2. To determine the quality and extent of Preferred Koala Habitat (PKH) within the SLAs,
3. To evaluate the value of the SLAs for koala conservation based on PKH and occupancy considerations,
4. To evaluate the feasibility of establishing connections across Appin Road, and determine whether mitigation measures should facilitate or restrict connectivity, and
5. To provide any management and movement strategies in context of future development and infrastructure provision.

2 Methods

2.1 Study area

The general area of interest for this study was that associated with the network of east-west SLAs located in the southwestern corner of the CC LGA as identified in Figure 5.3 the draft CKPoM (Figure 1). From north to south, the three SLAs are hereafter referred to as:

1. *Menangle Creek Corridor*
2. *Woodhouse/ Menangle Creek & Nepean Creek Corridors*[2]
3. *Mallaty Creek Corridor.*

[2] Woodhouse / Menangle Creek and Nepean Creek are regarded as two separate corridors by Council mapping.

The preceding corridors exist in the form of remnant vegetation associated with 2nd order streams / drainage lines and are bounded in the east and west by the riparian landscapes of the Georges and Nepean Rivers respectively.

2.2 *Vegetation*

The majority of remnant vegetation cover across the study area is mapped as *Woodland on Wianamatta Shale* (Vegetation Codes 16 & 20), with smaller areas of *Western Gully Forest* or *Woodland on Hawkesbury Sandstones* (Vegetation Codes: 1, 4 & 8). Preferred Koala Food Tree species (PKFTs) for the Campbelltown LGA which occur in these vegetation communities include grey box *Eucalyptus moluccana*; forest red gum *E. tereticornis* and grey gum *E. punctata* (Phillips and Callaghan 2000; Ward *et al*. 2013; Biolink 2016).

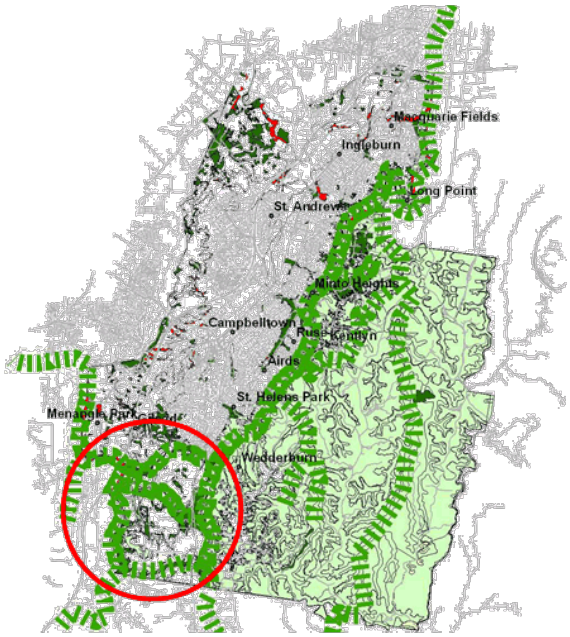

Figure 1. The general area of interest (red circle) is located in the southwestern corner of the Campbelltown LGA where a series of SLAs connect the Georges and Nepean River catchments and their associated koala populations.

Vegetation assessments were undertaken by recording height and species for the tallest-strata vegetation within a 25 m radius of each sampling point (see below). Abundance data for the tallest stratum were also collected by identifying the closest standing live stem

intersected by sighting along cardinal and intermediate compass points (*i.e.* a maximum of 8 samples in total) from the central sampling point (*sensu lato* Phillips *et al*. 2013).

2.3 *Habitat utilisation by koalas*

Koala occupancy was determined using Rapid-SAT sampling protocols reliant upon the presence of diagnostic koala faecal pellets within a prescribed search area of 1 m around the bases of the abovementioned PKFTs. The Rapid-SAT approach is predicated by knowledge that in areas being utilised by koalas, there is a 50% probability of faecal pellets occurring within 1 m of the base of any PKFT ≥ 350 mm diameter at breast height (DBH) (Phillips & Wallis 2016).

Vegetation containing PKFTs was sampled at approximately 500 m intervals throughout the study area. Some flexibility with site placement (+/- 25 m) was permitted so as to optimise the numbers of PKFTs being sampled at any point. Assessment at a given sampling point ceased when one or more koala faecal pellets had been detected. Conversely, if no pellets were detected, sampling ceased once the required numbers of PKFTs had been assessed so as to afford a high level of statistical confidence (*e.g.* 95 – 99%) that koalas were not using habitat in the immediate vicinity (Table 1).

Table 1. Binomial expansion showing confidence of 'koala absence' at an individual site based on the numbers of PKFTs that have been sampled with no koala faecal pellets being detected. Expansion is based on knowledge that in areas being utilised by koalas, there is a 50% probability of one or more koala faecal pellets being present within a distance of 1 m from the base of each PKFT ≥ 350 mm dbh that has been sampled.

No. of PKFTs	Binomial Distribution (probability)	Confidence
1	0.5	50%
2	0.25	75%
3	0.125	88%
4	0.0625	>90%
5	0.03125	>95%
6	0.015625	>95%
7	0.0078125	>99%

Opportunistic observations of other wildlife were recorded throughout the field survey component.

3 Results

3.1 Vegetation

Field survey was undertaken over 21st – 23rd November, 2017 during which time twenty-five field sites were assessed, the distribution of which is illustrated in Figure 2. Permission to survey lands associated with the Mallaty Creek Corridor in the south of our study area was not forthcoming, the implications of which are discussed elsewhere in this report.

Collectively, at least 16 tree species were recorded in the tallest-stratum vegetation, including 3 species of *Angophora* (narrow-leaved apple *A.bakeri*, rough-barked apple *A. floribunda* and Sydney red gum *A. costata*) and at least two species of Ironbark (narrow-leaved Ironbark *E. crebra* and broad-leaved Ironbark *E. fibrosa*). Grey box and forest red gum were the most commonly recorded species with one or both being represented in 80% (20/25) of the sampled field sites.

Schedule 2 of SEPP 44 lists forest red gum and grey gum as feed tree species for koalas. Discounting the importance of grey box as a PKFT[3], the percentage equivalent proportional representation of forest red gum and grey gum within the vegetation communities sampled by the field survey was 43% ± 4.61% (SE), thus readily qualifying the SLAs as *Potential Koala Habitat* for the purposes of SEPP 44.

3.2 Habitat Utilisation by koalas

Evidence of koalas in the form of diagnostic faecal pellets was recorded at 12 of the 25 sampled field sites. The data confirmed that koalas were present in each of the SLAs that we were able to access, as well as in the Nepean & Georges Rivers riparian landscapes to the west and east respectively (Figure 2). Across the study area these data further enable an overall habitat occupancy estimate for koalas of 48.0% ± 0.1% (SE) of the available habitat. Koala faecal pellets were equally associated with each of the 3 designated PKFTs being targeted (**Section 2.2 refers**). These outcomes confirm both optimal occupancy rates by koalas within the area subject to sampling and connectivity between koala populations occupying the Nepean and Georges River catchments. Appendix 1 provides a summary of the field survey data.

The median number of PKFTs sampled in sites where koala faecal pellets were NOT recorded was 7 (range 6 – 11), thus affording a high measure of confidence (> 99%) that koalas were not utilizing habitat in these areas (Table 1 refers). Areas without pellets were

[3] This species is a PKFT but not currently listed on Schedule 2 of SEPP 44.

more common towards the north-western corner of the study area near the junction of the Woodhouse – Menangle and Nepean Creek SLAs, where eutrophication arising from a waste water management program appears to have resulted in extensive areas of Eucalyptus dieback. Species most affected by eutrophication include PKFTs of the sub-Genus *Symphomyrtus* which includes forest red gum, grey gum, and grey box (Figures 2 & 3).

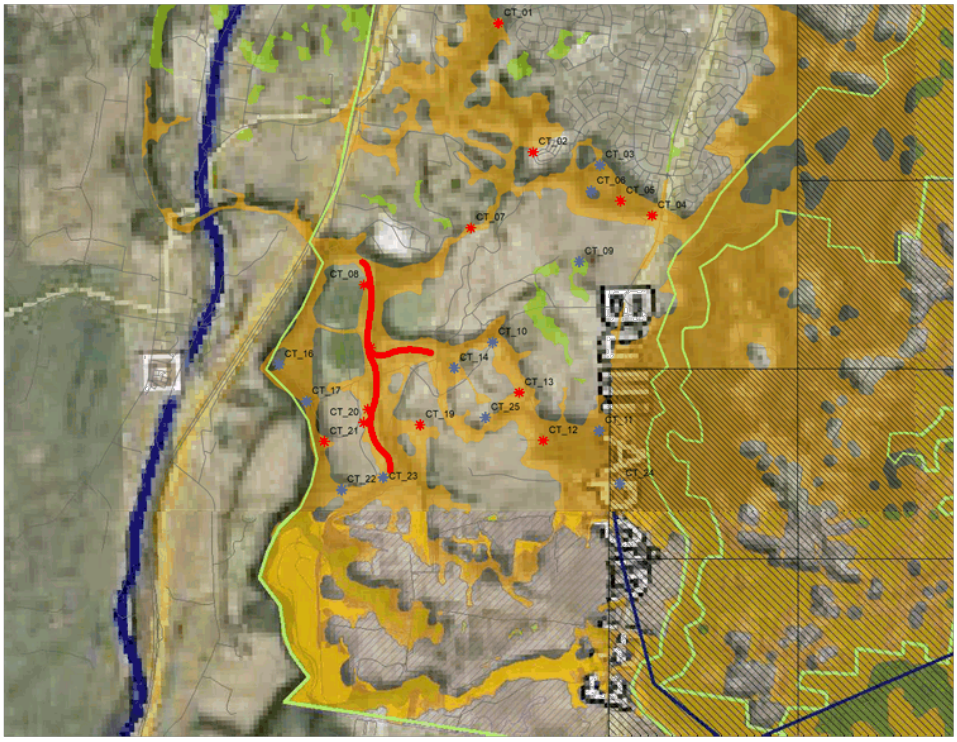

Figure 2. Location of 25 field sites used to assess koala occupancy and habitat across the study area. Orange shading represents vegetation cover; blue asterisks represent sites where evidence of koalas was recorded, red asterisks represent where sites where no evidence of habitat used by koalas was detected. The approximate extent of Eucalypt dieback arising from the eutrophication referred to in 3.2 is illustrated by a red line.

Figure 3. Dieback of *Eucalyptus* spp. in riparian zones associated with the junction of the Woodhouse – Menangle and Nepean Creek corridors.

3.3 *Opportunistic fauna observations*

Foxes were observed on numerous occasions, as well as evidence of denning activity in several locations within the SLA / bushland areas that were assessed. Other native species were also recorded, including 4 – 5 species of Macropod: wallaroo *Macropus robustus*, grey kangaroo *M. giganteus*, red-necked and swamp wallabies (*Macropus rufogriseus* and *Wallabia bicolor* respectively), Brush-tailed Rock Wallaby[4] *Petrogale penicillata*, echidnas *Tachyglossus aculeatus* and wombats *Wombatus ursinus*. Scats of brush-tail possums *Trichosurus vulpecula* were also observed in several field sites, as was evidence (pock marks on bark) typically indicative of glider (*Petaurus* spp[5].) use. Amongst the more interesting birds observed were dusky woodswallow[6] *Artamus cyanopterus*, varied sittella *Daphoenositta chrysoptera* and beautiful firetail *Stagonopleura bella*.

[4] Tentative sighting only – brief glimpse of a small macropod ascending a near-vertical rock face @ Easting: 294478; Northing 6221118 (GDA94)

[5] We suspect Squirrel Glider *P. norfolkensis* based on absence of a complex understory.

[6] General area for this species and Varied Sitella defined as within a 50 m radius of Easting 293695; Northing 6219678 (GDA 94)

4 Discussion

This study examined matters relating to habitat utilisation by koalas in a key area of the CCC LGA. A paucity of historical records in the study area has meant koala issues in this particular area have tended to be overlooked and/or under-estimated; hence the outcomes described herein are important in terms of their potential to further inform and guide planning decisions relating to any future development. *De facto*, the results further attest to the ongoing recovery and associated range expansion of koalas in the CCC LGA. The key results and implications of the study are explored in more detail in the sections that follow.

During the study, we were denied permission to sample habitat in the Mallaty Creek Corridor. While this is unfortunate, we remain confident that results from the overall survey can be broadly extrapolated into this area. Most importantly this extrapolation relates to the suitability of linear / riparian vegetation as areas of PKH and that the presence of koalas therein will be at a occupancy level commensurate with the 48% estimated for areas to the north, especially given the evidence of koala activity we recorded in close proximity to lands traversed by the Mallaty Creek Corridor.

4.1 Preferred (Potential) Koala habitat (PKH)

PKH as defined by both SEPP 44 and the Draft Campbelltown CKPoM is widespread and comprises the greater proportion of all sampled SLAs. Moreover, densities of large size-class PKFTs are also high, averaging more than 40% of the tallest stratum species across the area covered by the survey program. In combination with high koala occupancy rates discussed in more detail below, this outcome confirms the importance of these SLAs for koalas and provides Council with the knowledge to minimise further losses to PKFTs in these areas through appropriate planning measures.

4.2 *Eucalypt dieback*

The issue of eucalypt dieback in the north of the study area is not a trivial matter; impacts are substantive and widespread around the junction of the Woodhouse – Menangle and Nepean Creeks where treated effluent (presumed) is discharged by mechanised boom sprays across a series of 5 - 6 relatively large (20 ha) circular areas. While the frequency of watering and resting of these areas is unknown to us, it is inarguable that the cumulative impacts over time on these 2nd order stream networks have had a significant ecological impact on native vegetation and constituent PKFTs.

The extent of dieback and associated impacts we observed implies the need for an urgent intervention that must include review of current practices and standards, a minimum

outcome from which should be a reduced radial spray area so as to increase the buffer to adjoining riparian areas. While we have undertaken a cursory review of the literature in an attempt to proffer some advice on this matter, there does not appear to be a unanimous standard that effectively relates to the soil landscape in question. Given the extent of ecological damage, we are thus obliged to advocate for a minimum buffer distance of 65 m from top of bank on either side given that buffers of this size will likely avoid short-term negative impacts on macro-invertebrate communities (Culp and Davies 1983; Davies and Nelson 1994); however, given the coarse and highly porous nature of the soil landscape in the study area it is possible that even larger buffers may be needed to effectively protect water quality.

We cannot stress the importance of urgent remedial action on this issue which also has implications for the longer-term management of riparian corridors / habitat linkages in the context of immediately adjoining areas of envisioned residential development where the threat of eutrophication from concentrated urban run-off similarly mandates the need for large(r) buffer areas than might otherwise be contemplated or proposed. Given the need for a precautionary approach, such considerations imply that a minimum overall width of ~ 200 m (*i.e.* 100 m either side of central drainage line) will likely be the minimum necessary to secure ecological integrity where 2nd order drainage lines form the basis of SLAs in the MGPGA.

4.3 Koala occupancy and corridor use

The extent of habitat use by koalas recorded by this survey was higher and more extensive than we anticipated. Indeed, in any area containing suitable PKH, we regard 50% occupancy as optimal benchmark for sustainable koala management. Thus the SLAs and associated habitat areas are already sustaining resident koala populations, are Core Koala Habitat for planning purposes and are clearly important in terms of assisting ongoing recovery of the Campbelltown koalas. Occupancy by koalas of these key areas also function to afford some resilience to the population by being strategically located to the west of Appin Road and so being capable of facilitating recovery following a future catastrophic fire event in habitat areas to the east.

Results also confirm – perhaps for the first time - that the Campbelltown and Nepean koala populations are in contact. This is a positive outcome which additionally enhances longer-term resilience of both populations by potentially increasing genetic diversity. In this context the merit of maintaining and/or optimising the current SLA configuration is laudable, as is the need to ensure that connectivity measures that enable this connection to be maintained are

neither severed nor further compromised by poorly informed planning proposals. Minimum standards for the design of SLAs / corridors in this low carrying capacity landscape are discussed in more detail below.

4.4 *Appin Road Upgrade*

Commensurate with a progressively recovering / expanding koala population, Appin Road is the subject of increasing numbers of vehicle-strikes resulting in injury to or death of koalas. We understand that planning to upgrade Appin Road from 2 to 6 vehicle lanes has commenced, as have preliminary discussion regarding the likely need to service wildlife movement / mitigate against ongoing vehicle-strike, in which context it has been suggested that connectivity should be truncated and would be best maintained in the south (*i.e.* past the township of Appin). Such an outcome would likely be realised by installing fauna exclusion fencing on the eastern side of Appin Road for approximately 8 km extending from urban areas in South Campbelltown to the township of Appin. This current proposed mitigation assumes habitat in the study area is NOT important for maintaining koala connectivity and/or does not support suitable habitat. This assumption is clearly repudiated by the results of this study, which has confirmed that these SLAs are important for koalas and other wildlife in the CCC LGA. The key outcomes that support this conclusion are:

i. The presence of a substantive area of Generational Persistence / Core Koala Habitat associated with the Wedderburn KMP, the western extent of which abuts and (now) extends across Appin Road in some areas; hence forecasting a strong likelihood of ongoing population expansion and use of PKH in this area.
ii. High quality PKH is present to the west of Appin Road where vegetated SLAs, increasing numbers of koala sightings and vehicle- strike records are predominately located.
iii. Koala occupancy within SLAs to the west of Appin Road is at near optimum levels, with high quality PKH available throughout the study area.

Given the field-based evidence, it is clear that any upgrade to Appin Road in the area south from the current southern limits of residential development at Campbelltown should ideally aim to both minimize the potential for vehicle strike, but also ensure that east-west connectivity for koalas is maintained, rather than truncated. This is important because this area provides linkages connecting the currently known southwesterly extent of koala distribution in the Georges River catchment with those inhabiting the Nepean River Catchment. Moreover, the preservation and consolidated connectivity of these SLAs represents one of the last opportunities to establish viable connectivity between

Campbelltown koalas with larger habitat areas such as the Nattai National Park to the southwest.

For the most part, the current alignment of Appin road within the CCC LGA traverses a ridgeline, which minimizes opportunities for any future road upgrade to incorporate underpass structures as a means of accommodating the movement of koalas and other wildlife. Contingent upon a consolidation of the SLA network so as to offer a guarantee of long-term ecological integrity (see below), we thus perceive the minimum requirements to minimise potential for vehicle-strike along that section of Appin Road within the CCC LGA to include:

a) A minimum of three fauna overpasses strategically located between the southern limits of residential development at Campbelltown and the northern limit of residential development at Appin (Figure 4)
b) Reinforcement of overpass utility by use of wildlife exclusion fencing along both sides of Appin Road between the southern limits of residential development at Campbelltown and the northern limit of residential development at Appin, and
c) The installation of koala-grids on all residual driveways and road intersections entering the area of the Appin Road upgrade.

Precedents and monitoring data from a numbers of studies are available to support application and efficacy of each of the three preceding mitigation measures. However, their implementation remains contingent upon consolidation of the SLAs so as to provide justification for any associated expenditure.

The management needs of koalas in low carrying capacity landscapes are more complex relative to those in higher carrying capacity habitats wherein small home range areas enable finer measures of resource partitioning. Koalas in the CCC LGA and adjoining landscapes spend more time on the ground to access their preferred food tree species, the palatability of which is influenced by ontogenetic and edaphic considerations. Commensurate with the low-carrying capacity landscape and based on a median female koala home range size of 36 ha, Biolink (2016) calculated the need for a 425 m buffer to effectively accommodate occupancy considerations in areas adjoining cells with evidence of generational persistence. Given considerations of spatial flexibility, it follows that any corridor / linkage area dedicated to the task of accommodating koala movement across this low carrying capacity landscape should ideally approximate the 425 m measure in terms of defining an optimal width.

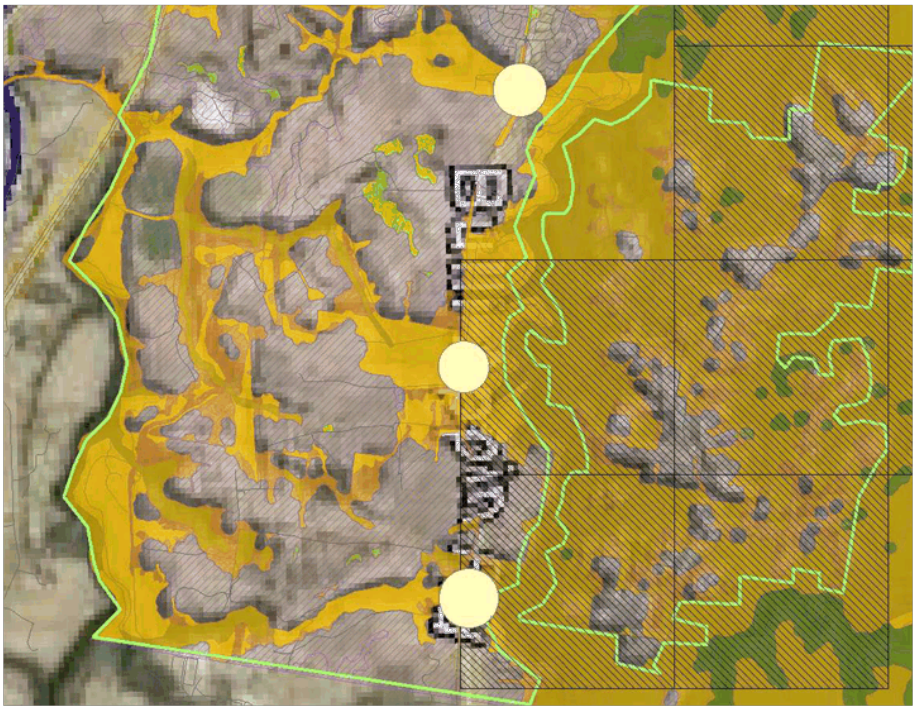

Figure 4 Recommended location of fauna overpass infrastructure along Appin Road.

4.5 *Conclusions*

Field assessment has confirmed utility by koalas of habitat in the south Campbelltown area and the active utilisation of SLAs currently linking the Nepean and Georges River catchments.

The aforementioned SLAs sustain high-quality PKH with high densities of PKFTs.

Eutrophication appears to be resulting in extensive dieback of PKFTs in the north-west of the study area in the general area of the junction of the Woodhouse – Menangle and Nepean Creeks.

The threat of further eutrophication impacts elsewhere in the study area arises from envisaged development outcomes, which historically will strive to optimise development outcomes (yield) at the expense of environmental considerations.

The proposed upgrading of Appin Road between Campbelltown and Appin will require extensive vehicle-strike mitigation measures including provision for a minimum of 3

dedicated fauna overpasses and supporting infrastructure in order to accommodate the movement of koalas and other wildlife.

Recommendations

1. In order to provide certainty for future planning purposes and a consolidated future for the Campbelltown koalas, Council should seek support from the NSW Department of Planning & Environment such that future planning for the GMPGA proceeds on the basis of at least three east-west SLAs, the minimum widths of which should range from 200 m - 425 m. To most effectively accommodate koalas, at least one of the three corridors should be designed specifically for the species by planning to ensure an optimal average width of 425 m is achieved[7].

2. Council should initiate further investigations into the issue of eutrophication and associated Eucalypt dieback in the general area of the junction of the Woodhouse – Menangle and Nepean Creek SLAs. This is not just an ecological issue given the location of this event within the GMPGA and the health risks that may arise given increased levels of public access as a consequence of any future development.

[7] This may require further analyses/consideration in order to identify optimum configuration.

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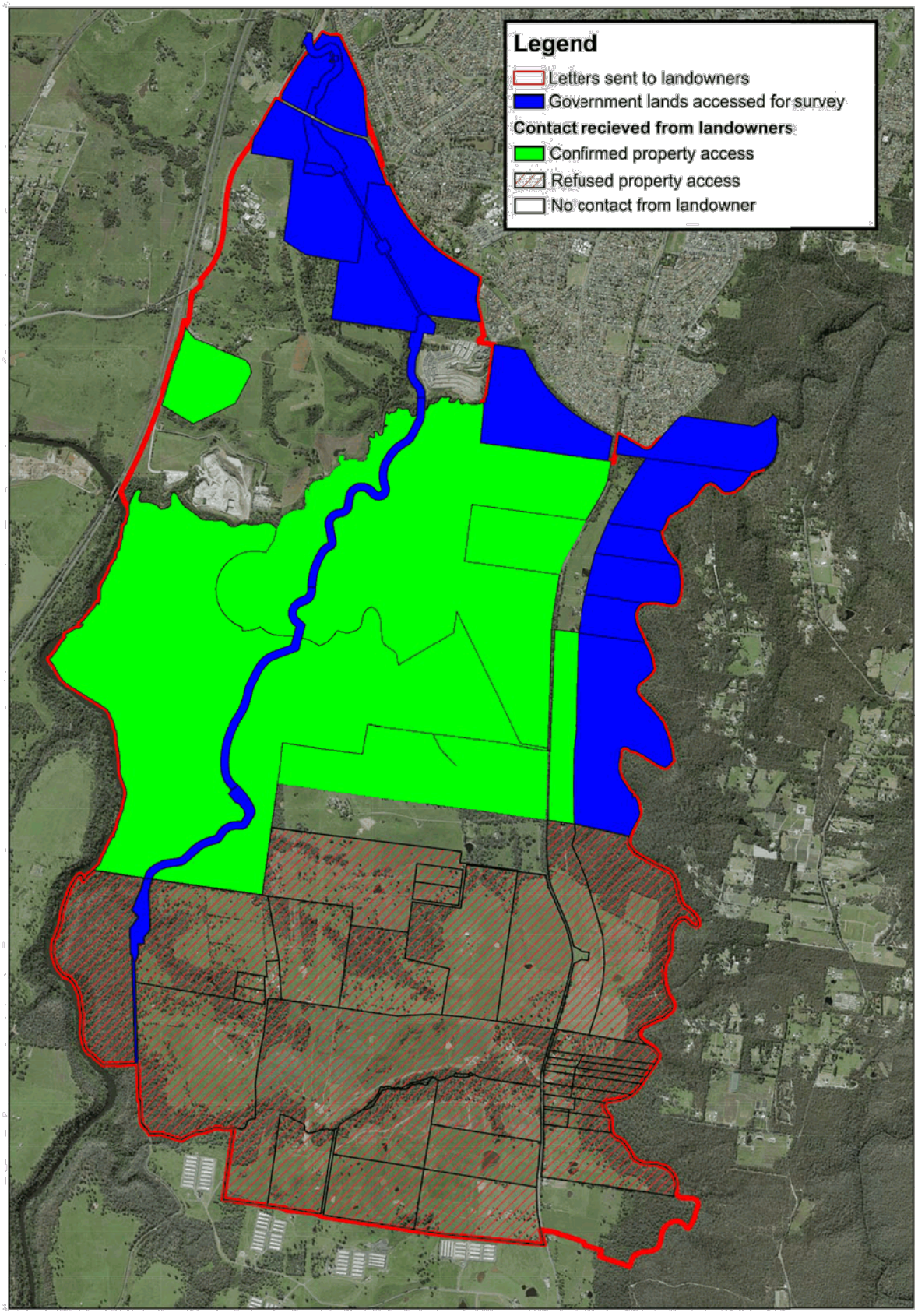
Appendix 1

Site coordinates and details relating to presence (√)/absence (×) of koala faecal pellets at each of the 25 sampled sites. 'No. PKFTs' corresponds to the number of Preferred Koala Food Trees sampled to determine presence/absence at a given site. 'PKFT' refers to the Preferred Koala Food Tree species recorded at each site. 'Corridor' represents corridor where site was located. If more than one corridor is listed = site is located within or between listed corridors.

Site No	Easting	Northing	Faecal pellet	No. PKFTs	PKFT	Corridor
1	296069	6222819	✓	5	*E. mol*	MC
2	296720	6222561	×	8	*E. ter*	MC
3	296382	6222717	×	7	*E. mol, E. ter*	MC
4	296162	6223098	✓	1	*E. mol*	MC
5	294613	6220940	✓	1	*E. pun*	WMC
6	294944	6220413	✓	1	*E. ter*	WMC
7	295562	6220168	×	7	*E. mol, E. pun, E. ter*	WMC
8	296154	6220273	✓	1	*E. pun*	WMC
9	296428	6219516	✓	1	*E. mol*	NC / WMC
10	295303	6220678	×	6	*E. pun*	WMC
11	295021	6221213	✓	5	*E. pun*	WMC
12	295941	6222071	✓	1	*E. ter*	MC / WMC
13	293694	6220499	×	7	*E. pun*	WMC
14	293724	6221157	×	6	*E. pun*	WMC
15	294250	6220336	×	9	*E. ter*	WMC
16	293652	6221824	×	6	*E. pun*	MC / WMC
17	293650	6220358	×	10	*E. mol, E. pun, E. ter*	WMC
18	293857	6219778	✓	1	*E. ter*	NC
19	293415	6219645	✓	1	*E. pun*	NRC / NC
20	292749	6220977	✓	1	*E. ter*	NRC
21	293229	6220158	×	7	*E. pun*	NRC
22	293041	6220585	✓	1	*E. ter*	NRC
23	294788	6222429	×	8	*E. mol, E. ter*	MC
24	295083	6224604	×	10	*E. mol*	MC
25	295452	6223235	×	11	*E. mol, E. ter*	MC

Abbreviations used for PKFTs and corridors in the table are as follows: *E. mol* = *E. moluccana*; *E. pun* = *E. punctata*; *E. ter* = *E. tereticornis*; MC = Menangle Creek; WMC = Woodhouse/ Menangle Creek; NC = Nepean Creek; NRC = Nepean River Corridor.


Legend
Letters sent to landowners
Government lands accessed for survey
Contact recieved from landowners
Confirmed property access
Refused property access
No contact from landowner