Wilton Koala Plan of Management

Prepared for Walker Corporation

July 2021

EMM

creating opportunities

Allens Creek Corridor Koala Conservation Plan and South East Wilton Koala Plan of Management

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13 July 2021

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Background

EMM Consulting Pty Limited (EMM) has been engaged by Walker Corporation to prepare a Koala Plan of Management (KPoM) associated with a proposed residential development at South East Wilton Precinct. The area proposed for development is predominantly cleared land but includes some native vegetation, mostly in a disturbed condition. The precinct contains areas identified under the Structure Plan for low and medium density residential, commercial, open spaces and environmental conservation and part of the far eastern portion of the precinct has been identified by the NSW Office of Environment and Heritage (OEH) as part of a movement corridor for koalas; referred to as the Allens Creek Corridor (Figure 1.5), which is continuous with the Nepean corridor to the north and the Cordeaux and Cascade corridors to the south (DPIE 2019).

Part of the eastern section of the precinct has been zoned for 'environmental conservation' to enable the existing native bushland to be retained (Figure 1.1). This KPoM aims to:

1. improve koala habitat quality within the site, noting that this will be achieved through implementation of actions identified in the associated Vegetation Management Plan (VMP, Ecoplanning 2020);

2. reduce threats to koalas from the development; and

3. seek to provide connectivity to the broader Allens Creek Corridor, which connects areas of koala habitat in the Upper Nepean State Conservation Area with habitat to the north along the Nepean River (Figure 1.4).

This document fulfils the requirement, where necessary, for the preparation of a site-specific KPoM, under State Environmental Planning Policy (Koala Habitat Protection) 2020 (Koala Habitat Protection SEPP) and fulfilling requirements in Section 2.2.2 of Circular no. B35, as outlined in Table 1.1 below. This KPoM was previously prepared to meet the requirement of State Environmental Planning Policy No. 44 - Koala Habitat protection (SEPP 44), and has been updated for consistency with the Koala Habitat Protection SEPP.

In addition to these statutory requirements, Walker Corporation and Wollondilly Shire Council entered into a Koala Deed of Agreement as part of discussions resulting from the rezoning of the South East Wilton Precinct. This Koala Deed of Agreement also required the identification of recommended management measures within the wider Allens Creek Corridor. Therefore, this document identifies how the South East Wilton Precinct fits into the Allens Creek Corridor (Section 1.2), and provides recommendations for management actions within the broader Allens Creek Corridor study area (Section 4.2). This KPoM therefore also fulfils the 12 matters specified in the Koala Deed of Agreement, as outlined in Table 1.2 below.

This document provides a KPoM that identifies management measures to occur within the South East Wilton Precinct, and also provides guidance on conservation actions for koalas within the Allens Creek study area. The management actions identified within the KPoM will be primarily the responsibility of Walker Corporation. However, the recommended conservation actions for the Allens Creek Corridor study area are outside of the South East Wilton Precinct and as such are not a requirement of the KPoM and cannot be enacted by Walker Corporation.

This KPoM has also been updated to achieve consistency with the proposed urban capable footprint contained within the draft Cumberland Plain Conservation Plan (CPCP; DPIE 2020) that was placed on exhibition between 26 August and 2 November 2020. To ensure consistency with the proposed urban capable footprint contained within in the draft CPCP, the Koala link corridor width adjacent to Picton Road has been increased in this version of the KPOM. It is recognised that the CPCP is currently in draft form and therefore, to the extent that the gazetted final CPCP proposes an urban capable footprint in the vicinity of the Koala link corridor adjacent to Picton Road that

is larger than that set out in the draft CPCP, then the Koala link corridor width adjacent to Picton Road within this KPOM will reduce accordingly.

This KPoM combines information from field studies carried out by EMM ecologists within both the South East Wilton Precinct and the Allens Creek Corridor study area region (Section 1.2), as well as supplementary information gathered from government reviews and policy documents, academic papers, council publications, results of previous surveys carried out at the site, local vegetation mapping, and databases of ecological records. All applicable documents that have been used to inform the preparation of this KPoM are referenced throughout where relevant.

The objectives of this document are thus to:

1. provide a KPoM for the South East Wilton Precinct;

2. provide guidance on koala management within the Allens Creek Corridor; and

3. identify monitoring actions to be implemented.

1.1.1 Land to which this KPoM applies

The land to which the KPoM applies has been restricted to Lot 4, DP 1263564 and Lot 2, DP 108340 (Figure 1.1).

References to the South East Wilton Precinct are retained in this document, but should be treated as contextual only, with the land where the KPoM applies is as specified in Figure 1.1.

1.1.2 Change of ownership of South East Wilton Precinct

In multiple sections of this KPoM there are references to actions to be undertaken by Walker Corporation, and performance measures to be achieved within the South East Wilton Precinct. For clarity, it is noted that should ownership of the South East Wilton Precinct change, that adoption of the Plan by successors in title via a special condition in any Contract for Sale of Land stipulating is to occur (except for individual residential lot purchasers).

Thus, any references to actions to be undertaken by Walker Corporation in this document should be read as applying to the landholder(s) at that point in time, in particular the landholder of E2 conservation lands.

Table 1.1 Matters to be considered as part of a site-specific Koala Plan of Management

Matters specified in circular no. B35	Where addressed in this KPoM
An estimate of population size.	Section 3.3
Identification of preferred feed tree species for the locality and extent of resource available.	Table 2.1, Section 3.2
An assessment of the regional distribution of koalas and the extent of alternative habitat available to compensate for that to be affected by the actions.	Sections 1.6, 2.5, 3.3, 3.4, 4.1.1, 4.2.1
Identification of linkages of core koala habitat to other adjacent areas of habitat and movement of koalas between areas of habitat. Provision of strategies to enhance and manage these corridors.	Sections 3.4, 4.1.2, 4.2
Identification of major threatening processes such as disease, clearance of habitat, roadkill and dog attack which impact on the population. Provision of methods for reducing these impacts.	Sections 4.1, 4.2
Provision of detailed proposals for amelioration of impacts on koala populations from any anticipated development within zones of core koala habitat.	Sections 4.1, 4.2
Identification of any opportunities to increase size or improve condition of existing core habitat, this should include lands adjacent to areas of identified core koala habitat.	Section 4.1.1, 4.2.1
The plan should state clearly what it aims to achieve (for example, maintaining or expanding the current population size or habitat area).	Section 1.1
The plan should state criteria against which achievement of these objectives is to be measured (for example, a specified population size in a specific time frame or the abatement of threats to the population).	Section 5.1
The plan should also have provisions for continuing monitoring, review and reporting. This should include an identification of who will undertake further work and how it will be funded.	Section 5, Funding - Section 5.9

Table 1.2 Requirements outlined in Koala Deed of Agreement

Matter specified in Deed of Agreement		Where addressed in this KPoM
3.1a The parties agree to work expeditiously together to develop a koala plan of management for the Allens Creek Corridor, in accordance with the guidelines in force from time to time under SEPP 44* and lodge such koala plan of management for approval with the Department of Planning and Environment. The koala plan of management is to include the following:		
(i)	A koala habitat restoration plan, with such a plan to also address the allocation of funding needed in order to implement the plan. All plantings for habitat restoration to use locally sourced seed	Section 4.1.1, 4.2.1 Funding – Section 5.9
(i)	Existing bushland weed management	Section 4.1.1, 4.2.1
(ii)	Appropriate exclusion fencing installation around the koala habitat conservation area to protect koalas from Picton Rd and the development interface with the South East Wilton development to facilitate safe movement of koalas through the existing culverts that already exist under Picton Rd and maintaining connectivity throughout the Allens Creek Corridor	Section 4.1.2 and 4.2.2 and Figure 4.3
(iii)	Bushfire asset protection zones for the South East Wilton Precinct to be clearly defined and not overlap the koala habitat conservation area	Section 4.1.5
(iv)	Areas undergoing environmental protection and habitat restoration works to be clearly identified and marked with signage including interpretive/educational information	Section 4.1.8

Table 1.2 Requirements outlined in Koala Deed of Agreement

Matter specified in Deed of Agreement		Where addressed in this KPoM
(v)	A koala monitoring program to be developed with such program to also address the allocation of funding needed in order to implement the program. Such a program could potentially include a citizen science project that can educate local communities and schools	Section 5.2
(vi)	The koala plan of management to be reviewed every 5 years	Section 5.8
(vii)	An information brochure about the significance of the local koala population to be produced	Section 4.1.8 and 4.2.8
(viii)	Where required, measures to exclude dogs and cats from the koala habitat conservation area as far as practicable	Section 4.1.3 and 4.2.3
(ix)	The installation of permanent koala warning signage in both directions on Picton Rd to the reasonable satisfaction of the Roads and Maritime Services	Section 4.2.2
(x)	The extent and placement of exclusion fencing referred to under clause 3.1(a)(iii) above along Picton Rd that is intended to both optimise underpass use and keep koalas from entering the exclusion area	Section 4.1.2 and 4.2.2 and Figure 4.3
(xi)	Detail the extent and specification of exclusion fencing and other infrastructure that will be used along the boundary of the exclusion areas	Section 4.1.2 and Figure 4.3
3.1b Until the End Date, the parties agree to work expeditiously together to undertake detailed assessments of any reasonable retro-fitting measures required to optimise utility of the two existing underpass structures under Picton Road as highlight in red on the plan set out in Annexure b [of the Deed] and where reasonable and practicable to do so, implement such measures		Section 4.2.2 Detailed design and installation to occur as set out in Table 4.2
3.1c Until the End Date, the parties agree to work expeditiously together and use reasonable endeavours to:		Section 4.1.1 and Table 4.1
(i)	investigate the widening of the koala corridor along Picton Road (including mechanisms to achieve any such widening), in the general area shown highlighted in yellow on the plan set out in Annexure B and use reasonable endeavours to implement any agreed widening, subject to there not being a reduction in lot yield of the widening having regard to the reasonable reallocation of any reduction in lot yield to other developable areas of the South East Wilton development and having regard to the requirement of any other relevant State Government Agency	
(ii)	investigate additional koala offset areas along Picton Road (through a land swap between the Wilton South East development and the Nepean Conservation Area, being the general area shown in blue on the plan set out in Annexure B	This was investigated but is not supported by Environment Energy and Science Group which jointly manages the Nepean Conservation Area with WaterNSW (EES 2020). As such it is not further discussed in this document.
(iii)	discuss the potential to create additional safe under-road passage locations for koalas in the Allens Creek Corridor to enhance the connectivity potential of the koala corridor and where such additional safe under-road passage locations are agreed between the parties and are within the Walker Land, implement such under-road passages	Section 4.2.2 Detailed design and installation to occur as set out in Table 4.2

* SEPP 44 has now been replaced by State Environmental Planning Policy (Koala Habitat Protection) 2020 (see Section 1.4).

1.2 Description of Allens Creek Corridor

The Allens Creek Corridor is an area of land that has been broadly identified as being a koala corridor (Figure 1.4, DPIE 2019). The corridor extends over approximately 10km in a north – south direction. The northern portion includes vegetation on the southern bank of the Nepean River close to Douglas Park, and also includes vegetation associated with Allens Creek to the north and east of the township of Wilton. Three key public roads pass through the corridor: the Hume Motorway in the north, Wilton Road, and Picton Road.

The corridor is identified as being a 'primary' corridor (DPIE 2019 defines this as containing contiguous 'core' koala habitat and greater than 380 ha in size). The corridor also links with other identified corridors: Nepean in the north, Cataract and Clements in the east, Cascade and Cordeaux in the south, and Stringybark to the west. Currently the northern portion is largely undeveloped, the central portion (in proximity to Wilton contains a number of properties, with vegetation in some areas sparse around large rural-residential properties, and the southern portion is largely undeveloped.

This document focussed on a study area within the Allens Creek Corridor, as defined in Figure 1.6. There is a range of land ownership within this region. In particular the central portion of the corridor in proximity to Wilton Road has a mix of ownership by different parties, reflecting the large rural-residential properties in this area.

The vegetation, geology, soils and context with regards to koala knowledge and management is discussed further in Section 2.

1.3 Commonwealth and State Legislation

The koala is listed as Vulnerable under both the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the NSW *Biodiversity Conservation Act 2016* (BC Act). Under this legislation consideration of impacts upon the koala is required, and environmental offsets may be required, depending on the approvals required and nature of the impacts. Furthermore, under the BC Act 'credits' can be generated from management of lands that are formally established and managed as stewardship sites.

This KPoM guides future management of the koala and koala habitat within the South East Wilton Precinct. It does not replace impact assessments or 'credits' required under either the BC Act or EPBC Act. Therefore, any future vegetation clearance or biodiversity impacts will need to be undertaken in accordance with the BC Act and the EPBC Act assessment requirements. It is likely that these impacts will be considered under the proposed Western Sydney Strategic Biodiversity Certification (NSW) and Strategic Assessment (Commonwealth) but could occur under other impact assessment processes such as Biodiversity Development Assessment Report (BDAR).

Similarly, this document does not prohibit the generation of credits (including koala credits) from management of lands as Stewardship site(s) under a Biodiversity Stewardship Site Assessment Report (BSSAR).

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) provides for the creation of environmental planning instruments (EPIs), such as state environmental planning policies (SEPPs), that must consider threatened species such as the koala. State Environmental Planning policy (Koala Habitat Protection) 2020 was created to improve the protection of koala habitat across the state (outlined below) and operates within the legislative framework of the EP&A Act.

1.4 State Environmental Planning Policy (Koala Habitat Protection) 2021

State Environmental Planning Policy (Koala Habitat Protection) 2021 (Koala SEPP 2021) commenced on 17 March 2021. This amended the State Environmental Planning Policy (Koala Habitat Protection) 2020 (Koala SEPP 2020) which commenced on 30 November 2020.

Koala SEPP2021 contains savings and transitional provisions, and applies where a plan of management for the whole, or part of, a local government area was submitted for approval before Koala SEPP 2021 applied (Part4, 20(1) of Koala SEPP 2021). This KPoM was submitted (as an updated document) in February 2021, and thus the transitional arrangements apply. This document was prepared under the requirements of Koala SEPP 2020, which is discussed below.

1.5 State Environmental Planning Policy (Koala Habitat Protection) 2020

Koala SEPP 2020 commenced on 30 November 2020 and replaced State Environmental Planning Policy (Koala Habitat Protection) 2019, which commenced on 1 March 2020 and replaced State Environmental Planning Policy No. 44 - Koala Habitat protection (SEPP 44). The Koala Habitat Protection SEPP effectively reverts back to controls within SEPP 44, with minor changes to controls affecting the creation of asset protection zones for legally erected dwellings destroyed by bushfires. This KPoM has prepared under the Koala SEPP 2020 controls.

The Koala Habitat Protection SEPP aims to 'encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline by:

- requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat;
- encouraging the identification of areas of core koala habitat; and
- encouraging the inclusion of areas of core koala habitat in environmental protection zones.

Under the policy, 'potential koala habitat' is defined as areas of native vegetation where the trees of the types listed in Table 1.3 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component, and 'core koala habitat' refers to an area of land with a resident population of koalas, evidenced by attributes such as breeding females and recent sightings of and historical records of a population.

Table 1.3 Feed tree species listed in Schedule 2 of the Koala Habitat Protection SEPP

Common name	Scientific name
Forest red gum	*Eucalyptus tereticornis*
Tallowwood	*Eucalyptus microcorys*
Grey Gum	*Eucalyptus punctata*
Ribbon or manna gum	*Eucalyptus viminalis*
River red gum	*Eucalyptus camaldulensis*
Broad leaved scribbly gum	*Eucalyptus haemastoma*
Scribbly gum	*Eucalyptus signata*
White box	*Eucalyptus albens*
Bimble box or poplar box	*Eucalyptus populnea*
Swamp mahogany	*Eucalyptus robusta*

The above list of food trees which is used to define koala habitat under the Koala Habitat Protection SEPP was compiled in 1995 and does not include all of the species used by koalas that are important to their survival throughout the state. Since that time further research has occurred, with various studies contributing to the knowledge base, with key summary studies reviewed in Section 2. In particular Ward (2002) identified that

vegetation within the home range of a breeding female koala radiotracked over multiple years at Wedderburn, south of Campbelltown, did not meet the Koala Habitat Protection SEPP definition of 'potential koala habitat'. Therefore, this KPoM also identifies trees other than those listed under the Koala Habitat Protection SEPP in terms of identifying koala habitat, based on current knowledge.

1.6 Koalas in NSW and the local area

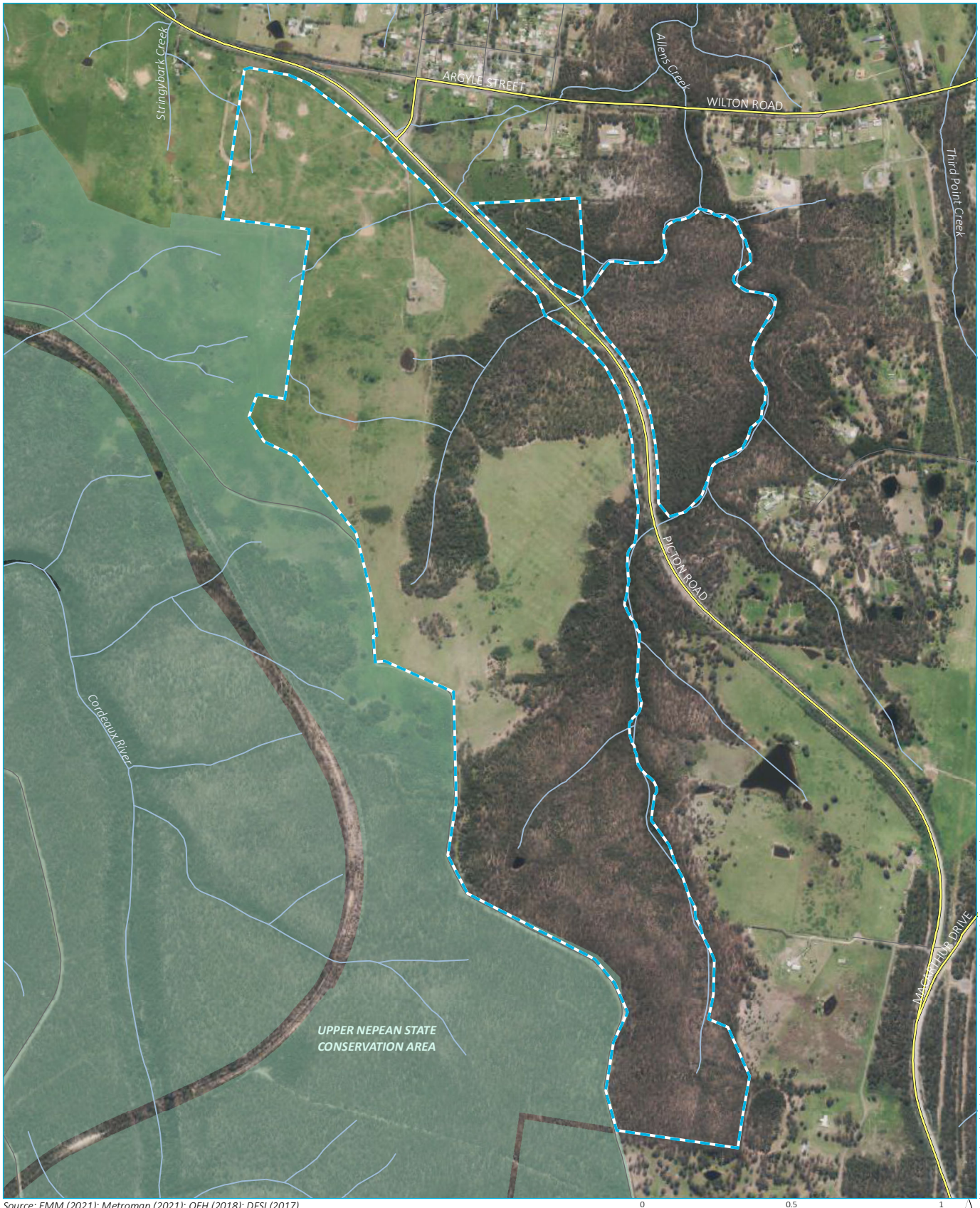
Koalas were formerly widespread in NSW, with a largely continuous distribution throughout coastal and inland areas of the state. Koala populations in NSW persist in fragmented areas of habitat, and connectivity between habitat is one of the major considerations for conservation of the species.

The NSW koala population has been divided into Koala Management Areas (KMAs) (DECC 2008), based on landscape characteristics and administrative boundaries. The Central Coast KMA (KMA2), which includes the Wilton area, covers a large area of coastal and highland areas from Wollongong to Newcastle. This area includes koala populations on the Central Coast, northwest of Sydney, the Blue Mountains, the Campbelltown/Appin area, the Wollondilly region, the southern highlands, and the Canyonleigh area west of Moss Vale.

Genetic analysis suggests that the koala population in Australia consists of many highly differentiated populations, with limited gene flow between them, partly due to habitat fragmentation. Restricted gene flow between populations can lead to a loss of genetic diversity, which presents challenges for the conservation of a species. With regards to koala genetics in the Sydney region Lee et al. (2010) identified three discreet populations (Campbelltown/Heathcote, Southern Tablelands, and Blue Mountains) with moderate to high levels of genetic diversity between them, and the Allens Creek Corridor area within the Southern Tablelands grouping.

Koalas live in breeding groups, where the home range of a dominant male overlaps with the home ranges of several females. Home range size varies greatly depending on quality of habitat available and the food trees present. They feed predominantly on eucalypt leaves, with a preference for particular species (detailed in Section 2.2). The feed tree species preferred by koalas varies from region to region. They tend to feed during the night when they are more active and move to non-food trees during the day for shelter and protection.

Koalas inhabit a range of eucalypt woodland communities and can also utilise isolated paddock trees (Schulz 2018). The suitability of habitat for koalas is determined by a range of factors, such as the species of trees present; the size of the trees and structural diversity of the habitat; soil nutrients, which affects the availability of nutrients within leaves; climate and soil moisture, which affects moisture content of leaves; and the level of disturbance and fragmentation.



Source: EMM (2021); Metromap (2021); OEH (2018); DFSI (2017)

0 0.5 1 km

GDA 1994 MGA Zone 56

N

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KEY

- Land to which the KPoM applies
- Main road
- Local road
- Watercourse
- NPWS reserve

Land to which the KPoM applies

Walker Corporation
Wilton Koala plan of management
Figure 1.1

EMM
creating opportunities

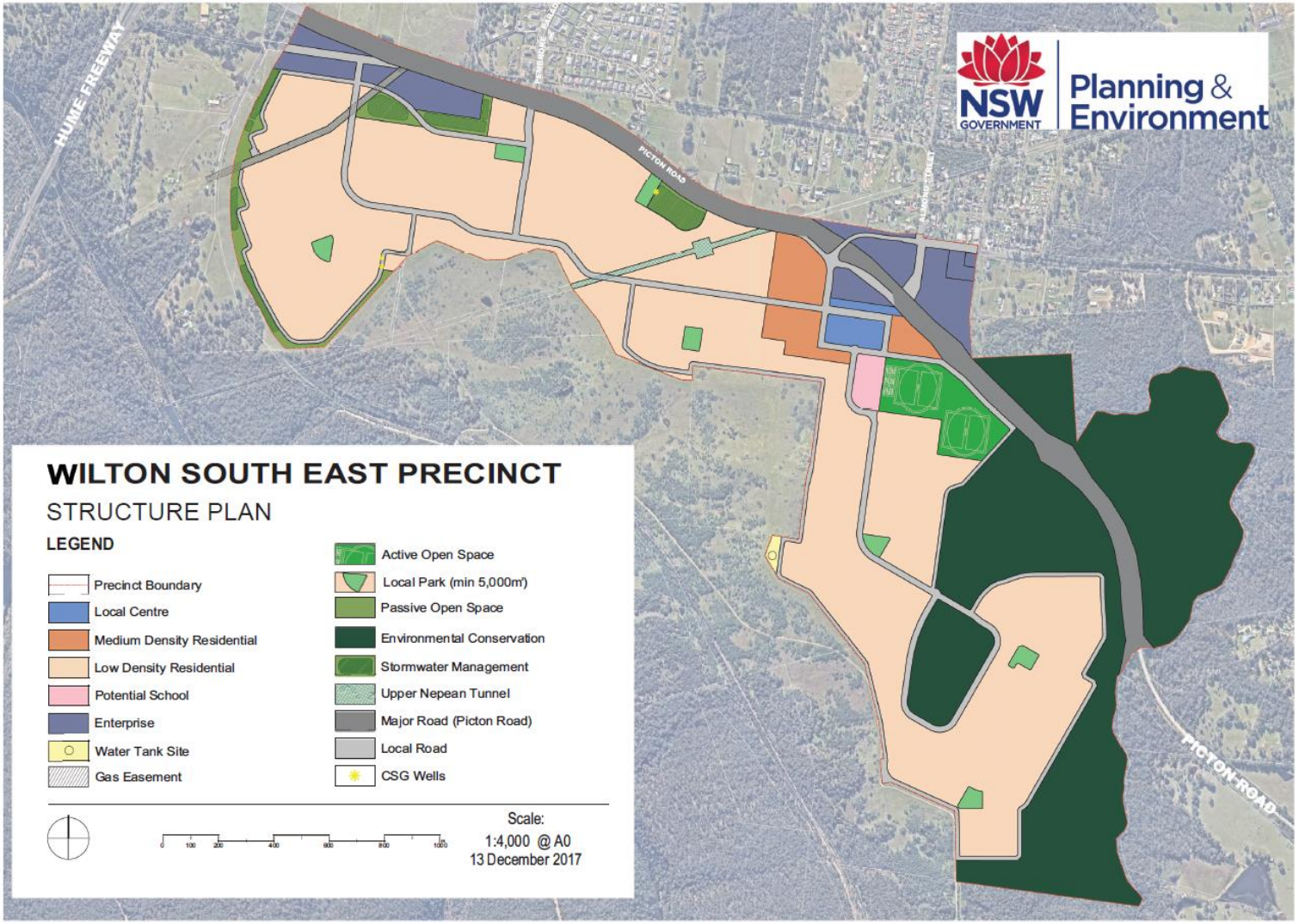
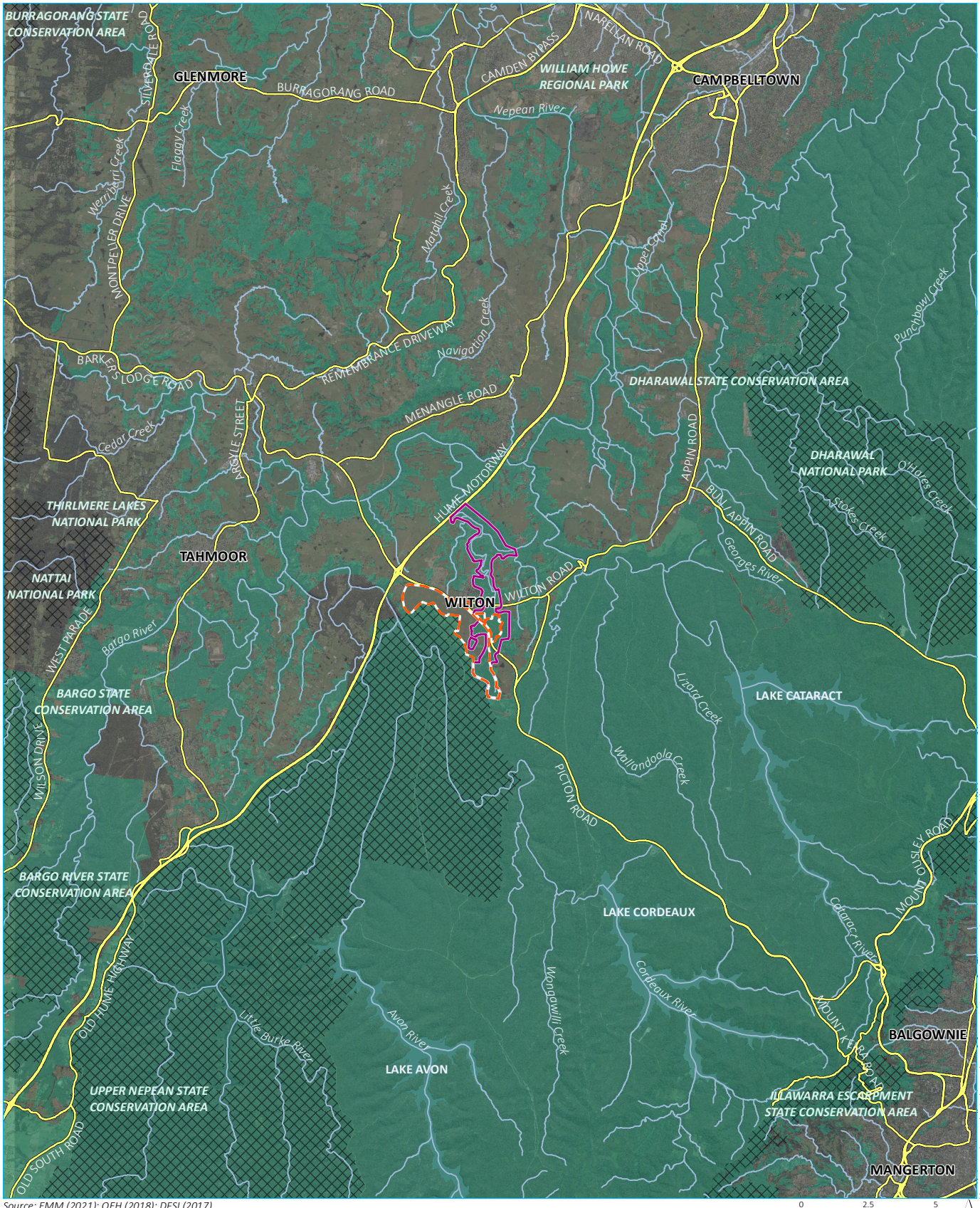


Figure 1.2 South East Wilton Precinct Structure Plan (DPE 2017)



Source: EMM (2021); OEH (2018); DFSI (2017)

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GDA 1994 MGA Zone 56

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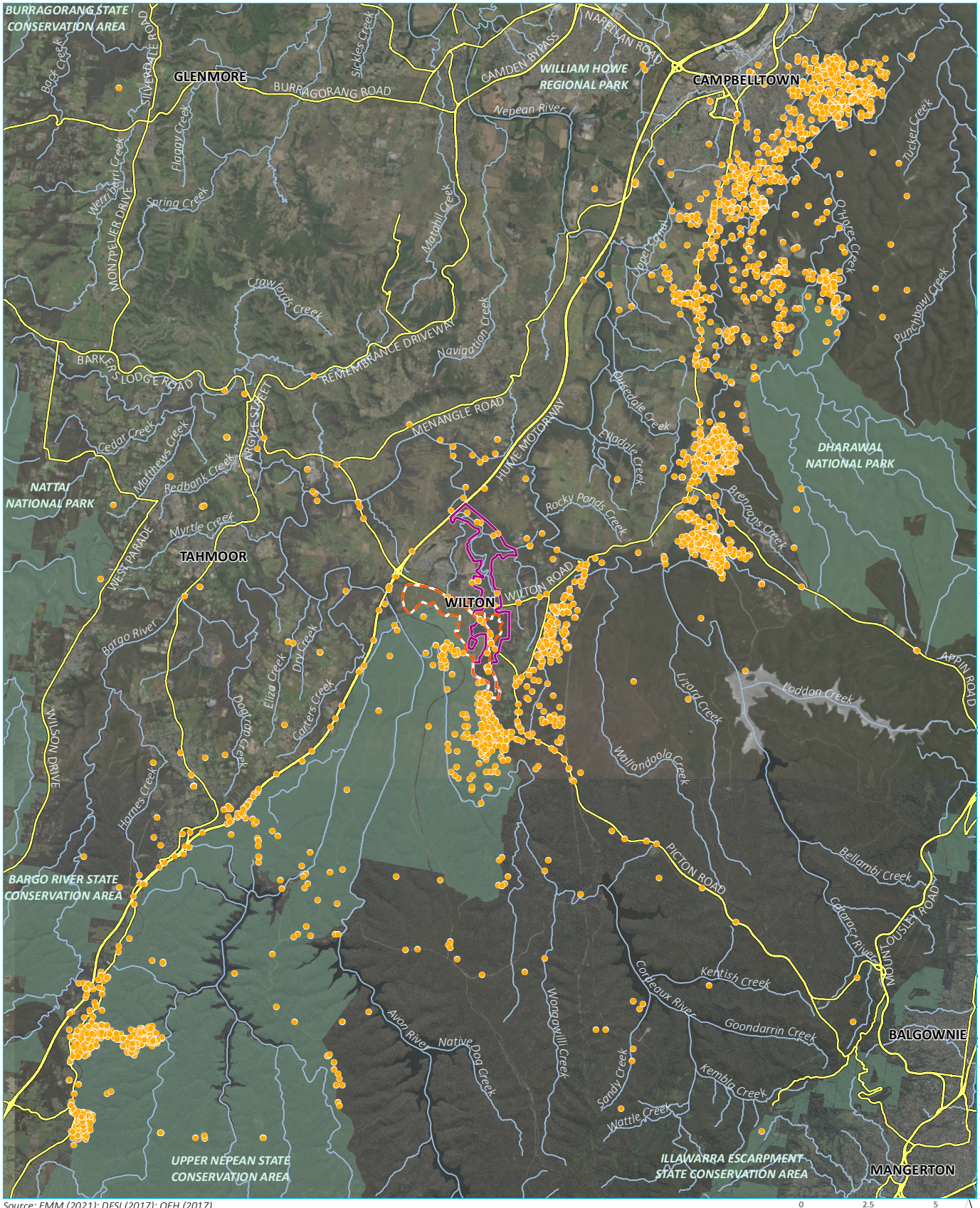
KEY

- Allens Creek corridor study area (576.33 ha)
- South East Wilton precinct (431.30 ha)
- Native vegetation
- Main road
- Watercourse
- Waterbody
- NPWS reserve

Native vegetation in the broader region

Walker Corporation
Wilton Koala plan of management
Figure 1.3

EMM
creating opportunities



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Source: EMM (2021); DFSI (2017); OEH (2017)

0 2.5 5 km
GDA 1994 MGA Zone 56

N

KEY

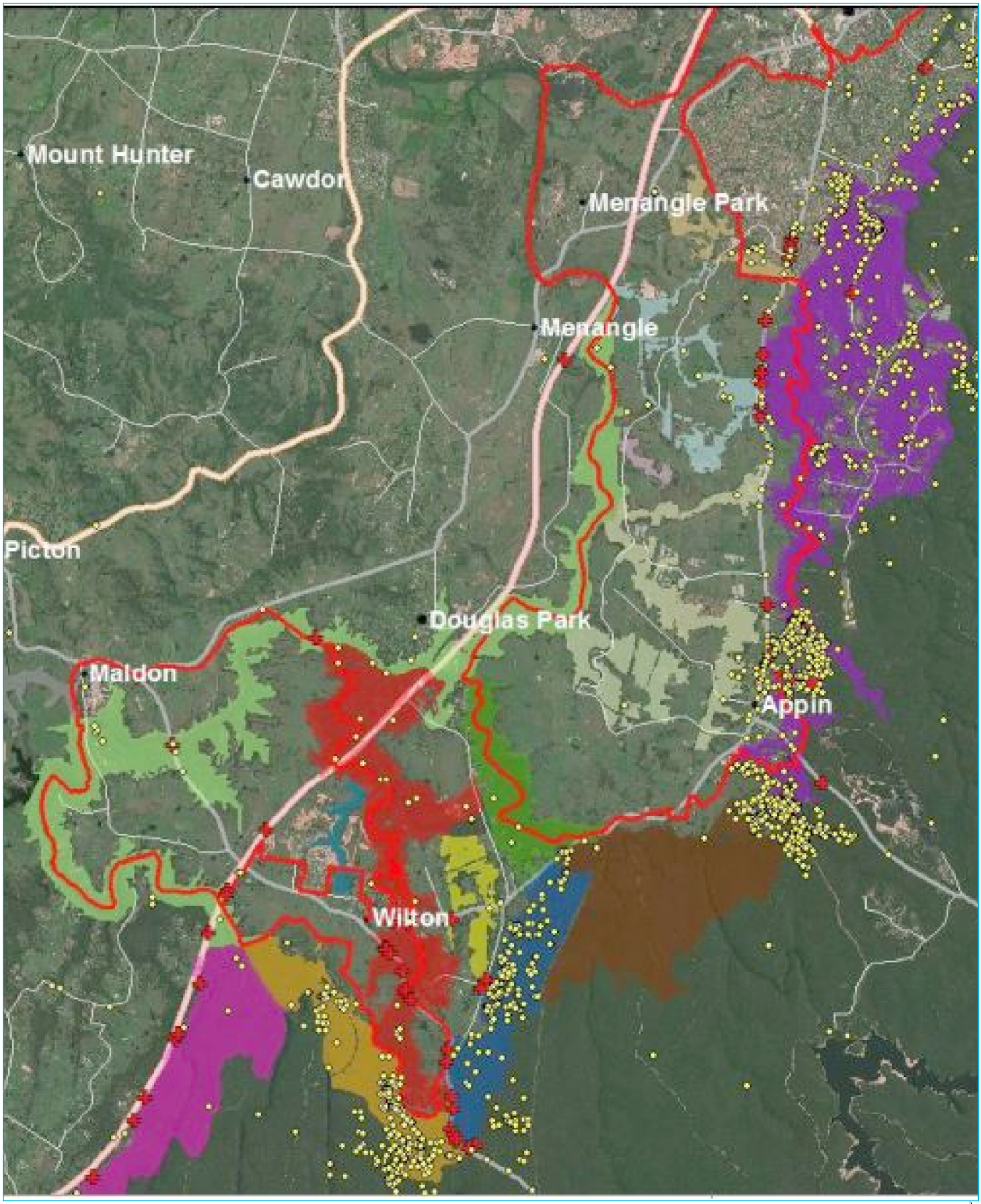
- Allens Creek corridor study area (576.33 ha)
- South East Wilton precinct (431.30 ha)
- Koala record*
- Main road
- Watercourse
- NPWS reserve

*Records of koala sightings were downloaded from the NSW Atlas of Wildlife (BioNet; OEH 2017) on 6 September 2019, and include all records since 1 January 1990

Koala sightings in the region

Walker Corporation
Wilton Koala plan of management
Figure 1.4

EMM
creating opportunities



Source: EMM (2019); OEH (2019)

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N

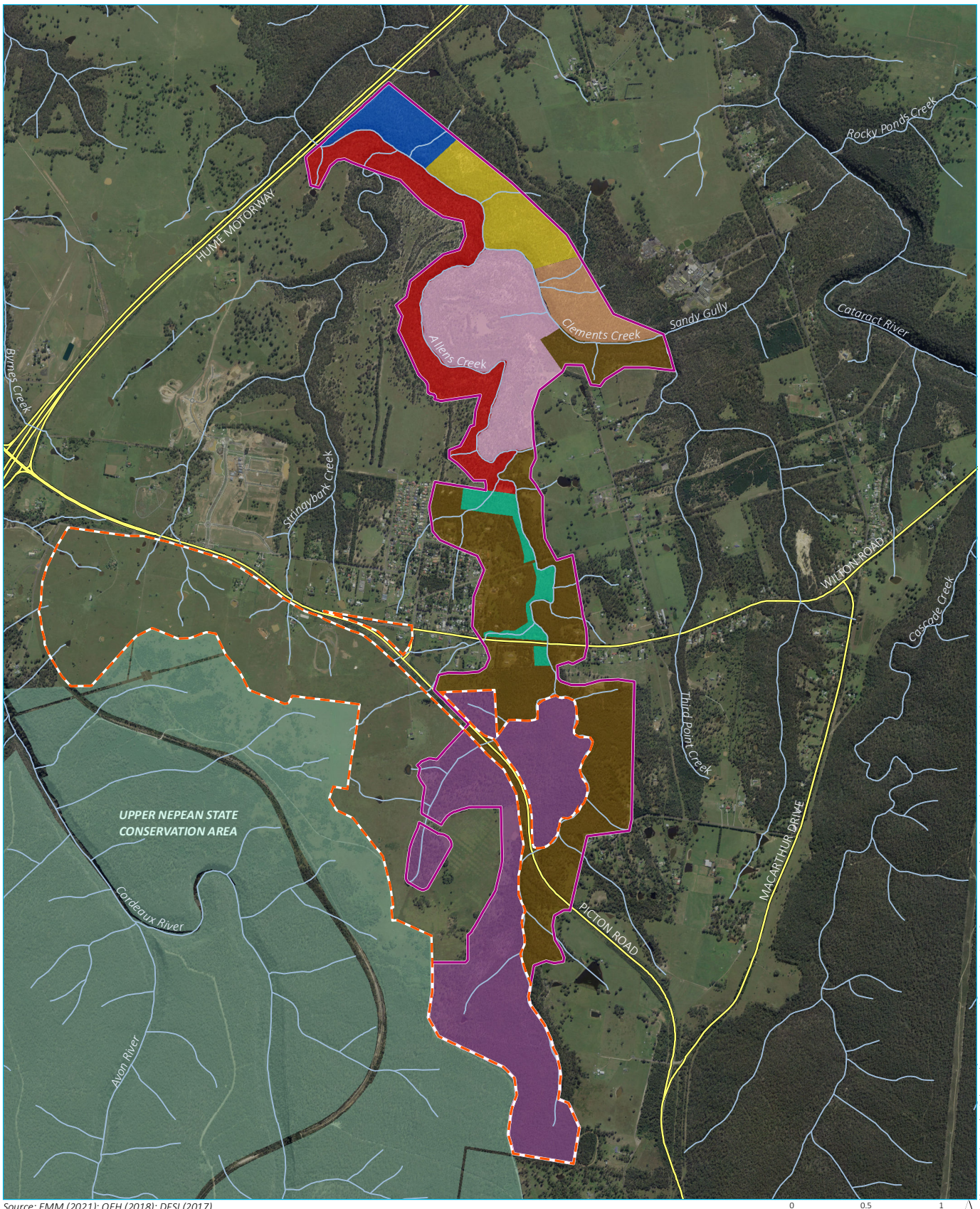
KEY

- Priority growth area
- Koala record
- Road kill koala
- Allens
- Avon-Nepean
- Cascade
- Cataract
- Clements
- Cordeaux
- Georges
- Myrtle
- Leafs Gully
- Nepean
- Noorumba
- Ousedale-Mallaty
- Simpsons-Elladale
- Stonequarry
- Stringybark
- Wallandoola-Cataract
- Woodhouse-Menangle

Identified koala corridors in the region

Walker Corporation
Wilton Koala plan of management
Figure 1.5

EMM creating opportunities



Source: EMM (2021); OEH (2018); DFSI (2017)

0 0.5 1 km

GDA 1994 MGA Zone 56

N

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KEY

- Allens Creek corridor study area (576.33 ha)
- South East Wilton precinct (431.30 ha)
- Main road
- Watercourse
- NPWS reserve
- Walker North
- Walker South
- Bingara Gorge conservation land
- Missionaries of the Sacred Heart Biobank site
- Missionaries of the Sacred Heart - other vegetated lands
- South 32
- Crown land
- Other lands

Land ownership in Allens Creek corridor

Walker Corporation
Wilton Koala plan of management
Figure 1.6

EMM creating opportunities

2 Literature review

As well as data gathered by EMM ecologists, this KPoM also incorporates data from previous studies in the area, particularly the report Conserving koalas in Wollondilly and Campbelltown Local Government Areas (LGAs) (DPIE 2019, Section 2.5). The report focuses on the Wilton and Greater Macarthur Growth Areas, and combines data collected by the Wollondilly Koala Conservation Project with existing database records. Koala records from these studies have been used to estimate population size for the purposes of this KPoM (Section 3.3).

2.1 NSW Koala Strategy

The NSW Koala Strategy (OEH 2018b) sets out initial actions towards the aim of securing koalas in the wild for the next 100 years, to stabilise and then increase koala numbers while ensuring genetically diverse populations across New South Wales. It focuses on the following key areas:

- koala habitat conservation – creating new reserves and protecting habitat corridors, and supporting private landholders to protect koala habitat through the Biodiversity Conservation Trust;
- conservation through community action – partnering and working with community groups, local councils, landholders, government agencies, Local Aboriginal Land Councils and koala experts to identify and agree on local actions for key koala populations across the State, and funding the delivery of on-ground local actions;
- safety and health of koala populations – improving the triage, treatment and rehabilitation of koalas by supporting fauna rehabilitators, creating a network of wildlife hospitals, funding research and fixing vehicle strike hotspots; and
- research and monitoring – funding research and developing a koala habitat information base that incorporates the best available information about koala habitat and distribution in New South Wales and implementing a state-wide monitoring program.

2.2 NSW Koala Recovery Plan

The approved *Recovery Plan for the koala (Phascolarctos cinereus)* (DECC 2008) outlines the actions required to address conservation requirements of the koala across its known range in NSW. The objective of the plan is to reverse the decline of the koala in NSW, to ensure that koala habitat is adequately protected, managed and restored, and to maintain healthy breeding populations of koalas. The plan outlines the current understanding of the status and distribution of koalas in NSW, their biology, and habitat requirements.

A list of koala food tree species for the Central Coast KMA (#2) is provided in Table 2.1. Primary food tree species are those that are used significantly more than other *Eucalyptus* spp. and are used in the same way regardless of their density. Secondary food tree species are used less than primary species and have other variables that determine their use, such as density and size class. Supplementary species are used less frequently, and their use is dependent on which other tree species are present in an area. These 'supplementary' species often tend to be Stringybarks.

Table 2.1 Koala food tree species in Koala Management Area 2: Central Coast

Common Name	Scientific name
Primary food tree species	
Parramatta red gum	*E. parramattensis*
Swamp mahogany	*E. robusta*
Forest red gum	*E. tereticornis*
Tallowwood	*E. microcorys*
Ribbon gum	*E. viminalis*
Cabbage gum	*E. amplifolia*
Secondary food tree species	
Broad-leaved sally	*E. camphora*
Swamp gum	*E. ovata*
Fuzzy box	*E. conica*
Brittle gum	*E. praecox*
Yertchuk	*E. consideniana*
White-topped box	*E. quadrangulata*
Dwyer's red gum	*E. dwyeri*
Red mahogany	*E. resinifera*
Slaty red gum	*E. glaucina*
Rudder's box	*E. rudderi*
Bundy	*E. goniocalyx*
Large-fruited red mahogany	*E. scias*
Craven grey box	*E. largeana*
Grey gum	*E. punctata*
Maiden's gum	*E. maidenii*
Monkey gum	*E. cypellocarpa*
Brittle gum	*E. michaeliana*
Woollybutt	*E. longifolia*
Western grey box	*E. macrocarpa*
Blue box	*E. baueriana*
Grey box	*E. moluccana*
Coast grey box	*E. bosistoana*
-	*E. notabilis*
Supplementary species	
Blue-leaved stringybark	*E. agglomerata*
-	*E. oblonga*

Table 2.1 Koala food tree species in Koala Management Area 2: Central Coast

Common Name	Scientific name
Thin-leaved stringybark	*E. eugenioides*
-	*E. ralla*
White stringybark	*E. globoidea*
-	*E. tenella*
Yellow stringybark	*E. muelleriana*
Privet-leaved stringybark	*E. ligustrina*
Red stringybark	*E. cannonii*
Brown stringybark	*E. capitellata*
-	*E. prominula*
Heart-leaved stringybark	*E. camfieldii*
Narrow-leaved stringybark	*E. sparsifolia*
-	*E. bensonii*
-	*E. imitans*
-	*E. blaxlandii*

The recovery plan also outlines the issues surrounding the management of koalas, and current management initiatives from across NSW that are mitigating some of the threats to koala populations. Management techniques from the recovery plan have been incorporated into the recommendations in Section 4 of this document.

2.3 Saving our Species Iconic Koala Project 2017-21

The Saving our Species Iconic Koala Project is aiming to secure populations of koalas in the wild for 100 years, by reducing critical threats, ensuring the protection and rehabilitation of koala habitat, and maintaining healthy breeding populations of koalas (OEH 2017a). The project supports a range of conservation actions that are most likely to have significant outcomes, and that are designed to inform future koala conservation actions through threat mitigation, research, monitoring and community engagement.

The actions toolbox identifies the following key threats to koalas:

- loss, modification and fragmentation of habitat;
- vehicle strike,
- predation by domestic or roaming dogs;
- intense prescribed burns or wildfires that scorch or burn the tree canopy;
- koala disease;
- heat stress through drought and heatwaves;
- human-induced climate change;

- inadequate support for fauna rehabilitation;
- poor understanding of sources of trauma and mortality;
- poor understanding of population distribution and trend; and
- poor understanding of animal movements and use of habitat.

The Iconic Koala Project also outlines a number of actions regarding research into areas that are poorly understood, and to encourage community engagement. It supports a range of actions across the state and maintains details in a database, facilitating the use of collaborative and evidence-based actions.

2.4 Southern Sydney studies

A number of koala studies have occurred with the southern Sydney region. From analysis of koala sightings and location with regards to vegetation communities from the Campbelltown – Appin to the coast, Ward and Close (2004) concluded that Shale Sandstone Transition Forest is highly preferred by koalas, followed by Upper Georges River Sandstone Woodland, and Western Gully Forest.

Ward (2002) investigated differences between female koalas that could access vegetation, of various types, growing on shale substrates, and females with access only to vegetation growing on sandstone substrates, and found that the females with access to the shale substrate vegetation were heavier, in better condition, and had a higher fertility rate than females on sandstone substrates only.

Phillips and Callaghan (2000) undertook an investigation in the Campbelltown area using the spot assessment technique (SAT) which involves searching up to 100 cm from the trunks of 30 trees at a site for koala faecal pellets. They concluded that Grey Gum (*Eucalyptus punctata*) and Blue-leaved Stringybark (*E. agglomerata*) were most preferred trees, but only when growing on shale-based substrates.

Sluiter et al. (2002) compared observations from radiotracking of three female koalas, with results from lead cuticle analysis from fresh faecal samples collected opportunistically. The study concluded that the results were consistent the with Grey Gum and Blue-leaved Stringybark being preferred koala feed trees (the hypothesis of Phillips and Callaghan 2000). It was also concluded that Turpentine (*Syncarpia glomulifera*) is preferentially selected, but that there was no evidence of this species being browsed upon, thus this indicated that trees, such as Turpentine which has a dense leafy foliage, can be selected for their ability to provide shelter.

2.5 Wollondilly Shire Council studies

The Wilton area was surveyed in 2016 by direct spotlighting and searches for indirect signs of koala activity, for the report *Baseline survey of koalas in Wollondilly Shire* (Colman 2016). Evidence of koalas (either sightings or scratching's) were found in six locations throughout the Allens Creek Corridor. They were found across a range of locations throughout the area, including sites close to human dwellings, within vegetation corridors, and in isolated paddock trees. Koalas were detected at a rate of 1 koala for every 15.75 hectares (ha) of habitat surveyed. This report identified a number of key threats to Koalas in the Wollondilly Shire, including:

- removal of vegetative corridors, inhibiting koala movement and directly removing habitat;
- removal of paddock trees;
- fire – high intensity burns that burn the canopy can kill koalas directly, reduce food sources, and increase exposure to the elements;
- domestic animal attacks; and

- car strikes.

Wollondilly Shire Council has undertaken various GPS tracking of captured koalas, with locations entered into Bionet (Stirling, pers. comm, WSC 2019). Six koalas were identified as utilising vegetation to vegetation to the east of the Allens Creek Corridor and Macarthur Drive, and at the southern end of Allens Creek Corridor, to the south of the South East Wilton Precinct within water catchment lands (Figure 2.1).

The report *Conserving koalas in Wollondilly and Campbelltown Local Government Areas (LGAs)* (DPIE 2019) focuses on the Wilton and Greater Macarthur Growth Areas, and combines data collected by the Wollondilly Koala Conservation Project with existing database records. Koala records from these studies have been used to estimate population size for the purposes of this KPoM, due to insufficient data gathered through our own field survey effort.

The report includes a series of maps of koala habitat and koala movement corridors, produced through the combination of numerous data input layers, including fine scale vegetation mapping of the area. This mapping has been considered as part of developing this KPoM. The report presents the following data for the area:

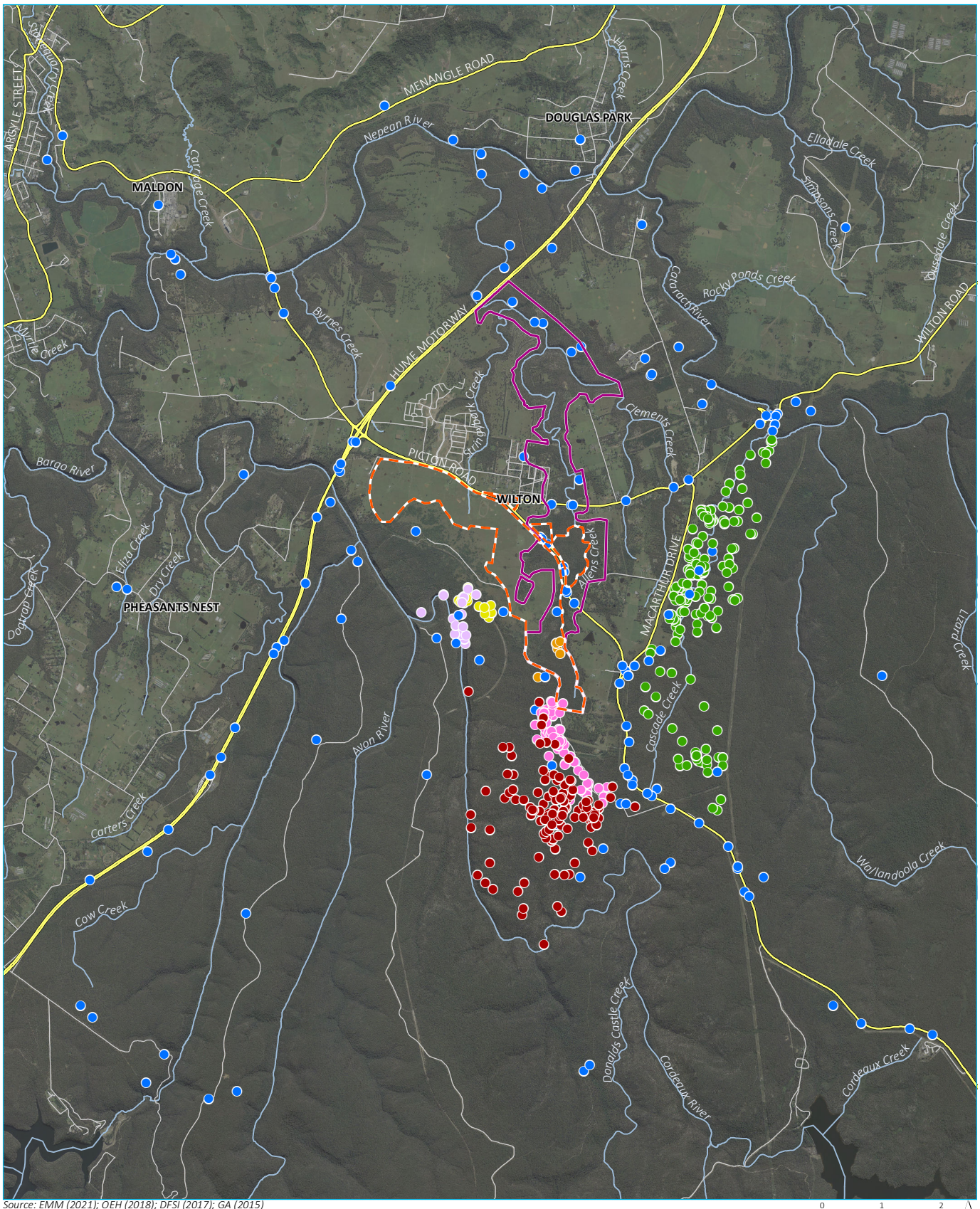
- koala sightings in the area, based on spotlighting surveys completed as part of the report, as well as existing Bionet database records. The report shows records of koalas immediately to the north and south of Allens Creek corridor, and with particularly high densities in the Upper Nepean State Conservation Area and around Appin. Bionet records are shown in Figure 2.1;

- vegetation mapping, showing areas of high quality koala habitat, based on soil type and fine scale vegetation mapping. Shale and shale-enriched vegetation types with a dominant eucalypt canopy were classified as high quality habitat. The figure shows Allens Creek Corridor as predominantly high quality habitat;

- core habitat mapping, depicting patches of high quality habitat greater than 100 ha. The Allens Creek Corridor is shown as core koala habitat. Note that the definition of core habitat in this report is not based on the criteria listed under Koala Habitat Protection SEPP (see Section 1.4);

- mapping of koala corridors, highlighting the areas of connecting habitat that koalas can use to move through the area, and named according to sub-catchments. The corridors have been ranked as primary, secondary or tertiary, based on the quality and extent of the habitat they contain. This mapping shows Allens Creek Corridor as a primary corridor, connecting to the Nepean corridor in the north and the Cordeaux corridor in the south (Figure 1.5); and

- roadkill hotspots, where koalas have been killed by vehicle strike. Along Wilton Road and Picton Road there have been multiple fatalities, highlighting the need for management along these roads, especially where they cross Allens Creek Corridor.



Source: EMM (2021); OEH (2018); DFSI (2017); GA (2015)

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GDA 1994 MGA Zone 56

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KEY

- Allens Creek corridor study area (576.33 ha)
- South East Wilton precinct (431.30 ha)
- Main road
- Local road
- Watercourse

Koala ID (no. locations in brackets)

- 971 Male (183)
- Podrick Male (7)
- Umber Male (15)
- Varys Male (18)
- Ellaria Female (71)
- Daenerys Female (120)
- Other Koala records (153)

Koala observations

Walker Corporation
Wilton Koala plan of management
Figure 2.1

EMM
creating opportunities

2.6 Vegetation and soils

2.6.1 Regional geology and vegetation mapping

Soil mapping (Hazelton & Tille 1990, Figure 2.2) identifies that there are two broad soil types present within the Allens Creek Corridor: Ashfield Shale and Hawkesbury Sandstone. Overall, Allens Creek consist of a gorge through sandstone, with the banks of Allens Creek generally steep and rugged. Adjacent to the Allens Creek Corridor are areas of soil derived from Ashfield Shale, and there is a transition zone between the shale and sandstone derived soils, and in this transition zone the shale can occur from large to small shale lenses (or outcroppings) depending on whether or not shale is exposed. Shale soils are recognised as being more fertile, and the sandstone soils as much less fertile.

Vegetation mapping has been compiled for the Allens Creek Corridor region and the South East Wilton Precinct, using Remnant Vegetation of the western Cumberland subregion mapping 2013 (VIS_ID 4207) (Figure 2.4). The vegetation communities reflect the geology of the area, with shale (Blacktown and Luddenham), shale-transition soils (Lucas Heights), and sandstone derived soils (Hawkesbury) affecting the vegetation present (Figure 2.2).

The Allens Creek Corridor is mapped as supporting three plant community types (PCTs):

- 1081 – Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion (also consistent with previous Sydney Hinterland Transition Woodland);
- 1181 – Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion (also consistent with Upper Georges River sandstone woodland and Western Sandstone Gully Forest); and
- 1395 – Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion (part of the Critically Endangered Ecological Community Shale Sandstone Transition Forest in the Sydney Basin Bioregion).

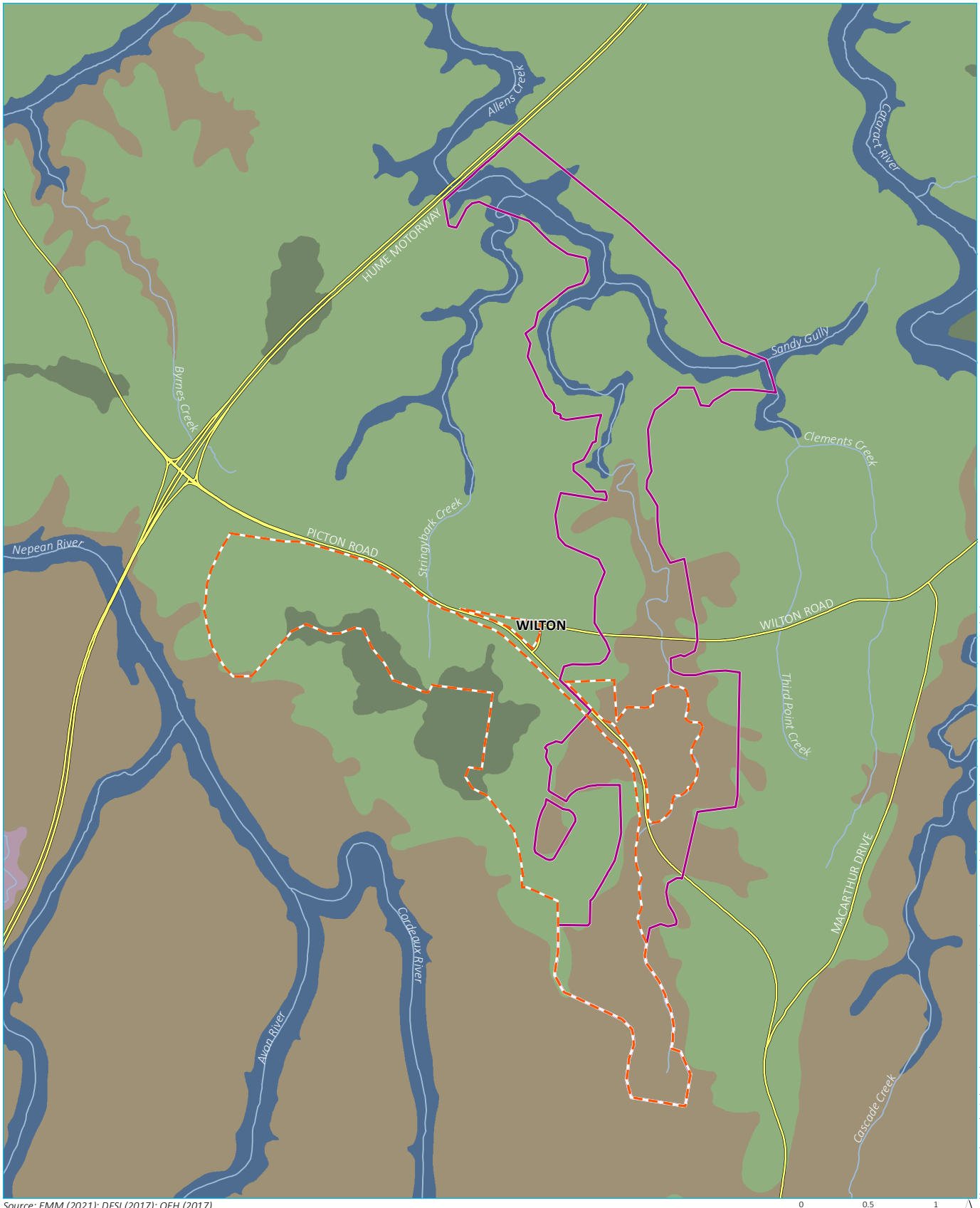
The upper stratum of the above PCTs contain multiple eucalypt species that are known koala feed trees, such as Blackbutt (*Eucalyptus pilularis*), Grey Gum (*E. punctata*), and Sydney Peppermint (*E. piperita*), as well as other eucalypt species that are used by koalas as habitat trees. Habitat on shale-based soils is often preferred by koalas due to the effect of the nutrient rich soils on the leaves. PCT 1181 occurs on sandstone-derived soils on the slopes of gullies, and although this soil type is less favourable to koalas, there are many suitable feed trees present in this vegetation community. PCT 1081 is mapped as occurring in only a small area in the south of the Allens Creek corridor (Figure 2.3).

2.6.2 Local vegetation mapping

The vegetation mapping completed by Cumberland Ecology and Gunninah (2016) used the mapping previously completed by SLR Consulting as a basis. They updated it with additional data within grassland areas and addressed the reclassification of Shale Sandstone Transition Forest to a critically endangered ecological community. Their vegetation mapping was the result of desktop reviews of SLR's data, two phases of field surveys and analysis of geology, soils and topography data to refine the boundaries of vegetation communities.

The results of the flora assessment identified extensive areas of the South East Wilton Precinct as being previously cleared and modified for agricultural practices. The remaining woody vegetation in the high and broadly flat areas is characterised by open grassy woodland. As the land slopes down towards the rivers and creeks, the terrain becomes increasingly steep and the vegetation transitions towards scrubby woodland and dry sclerophyll forests. Grass species gradually become replaced by hardy shrubs.

Vegetation mapping for the South East Wilton Precinct is shown in Figure 2.4. Lands at Bingara Gorge have also had vegetation mapping undertaken as part of studies for those lands (ELA 2019, Figure 2.5), and broadly correspond with the regional mapping (Figure 2.5).



Source: EMM (2021); DFSI (2017); OEH (2017)

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KEY

- Allens Creek corridor study area (576.33 ha)
- South East Wilton precinct (431.30 ha)
- Main road
- Watercourse

Soil landscape

- Black town
- Gymea
- Hawkesbury
- Lucas heights
- Luddenham

Soils mapping in Allens Creek corridor

Walker Corporation
Wilton Koala plan of management
Figure 2.2

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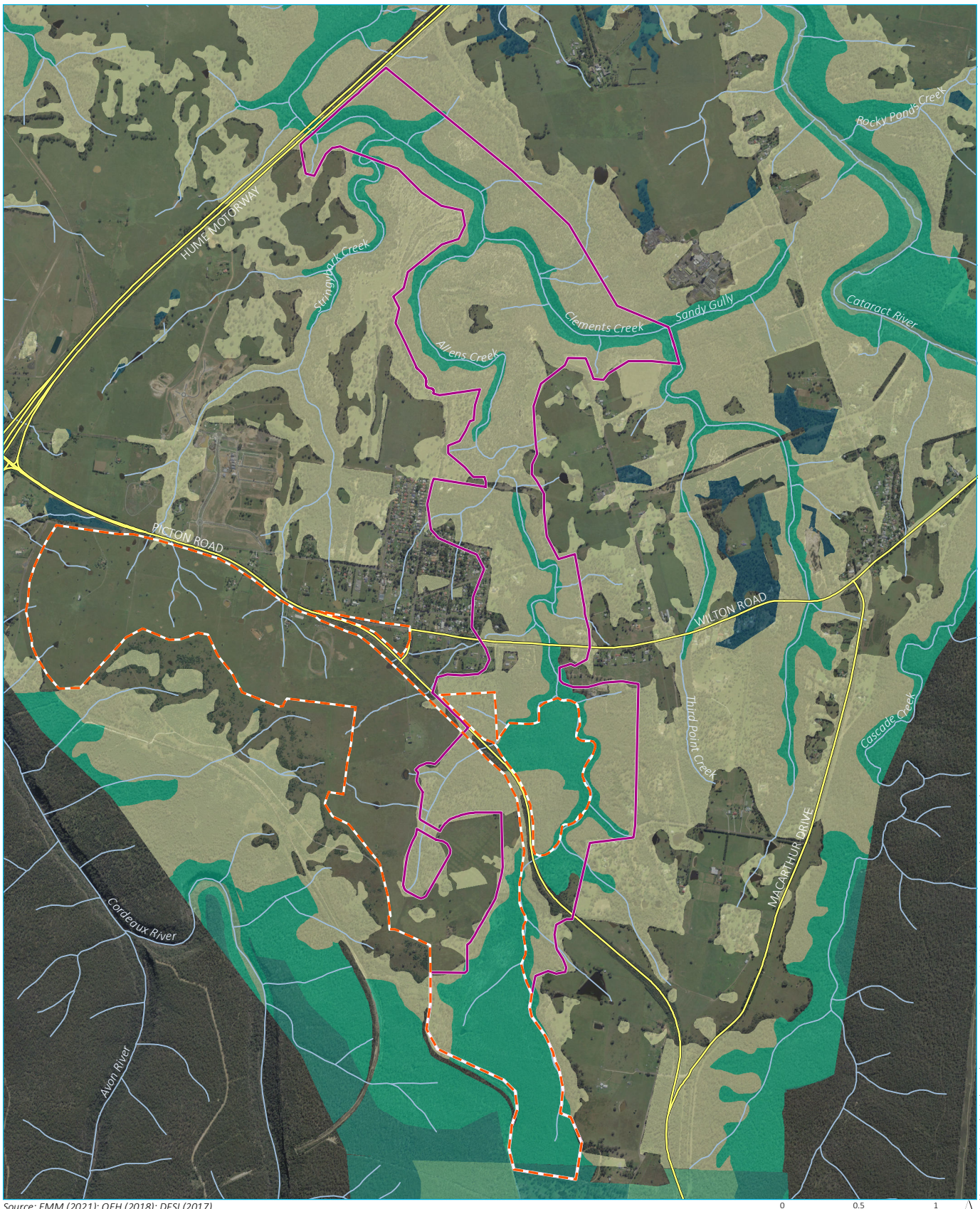

Source: EMM (2021); OEH (2018); DFSI (2017)

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KEY

- Allens Creek corridor study area (576.33 ha)
- South East Wilton precinct (431.30 ha)
- Main road
- Watercourse

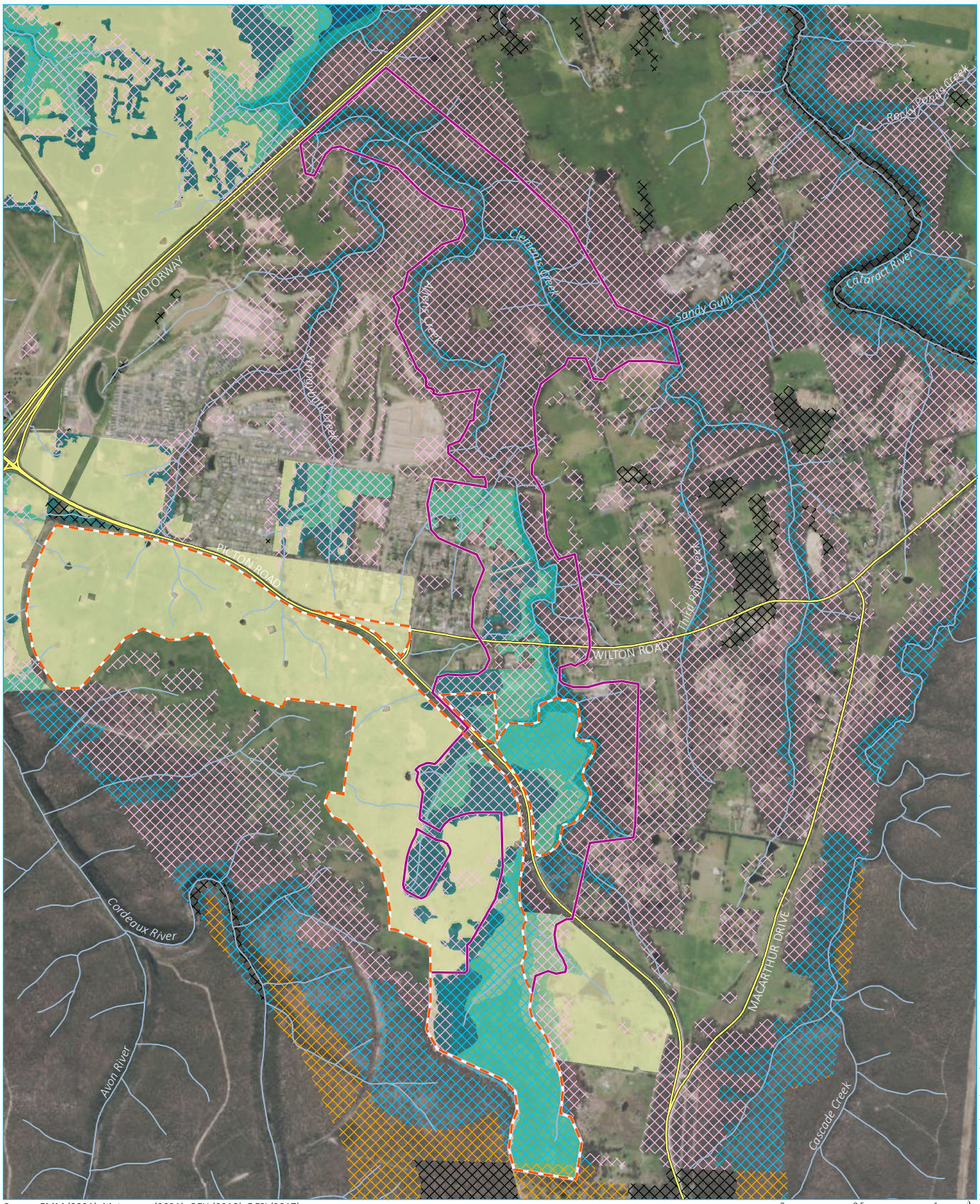
Plant community type

- 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- 850 - Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion
- 1081 - Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion
- 1181- Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion
- 1253 - Sydney Peppermint-White Stringybark-Smooth-barked Apple Forest on shale Outcrops, Sydney Basin Bioregion
- 1292 - Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion
- 1395 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion

Vegetation mapping for Allens Creek corridor

Walker Corporation
Wilton Koala plan of management
Figure 2.3

EMM
creating opportunities



Source: EMM (2021); Metromap (2021); OEH (2018); DFSI (2017)

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KEY

- Allens Creek corridor study area (576.33 ha)
- South East Wilton precinct (431.30 ha)
- Main road
- Watercourse

Plant community type (2016)

- 862 - Grey Gum - Hard-leaved Scribbly Gum woodland of the Coxs River Valley, Sydney Basin Bioregion
- 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- 1181 - Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and souther Sydney, Sydney Basin Bioregion
- 1395 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion
- 1789 - Smooth-barked Apple - Blackbutt - Red Bloodwood open forest in enriched sandstone gullies of the western Woronora plateau
- Derived Native Grassland

Regional Plant community type

- 1081 - Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion
- 1181 - Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion
- 1395 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion
- Other regional PCT

Vegetation mapping comparison for Allens Creek corridor

Walker Corporation
Wilton Koala plan of management
Figure 2.4

EMM
creating opportunities

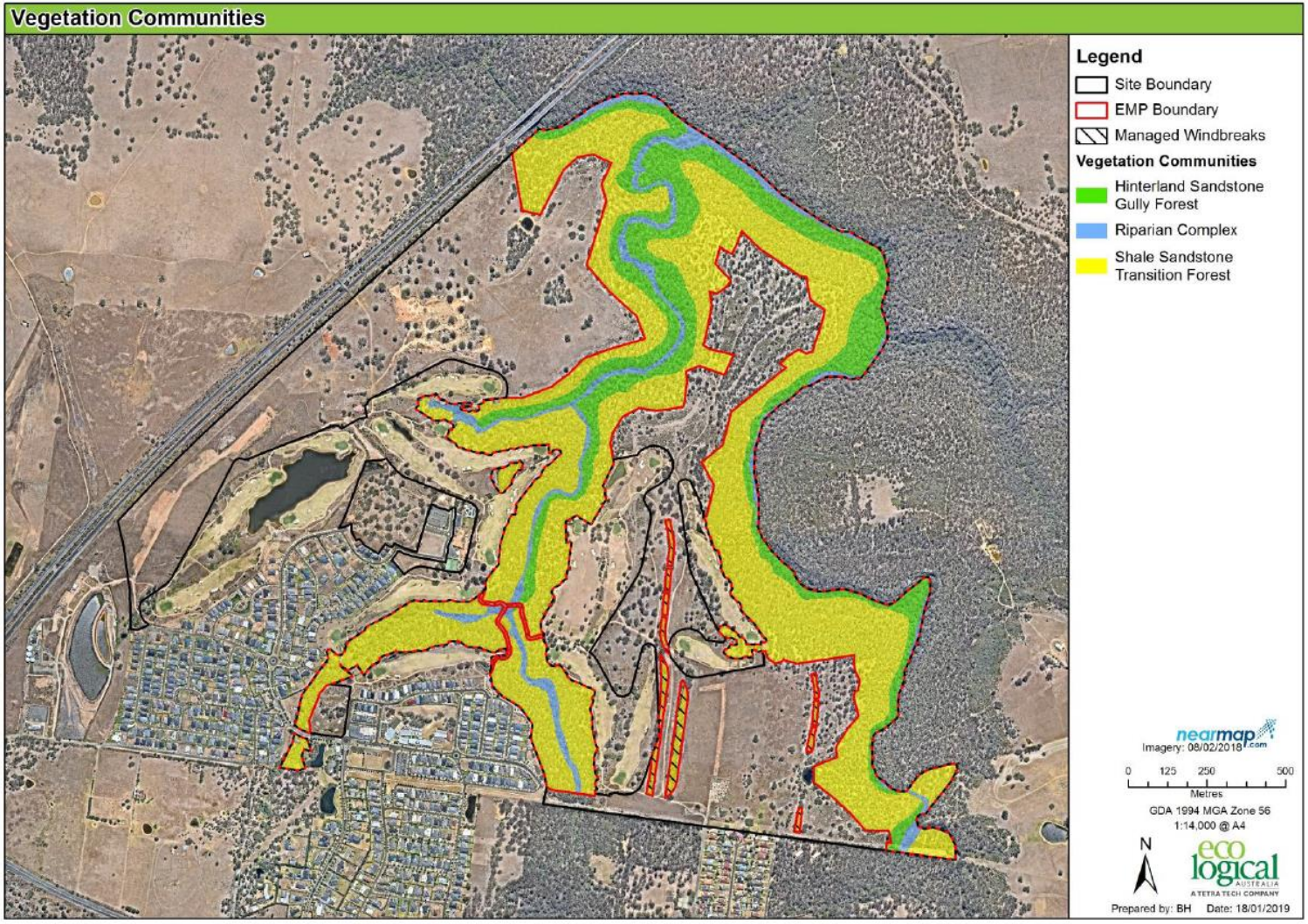


Figure 2.5 Bingara Gorge vegetation mapping (ELA 2019)

2.7 Bingara Gorge Koala Plan of Management

A Koala Plan of Management is in place and applies to Bingara Gorge lands (ELA 2017). This document noted that: "Comprehensive assessment of vegetation and koala searches (HWR 2006) within the site, followed by more recent extensive site surveys (ELA 2-13-2015), have not identified the site as core habitat for the koala as defined under the SEPP [referring to SEPP 44]". Nonetheless, known koala food trees Grey Gum and Forest Red Gum were identified as being present. The Bingara Gorge vegetation within the Allens Creek Corridor is part of the 132.2 ha of koala habitat identified as being retained under the KPoM (ELA 2017), with 32.5 ha of potential foraging habitat removed. The retained vegetation is identified and mapped as being a combination of Shale Sandstone Transition Forest on the western and southern sides of Allens Creek, with Hinterland Sandstone Gully Forest present along the Allens Creek gorge and Stringybark Creek tributary, and Riparian Complex vegetation immediately adjacent to Allens Creek and the Stringybark Creek tributary (ELA 2019).

The management measures proposed included:

- koala friendly fencing that discourages but does not necessarily excludes koalas (ie fences that koalas can pass and which does not completely prohibit their movement);
- community education campaign promoting responsible dog-ownership, with domestic pets excluded from Environmental Protection and Recreation Lands;
- temporary fencing during construction to prevent koala access to construction zones;
- education media campaign and permanent signage adjacent to pathways and entry roads to the site highlighting the potential presence of koalas; and
- roads to have a maximum speed of 50km/hr and roadside vegetation to be maintained to minimise the height of ground cover to increase the visibility of roadside fauna.

2.8 Cumberland Ecology 2017b

Cumberland Ecology (2017b) were engaged to undertake detailed ecological investigations (2014-2016) in the Wilton area including:

- literature and database review;
- comprehensive review of SLR Consulting detailed flora and fauna surveys (2013-2014);
- detailed vegetation assessment and mapping; and
- field surveys of koalas in forested land using SAT (Spot Assessment Technique) (Phillips & Callaghan 2011).

A summary of the key findings is provided below. The South East Wilton Precinct comprised the southern section of the study area, but investigations also extended to the north of Picton Rd, as well as to an area between the Hume Highway and the Nepean River in the north.

Cumberland Ecology (2017b) undertook fauna assessments and note that the majority of the South East Wilton Precinct is characterised by cleared grasslands, containing limited habitat for koalas or other fauna. They identified the corridor of woodland habitat in the east of the precinct along Allens Creek as the exception. Cumberland Ecology reviewed the previously completed surveys by SLR Consulting, which used the following methodologies applicable to koalas:

- deployment of infrared cameras;
- call play-back and spotlighting;
- stag (dead standing trees) watching at dusk;
- diurnal searches in woodland areas for koala scats; and
- extensive diurnal surveys for diurnal fauna, habitat characterisation, hollow bearing trees, and collection of indirect evidence (feathers, fur, scats).

No koalas or koala scats were recorded in the South East Wilton Precinct during Cumberland Ecology surveys, or during the 2013 and 2014 field surveys by SLR Consulting. Subsequent to the previous studies summarised above, further investigations of koala habitat and koalas within the South East Wilton Precinct occurred (Cumberland Ecology 2017a). These additional investigations included:

- GIS mapping techniques to map and explore the information available about the proposed koala corridor network;
- updated field surveys of Koalas in forested land within Walker Corporation Land using the SAT techniques; and
- consultation with Office of Environment and Heritage (OEH) field staff re the movement of a recently collared Koala that moved into forest on Walker Corporation Land.

These most recent SAT surveys of koala habitat usage in Walker Corporation lands found no koalas but detected koala scats at three locations beside Allens creek (Figure 2.6).

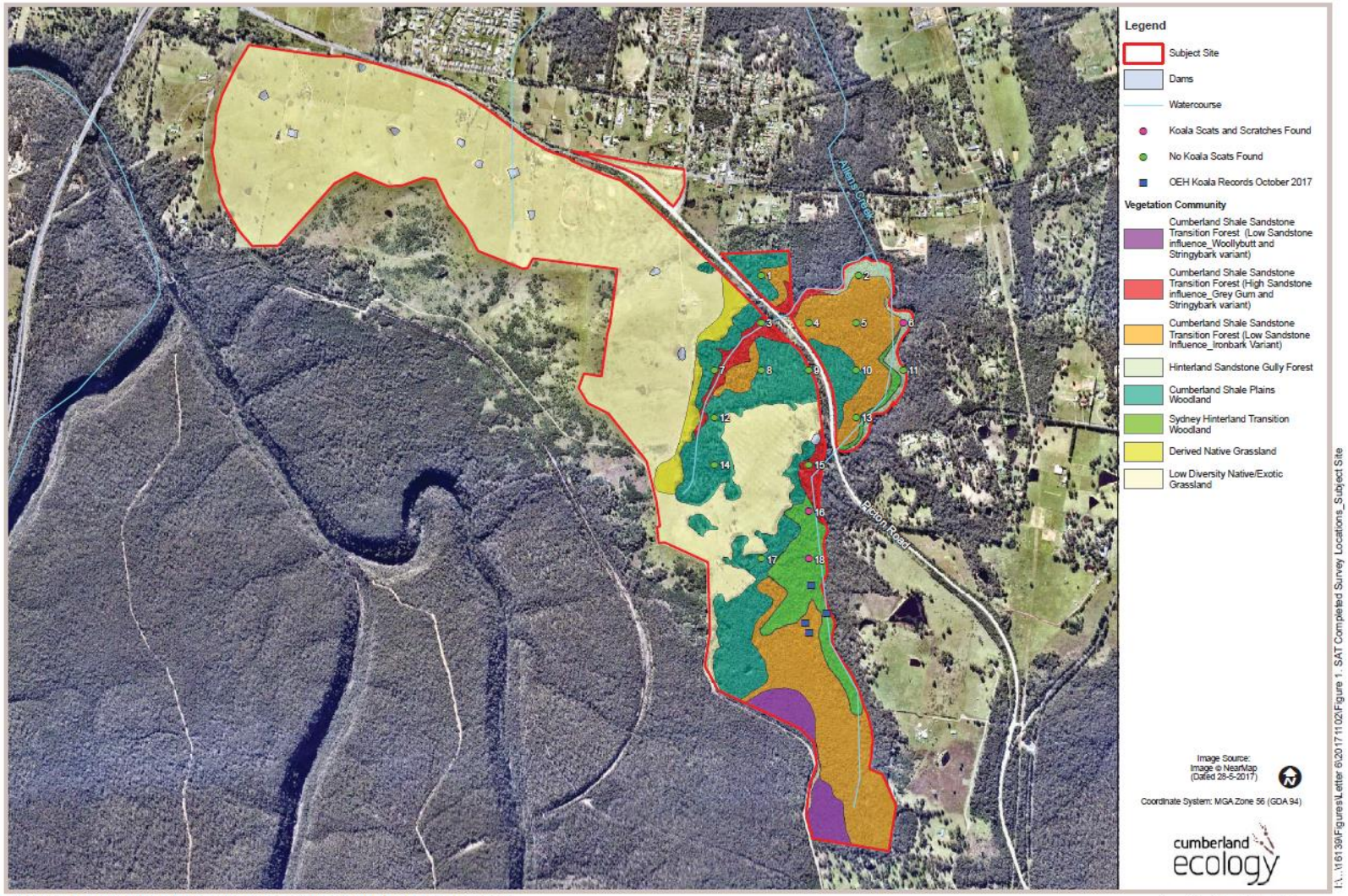


Figure 1. Completed SAT survey locations & vegetation mapping

Figure 2.6 SAT survey site locations and results (Cumberland Ecology 2017a)

3 Site assessment

3.1 Targeted koala survey methods and results

EMM were commissioned by Walker Corporation to undertake koala surveys within both the South East Wilton Precinct and the broader Allens Creek Corridor region. The survey method applied was spotlighting, as this method was specifically requested after consultation on koala survey methods with Wollondilly Shire Council.

Spotlighting surveys were performed across the Allens Creek Corridor study area at sites spaced 500 metres apart. 24 spotlight sites were identified in the planning stage; however, access was only available for 18 of those sites. Spotlighting survey locations are shown on Figure 3.1.

The spotlighting surveys followed the DPIE survey protocol, with two ecologists, George Madani and Ireni Clarke, walking a 200m transect and surveying 50m either side of the transect with spotlights, covering a 2 ha survey area (DPIE 2019). Ecologist Dr Steven Ward was also present for all of the first night. The midpoint of the transects was generally situated around the predetermined points for survey sites, however the specific start and end points of the transects were determined in the field, to incorporate topographic, logistical and safety considerations. Ecologists recorded all fauna observed along each transect, as well as the tree species present in the canopy of each site.

Spotlighting surveys were undertaken across three consecutive nights, from the 13-15 May 2019. Surveys commenced just after sunset at approximately 6pm and continued until approximately midnight each night.

No koalas were observed during the spotlighting surveys. A number of other fauna species were recorded and are summarised in Table A.1.

3.2 Habitat results for Allens Creek Corridor

Table 3.1 outlines the tree species that were observed along each of the spotlighting transects, their use to koalas as described by the Wollondilly Koala Conservation Project, and the relative level at which the species is used by koalas within the Central Coast Koala Management Area (KMA 2), as defined in the OEH's 2018 review of koala tree use across NSW (OEH 2018a).

All tree species recorded along spotlighting transects have been documented as being used by koalas in the Central Coast Koala Management Area to some degree, and most have a significant or high level of koala use (Table 3.1). Six species of koala feed trees were identified within the survey sites. Every transect surveyed contained either primary or secondary food tree species, with most sites comprising over 50% koala feed tree species (Table 3.2).

The parent geology in Allens Creek Corridor is predominantly on Hawkesbury Sandstone, with shale soils in the surrounding areas (Figure 2.2), though in practice it is considered that there will be a complex transition between sandstone and shale geologies, which is reflected in much of the mapped vegetation being Shale Sandstone Transition Forest (Figure 2.3).

Soil type is known to affect koala habitat use, with shale soils being preferred as they contain more nutrients. Some of the vegetation communities within Allens Creek Corridor lie on the transition area between shale and sandstone areas, so would provide superior feeding habitat to the vegetation communities on sandstone.

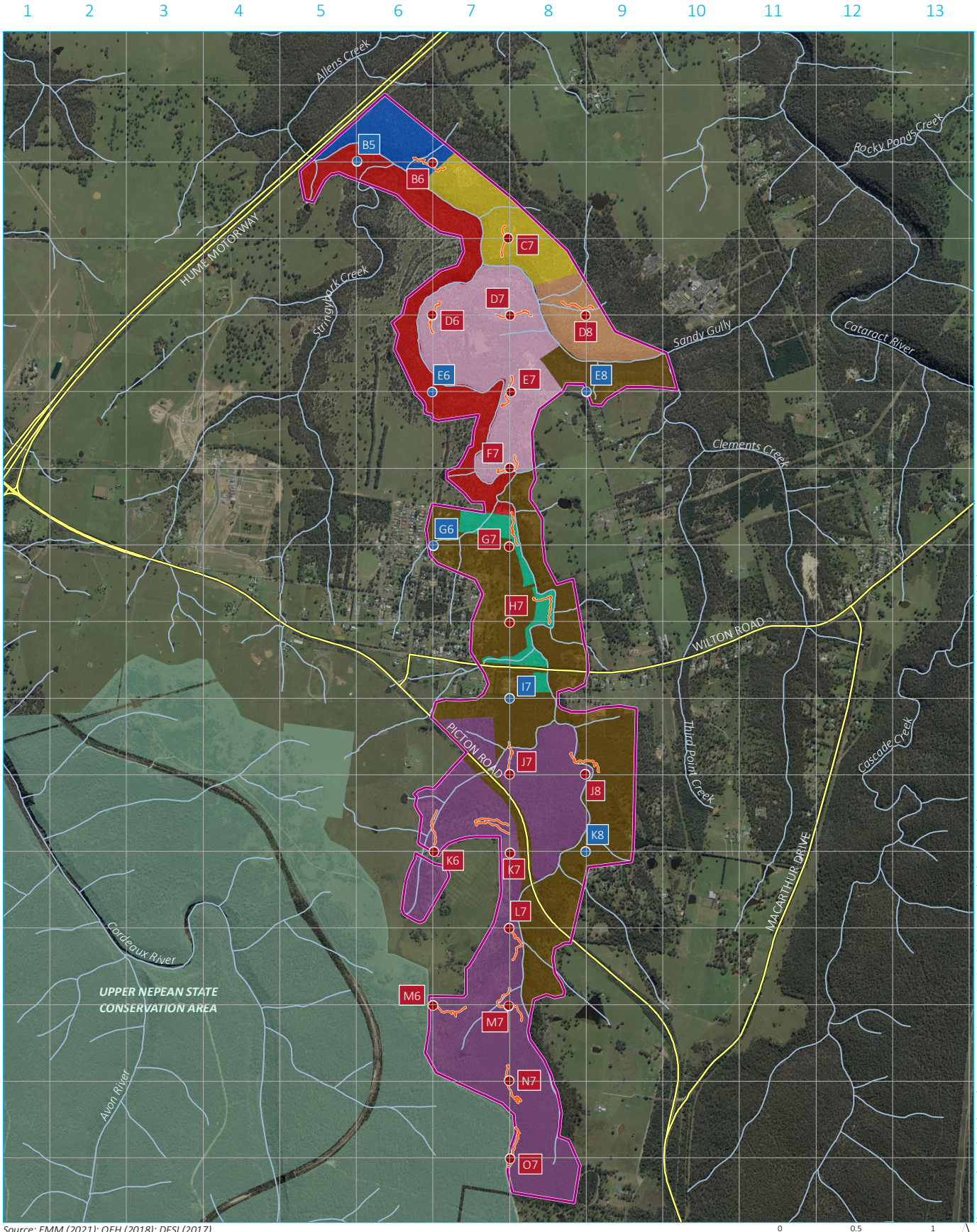
EMM's survey results confirm that the habitat within the Allens Creek Corridor is a suitable foraging resource for the koala population in the region. Furthermore, given the presence of sightings within the surrounding areas it is considered that they are likely to be present in low numbers, as koalas are cryptic in nature, or if not present koalas have potential to expand into and use the vegetation along the Allens Creek Corridor over time. For this reason vegetation has been identified in terms of its potential to provide habitat (Figure 3.2).

Table 3.1 Tree species observed in Allens Creek Corridor (refer to Appendix B for full details)

Species	No. of sites observed (total of 18)	Koala use (DECC 2008, Wollondilly Koala Conservation Project)	Level of documented use in Koala Management Area 2 (OEH 2018a)
Grey Gum *Eucalyptus punctata*	14	Secondary food tree species	High
Forest Red Gum *Eucalyptus tereticornis*	6	Primary food tree species	High
Stringybarks (various species)	16	Supplementary food tree species	High
Woollybutt *Eucalyptus longifolia*	4	Secondary food tree species	High
Blackbutt *Eucalyptus pilularis*	4	Secondary food tree species	High
Ironbark (various species)	8	Habitat species	Significant-high use for various Ironbark species
Sydney Peppermint *Eucalyptus piperita*	7	Food tree species	Significant
Scribbly Gum *Eucalyptus sclerophylla*	5	Habitat species	High
She-oaks Casuarinaceae (various species)	13	Habitat species	Low
Bloodwood (various species)	2	Habitat species	Significant-high use for various Bloodwood species
Narrow-leaved Apple *Angophora bakeri*	3	Habitat species	Low

Table 3.2 Koala feed tree species observed at Allens Creek Corridor

Site #	% feed tree species (proportion of total trees present)	Feed tree types
B6	5	Secondary
C7	35	Secondary/Supplementary
D6	90	Secondary/Supplementary
D7	45	Secondary/Supplementary
D8	50	Secondary/Supplementary
E7	85	Secondary/Supplementary
F7	50	Primary/Secondary/Supplementary
G7	95	Secondary
H7	75	Secondary/Supplementary
J7	15	Secondary/Supplementary
J8	65	Primary/Secondary/Supplementary
K6	85	Primary/Secondary/Supplementary
K7	65	Primary/Secondary/Supplementary
L7	45	Secondary/Supplementary
M6	60	Primary/ Supplementary
M7	55	Secondary/Supplementary
N7	65	Secondary/Supplementary
O7	70	Primary/Secondary/Supplementary



Source: EMM (2021); OEH (2018); DFSI (2017)

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KEY

- Allens Creek corridor study area (576.33 ha)
- Indicative survey points within study area*
- Survey site not accessible
- Survey tracks
- Main road
- Watercourse
- NPWS reserve
- Missionaries of the Sacred Heart Biobank site
- Missionaries of the Sacred Heart - other vegetated lands
- South 32
- Walker South
- Walker North
- Crown land
- Bingara Gorge conservation land
- Other lands

*NOTE: Locations are based on indicative 500 m grid spacing and alignment. Actual spotlight locations were as close as possible to the grid points, considering site access constraints, topography and safety.

Survey effort: designated spotlighting sites and GPS tracks

Walker Corporation
Wilton Koala plan of management
Figure 3.1

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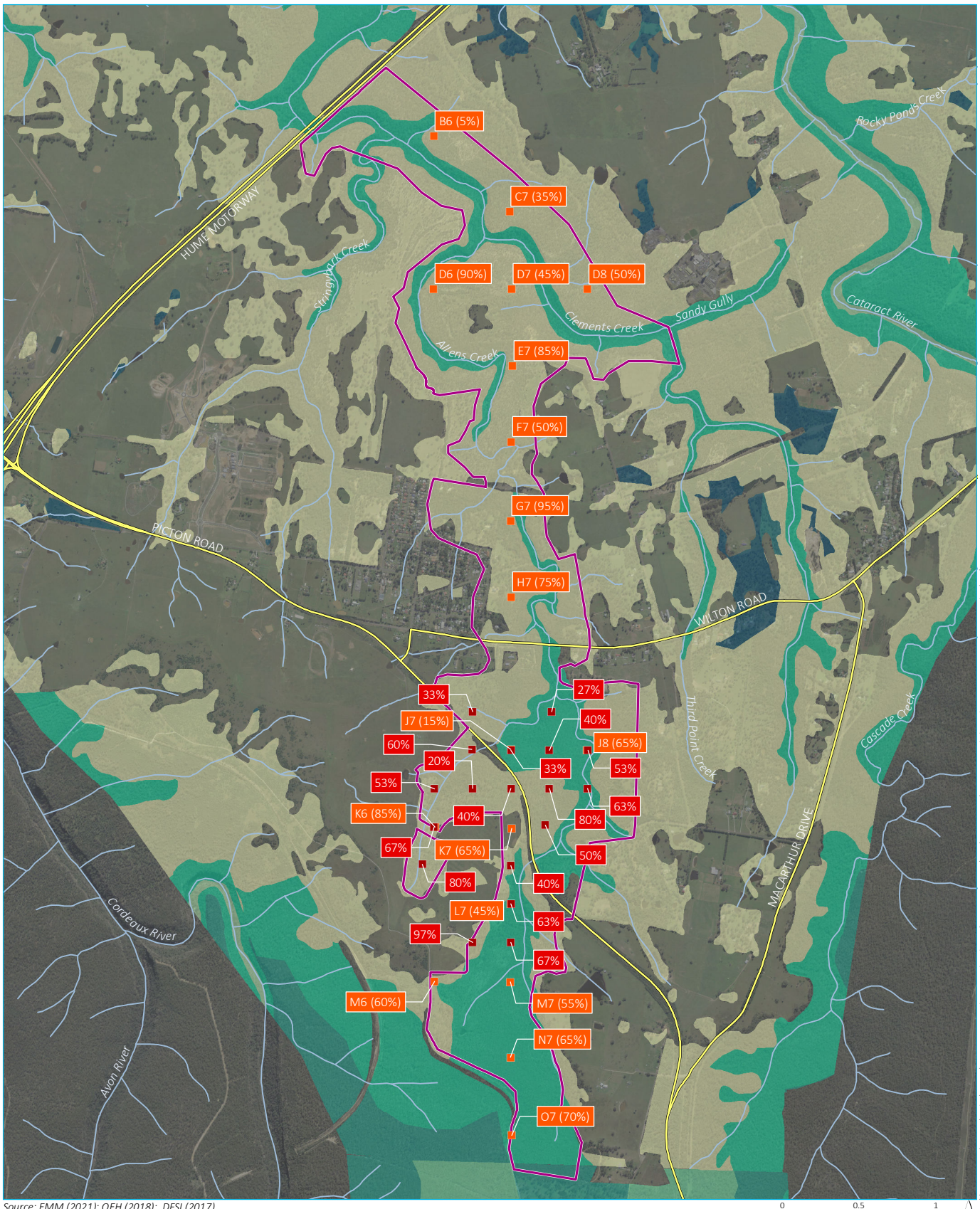

Source: EMM (2021); OEH (2018); DFSI (2017)

0 0.5 1 km

GDA 1994 MGA Zone 56

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KEY

- Allens Creek corridor study area (576.33 ha)
- SAT
- Indicative survey points within study area*
- Main road
- Watercourse

Plant community type

- 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- 850 - Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion
- 1081 - Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion
- 1181- Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion
- 1253 - Sydney Peppermint-White Stringybark-Smooth-barked Apple Forest on shale Outcrops, Sydney Basin Bioregion
- 1292 - Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion
- 1395 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion

*NOTE: Locations are based on indicative 500 m grid spacing and alignment. Actual spotlight locations were as close as possible to the grid points, considering site access constraints, topography and safety.

Koala food tree abundance within Allens Creek corridor

Walker Corporation
Wilton Koala plan of management
Figure 3.2

EMM
creating opportunities

3.3 Estimate of population size

Based on EMM's targeted koala surveys the density of koalas within the Allen's Creek Corridor is believed to be lower than that of the surrounding region, such as in the Upper Nepean State Conservation Area and in areas to the north near Campbelltown (Figure 1.4). No koalas were observed over the three nights of spotlighting surveys.

Spotlighting is not a perfect method for detecting koalas, and it is possible that koalas in the area can remain undetected, leading to an underestimation of koala density. Also, koalas may have been present within the Allens Creek Corridor, but not within the area covered by spotlight transects when they were conducted.

The spotlighting survey method used is consistent with that used by DPIE to survey the region as part of the Wollondilly and Southern Highlands Koala Conservation Projects (DPIE 2019). There are limitations associated with the survey effort as it was carried out over three consecutive nights and there are a number of environmental factors that can affect animal sightings on any one night. Recommendations for a future monitoring program is provided in Section 5.

A 2016 baseline study for the Wollondilly LGA recorded five koalas over a period of four nights within the Allens Creek Corridor area surveyed by EMM, as well as one record just to the south, outside of the area surveyed for this KPoM (Colman 2016).

The quality of koala habitat is determined by the vegetation communities present and the soil nutrients, as shale derived soil types are favoured by koalas. Within 'high quality' habitat in the Wollondilly Shire, koalas are expected to occur at a density of 0.078 koalas per ha (DPIE 2019), which equates to an average of one koala per 12.82 ha. 'Non-high quality' habitat in the area has an estimated koala density of 0.017 koalas per ha, or one koala per 58.85 ha.

Allens Creek Corridor was classified as high quality koala habitat by DPIE (2019). For the purposes of generating a population size estimate EMM has designated mapped PCTs from western Cumberland subregion mapping (Section 2.6.1) to koala habitat qualities where possible, using both koala habitat quality assessments from DPIE (2019), geology, and abundance of koala food trees (Section 3.2). The classifications assigned were:

- 1081 – Unknown quality (small area in southeast corner);
- 1181 – High quality;
- 1395 - High quality; and
- Cleared areas – non koala habitat.

Using these classifications, there is a total of 3 ha of unknown koala habitat quality within both the Allens Creek Corridor study area and South East Wilton Precinct (associated with PCT 1081), and 540 ha of high-quality koala habitat within the Allens Creek Corridor study area, and 173 ha within the South East Wilton Precinct. This gives a koala population estimate of 42 koalas within the Allens Creek Corridor study area, and 13.5 koalas within the South East Wilton Precinct, based on the koala densities calculated above (DPIE 2019).

3.4 Connectivity

Allens Creek Corridor has been identified as an area of high-quality koala habitat and a primary movement corridor for koalas (DPIE 2019), based on the quality and extent of the habitat. A 2016 baseline study estimated that there are 41,313 ha of koala habitat in the Wollondilly Shire (Colman 2016). The corridor of native vegetation along Allens Creek connects the Upper Nepean State Conservation Area in the south to the Nepean River in the north. In terms of koala movements road crossings are a key issue, due to the potential for koala fatalities. This is discussed in Section 4.2.

The regions identified as being koala roadkill hotspots and culverts along Wilton Road and Picton Road were visually inspected, where possible (Figure 4.3). A brief description is provided below in Table 3.3 to Table 3.6 of the culverts inspected, based on the potential use by koalas for movements.

The aspects considered for each culvert was:

a) whether a wet or dry culvert (or intermittent) was in place, noting that the observations were undertaken after a protracted dry period with a small amount of rainfall a few days prior to the site inspection;

b) potential to accommodate installed fauna furniture such as horizontal logs which would help to facilitate koala movements;

c) relative length of the culvert; and

d) whether vegetation comes into close proximity of the culvert openings so that koalas are more likely to come close to the culvert.

An overall subjective rating of the potential to facilitate koala movements is provided for each culvert (assuming that a koala encounters the culvert).

Table 3.3 Wilton Road : culvert 1

Criteria	Discussion
Description	Three adjacent rectangular culverts of large size (approx. 3.6 m by 3.6 m each).
(a) whether a wet or dry culvert (or intermittent), noting that the observations were undertaken after a protracted dry period with small rainfall a few days prior	The culverts were dry when inspected but are clearly intended to carry water. However, flows will be intermittent, and due to the presence of three large size culverts it is likely that one or more culverts would be predominately dry under most conditions.
(b) potential to accommodate installed fauna furniture such as horizontal logs which would help to facilitate Koala movements	Significant potential to accommodate fauna furniture.
(c) relative length of the culvert	Relatively short culvert (estimated as being ~30-40 m in length).
(d) whether vegetation comes into close proximity of the culvert openings so that Koalas are more likely to come close to the culvert	Vegetation is in close proximity on both sides of the culvert openings.
Conclusion	Overall considered to have high potential for facilitating Koala movements.
Photo	

Table 3.4 Picton Road : culvert 2

Criteria	Discussion
Description	Two adjacent round tubes (approx 2-m diameter each), with concrete arches covering both round concrete tube at either end. Also, two smaller box culverts (approx. 1 m by 1 m) observed as being present higher on the batter slope on either side of the main.
(a) whether a wet or dry culvert (or intermittent), noting that the observations were undertaken after a protracted dry period with small rainfall a few days prior	The large round culverts are clearly intended to carry water. A small amount of water was present on the floor during the inspection. It is likely that that the culverts would generally have a wet floor under most conditions.
(b) potential to accommodate installed fauna furniture such as horizontal logs which would help to facilitate Koala movements	Some potential to accommodate fauna furniture by fixing vertical logs to the side of the large round culverts, though it would need to be confirmed if this would affect the ability of the culvert to carry water. The box culverts do not appear to require fauna furniture, though fencing to direct fauna to the culvert openings could be desirable (noting that these are located on steep batter slopes which may make facilitating Koala use difficult).
(c) relative length of the culvert	The large round culverts are relatively long (estimated as being ~50-60 m in length). The box culverts are relatively short (~25–30 m).
(d) whether vegetation comes into close proximity of the culvert openings so that Koalas are more likely to come close to the culvert	Vegetation is in close proximity on both sides of the culvert openings.
Conclusion	Overall considered to have low current potential for facilitating Koala movements, or low-moderate potential with alterations to encourage Koala usage.
Photo (round culverts)	

Table 3.5 Picton Road : culvert 3

Criteria	Discussion
Description	Very large culvert (approx 6 m height by 5 m width). Appears to have been installed to facilitate access across Picton Road for construction machinery. Vehicle access track present on both north and south side, though southern side has some regrowth vegetation.
(a) whether a wet or dry culvert (or intermittent), noting that the observations were undertaken after a protracted dry period with small rainfall a few days prior	Dry culvert.
(b) potential to accommodate installed fauna furniture such as horizontal logs which would help to facilitate Koala movements	Significant potential to accommodate fauna furniture, and it would be desirable to increase vegetation cover on either side, subject to requirements for future site access.
(c) relative length of the culvert	Relatively short (estimated as being ~30 m in length).
(d) whether vegetation comes into close proximity of the culvert openings so that Koalas are more likely to come close to the culvert	Approx 30 m to vegetation on the northern culvert opening, and approx 10 m to vegetation on southern culvert opening.
Conclusion	Overall considered to have moderate current potential for facilitating Koala movements. Could potentially be increased to a high potential with alterations (if possible).
Photo	

Table 3.6 Picton Road : culvert 4

Criteria	Discussion
Description	Large bebo arch culvert (approx 20 m width and 3 m height). Small concrete plinth at each edge of the arch.
(a) whether a wet or dry culvert (or intermittent), noting that the observations were undertaken after a protracted dry period with small rainfall a few days prior	Both wet and dry. A portion of the base, which is a mixture of earth and rock, is lower and would carry water, but approximately 3 m of the culvert width should remain dry in all but extremely high rainfall conditions.
(b) potential to accommodate installed fauna furniture such as horizontal logs which would help to facilitate Koala movements	Potential to accommodate fauna furniture, though it may not be required. If fauna furniture were to be installed it could consist of a small raised wooden platform adjacent to one of the concrete plinths at the edge of the arch
(c) relative length of the culvert	Medium length (estimated as being ~40 m in length).
(d) whether vegetation comes into close proximity of the culvert openings so that Koalas are more likely to come close to the culvert	Vegetation immediately adjacent on both sides of the culvert openings. Weed control desirable (small amount of blackberry observed on the southern side).
Conclusion	Overall considered to have high current potential for facilitating Koala movements
Photo	

4 Management actions and recommendations

The following chapter addresses the key threats facing koalas and the koala population in the region and how they can be addressed at the site based scale and broader Allens Creek Corridor. Management recommendations have been developed and tailored to the South East Wilton Precinct (Figure 1.2) and the greater Allens Creek Corridor (Figure 1.6) based on the particular threats and koala specific requirements for each of those areas.

The NSW Koala Recovery Plan (DECC 2008) identifies a number of key threatening processes relevant to koala populations in NSW including:

- habitat loss and fragmentation;
- habitat degradation;
- road kills;
- dog attacks;
- fire;
- disease;
- severe weather conditions (such as droughts, heatwaves or floods); and
- swimming pools.

In addition to these, additional site and regional specific threatening processes have been addressed in the following sections. Management and mitigation actions for South East Wilton Precinct address all three phases of the Project including pre-construction, construction and operation.

A summary table for actions both for the South East Wilton Precinct (Section 4.1) is provided in Table 4.1, and the Allens Creek Corridor (Section 4.2) is provided in Table 4.2 South East Wilton Precinct.

The following outlines the management and mitigation actions that will be implemented within the South East Wilton Precinct to reduce threats and impacts on koalas. These actions will primarily be funded by Walker Corporation as they pertain to the development site and within their control. However, some actions such as koala exclusion fencing and culverts within the main road corridors will need to be implemented in consultation with RMS.

4.1 South East Wilton Precinct

4.1.1 Habitat loss, degradation and fragmentation

A large portion of the South East Wilton Precinct is cleared grazing land with sparse individual trees. The koala habitat occurs in the eastern portion of the site which forms part of the Allens Creek Corridor. Vegetation clearing and loss of koala habitat has been minimised through the layout of the precinct. Some disturbed native vegetation will be cleared (8.77 ha) though noting that most of this vegetation would be poor quality koala habitat due to its disturbed nature and young regrowth (Figure 4.1). Any native vegetation clearance will need to follow impact assessment and offset procedures under the NSW *Biodiversity Conservation Act 2006*, and the Commonwealth *Environmental Protection Biodiversity Conservation Act 1999*, or be biocertified under the proposed Cumberland Plain Conservation Plan.

The koala sensitive design elements which will result in retention of koala habitat and reduce fragmentation are listed below:

- bushland within the 'Environmental Conservation' zone will be actively managed to improve its ecological condition as identified in a vegetation management plan (VMP, Ecoplanning 2020). The VMP identifies that there will be 'assisted natural regeneration and protection'. As noted in Section 1.1 the Environmental Conservation zone (E2) boundaries were adjusted to reflect proposed zonings within the draft CPCP. Consequently the extent of assisted natural regeneration and protection within additional E2 lands was based on mapped native vegetation extent. Furthermore, public access to the conservation areas to the identified conservation areas within the South East Wilton Precinct will be subject to necessary approvals for such usage;

- establishment of a 'link corridor' which is to consist of lands to the west of Picton Road between larger patches of vegetation, as shown in Figure 4.2. There is to be no public access to the 'link corridor' lands. The dam currently present in the south of the proposed link corridor will be removed, and revegetation works will occur as per the VMP (Ecoplanning 2020). Further, all lands within the link corridor are to achieve >30% native tree species cover >1.5 m in height within three years of approval of the KPoM. Should this not be achieved supplementary planting of Forest Red Gum (a koala food tree) using locally sourced seed or plant stock is to occur and be maintained until such time as the native tree cover objective is achieved across the entirety of the link corridor. South of the link corridor the width of the vegetation to the west of Allens Creek increases to 300 m, with additional vegetation also present to the east of Allens Creek (Figure 4.2);

- bushfire management to minimise hot bushfires occurring (Section 4.1.5);

- koala exclusion fencing will be installed along southern boundary and bushland areas to limit koala interaction with residential areas and roads (Figure 4.1). Fencing will assist to keep koalas within bushland areas and therefore increasing connectivity in the eastern portion of the precinct. Koala exclusion fencing is to be installed after vegetation is cleared, and prior to any major civil earthworks for each stage of the South East Wilton Precinct (Section 4.1.2); and

- as part of a Construction Environment Management Plan (CEMP) preclearance surveys for koalas should be prepared utilising procedures and processes specified in the Transport for NSW Fauna Management Guideline (TfNSW 2015), including checks by ecologists prior or during surveys as appropriate. If any koala(s) are detected during preclearance surveys, then they should be left in the tree and allowed to move on of their own accord.

The draft Wilton Development Control Plan (DCP) has identified a koala exclusion fence through the centre of the vegetation within the eastern portion of the precinct, to the southwest of Picton Road. It is recommended that this is changed to reflect fencing following the boundary of the mapped vegetation as proposed in this KPoM (refer to Figure 4.1) provide additional koala habitat.

4.1.2 Connectivity and vehicle strike

Speed controls for local roads within the South East Wilton Precinct are not proposed, as it is intended that koala exclusion fencing will prevent koalas from entering the urban areas within the precinct.

Roads are a significant cause of koala death and injury (DECC 2008). OEH identified a roadkill hotspot on Picton Road, through Allens Creek Corridor, based on collation of records in the NSW Wildlife Atlas (Figure 5 of OEH 2017b).

The site boundary is to be fenced with koala exclusion fencing (refer to Figure 4.1 and Section 4.1.2). This will avoid koalas entering the precinct itself and potential vehicle strike within the precinct, and direct them to the eastern portion of the precinct supporting the Allens Creek Corridor (Figure 4.1). Roads and Maritime Services (RMS) has placed koala exclusion fencing along the vegetated site boundary along both the southern and northern sides of Picton Road (Figure 4.1). Culverts suitable for enhancement for koala crossings are identified in Section 3.4. Design of the culverts is needed in terms of ensuring that the fencing directs koalas to culverts suitable for road crossings, and retrofitting culverts with “fauna furniture”, that will encourage koalas to cross the roads safely.

Koala exclusion fencing is to be installed after vegetation is cleared, and prior to any major civil earthworks for each stage of the South East Wilton Precinct as shown in Figure 4.1. Koala exclusion fencing is to consist of a 2.1-m high chain mesh, with a 600-mm high sheet metal strip attached to the fence facing the side with koala habitat. Where fencing abuts the Metropolitan Special Area three strand barbed wire will occur on top of the fence. This is consistent with a koala-proof fence design (albeit modified to include barbed wire to prevent human access to the Metropolitan Special Area) identified in Koala-sensitive Design Guidelines (DEHP 2012). The following recommendations are also to be implemented:

1. fence bracing or supports are on the inside (northern) of the fence, away from koala access;

2. the top of the unclimbable section of fencing is at least 1.5 m from the ground to prevent koalas jumping up from the ground and gripping the top of the fencing;

3. fencing should extend to ground level with regard for uneven or undulating ground;

4. vegetation adjacent to the fence is regularly maintained to:

    a) exclude trees and shrubs from within 3 m of the fence; and

    b) keep canopies of trees trimmed to remove links to tree canopies on the other side of the fence;

5. remove fallen branches and vines growing on the fence which koalas may use to climb over the fence.

Exclusion fencing will be constructed along the southern border of South East Wilton Precinct, around the environmental conservation area, and on both sides of Picton Road where the road divides the environmental conservation area (refer to Figure 4.1)).

The exclusion fencing will also be designed to funnel koalas towards safe passage under the roads via existing Culverts. These culverts have been identified in Figure 4.1. For terrestrial species such as koalas, the underpass entrances will lead to natural habitat on both sides. Detailed design of fencing to direct koalas to the culverts, and for installation of ‘fauna furniture’, is to occur for the culverts along Picton Road where the road divides the environmental conservation area (as seen in Table 4.1). Furthermore, a koala crossing is to be designed and installed

for the road that will bisect the conservation lands via an elevated bridge (preferred if possible) or culvert designed to facilitate koala movements.

A limited number of gates along the E2 zoned land for South East Wilton Precinct are proposed so as to allow passive recreational access to the E2 lands (subject to approval for recreational access to these lands). Detailed design for the gate locations, gate design, and walking paths between the gates is to be commissioned by Walker Corporation, and implemented once designed and agreed with Wollondilly Shire Council, It is anticipated that the entry gates will be an automatically closing double gate system, such as found in zoo aviary enclosures, so as to prevent a gate being accidentally left open and allowed dogs and/or koalas to have unintended passage. It is noted that public access to the link corridor is to be prohibited, and passive recreation (ie walking paths) are to divert to run adjacent to the link corridor (within the development footprint). Should public access to conservation lands not be granted then lockable secure gates will be installed for the purposes of ongoing management.

Signage is to be erected at least every 100m along the koala exclusion fence, and at gates, identifying that the fencing is to prohibit koalas accessing the urban area, and dogs accessing the bushland, including details to report stray or roaming dogs to Council Rangers.

4.1.3 Predation by dogs

Dog attacks on koalas are closely associated with urban expansion, with exposure to dogs increasing as land adjacent to koala habitat is developed and occupied (Crowther et al. 2010; DSEWPaC 2011). To limit koala-dog interactions the exclusion fencing is required (Section 4.1.2), along with the following additional measures:

- complete exclusions on residents being able to walk dogs within bushland with the koala exclusion fencing surrounding the development site;
- the implementation of fenced off-leash dog areas in proposed active open space areas in locations isolated from conservation areas encouraging residents that these locations are more appropriate for walking their dogs and giving them exercise; and
- a community education and awareness program for responsible dog ownership including:
    - importance of retaining the koala habitat in the eastern portion of the precinct and why it needs to be conserved and managed for koalas; and
    - explain the necessity of keeping dogs out of the areas with koala exclusion fencing;
- signage along the koala exclusion fence (see Section 4.1.2).

4.1.4 Disease

It is suggested that non-local koalas should not be brought into the site. The majority of koalas observed in a 2016 study of the region appeared to be in good health based on a visual assessment (Colman 2016), with one displaying signs of possible symptoms of Chlamydia (stained fur). It is considered that disease monitoring should occur at a broader scale (see Section 4.2.4).

4.1.5 Bushfire

Bushfires and controlled fires can directly impact koalas through direct radiant heat or the inhalation of smoke and ash, or indirect impacts due to reduced, altered or complete loss of habitat. Fire management must take into consideration burn intensity, duration, floristic changes and koala refuge habitat (Turbill 2003; DECC 2008).

The Biodiversity Stewardship Agreement Management Plan template includes a 'Fire for Conservation Management Plan' which would be prepared for the subject site as part of entering into a Biodiversity Stewardship Agreement. The Fire for Conservation Management Plan would also consider impacts to fauna species, particularly the koala from any proposed ecological burns.

The following recommendations regarding fire management should be considered for inclusion in a South East Wilton Precinct Bushfire Management Plan. This would apply to the native bushland being retained in the east of the precinct:

- using roads as a fire break to the conserved bushland areas in the eastern portion of the precinct;
- no asset protection zones to be located within the E2 zoned vegetation within the koala exclusion fencing (E2 lands);
- make NSW Rural Fire Service aware of koala habitat, and coordinate with them during any fire management activities;
- coordinate with local wildlife carers and rehabilitators to ensure appropriate care for koala's post-fire; and
- make community aware of not lighting fires.

In addition, the Fire Burn Guidelines for koala habitat (Appendix C) should be considered for any planned ecological burns.

4.1.6 Heat stress and severe weather conditions

Severe weather conditions such as drought and heatwaves can have major impacts on local koala populations, with the quality and quantity of habitat available being an important factor for survival. Vegetated creek lines where soil moisture is higher play an important role as refuge areas (DECC 2008, Reed and Lunney 1990).

The E2 zoned lands includes Allens Creek itself, which will provide shelter and a cooler environment to koalas during heatwaves, and potential access to pools of water along Allens Creek.

4.1.7 Swimming pools

Koalas are often unable to escape if they fall into a swimming pool, although they are able to swim. Within the South East Wilton Precinct koala exclusion fencing is proposed to prohibit koalas potentially encountering swimming pools.

4.1.8 Community engagement and awareness

The NSW Koala Strategy is part of a long-term vision to stabilise and increase koala population numbers across the state. The strategy identifies a set of 24 actions under four pillars to be delivered over three years. One of the four pillars is conservation through community action. To align with this vision, it recommended that community engagement and education occurs across the South East Wilton Precinct.

Community engagement will be around; presence of koalas in their area and the significance of the local population, threats to koalas and how they can help, recording of koala sightings in a local app or website (to be determined, Section 4.2.8), koala habitat management and restoration occurring in their local area.

Permanent signage will be installed across the precinct, including but not limited to:

- areas undergoing environmental protection and habitat restoration works;

- at key entrances to the eastern conservation zone advising people it is an important koala corridor and they are not permitted to take dogs into this area;
- dog awareness (eg on-leash/off-leash areas, exclusion zones, koala movement and breeding cycle details, reporting stray or roaming dogs);
- how to report a koala sighting; and
- helping sick and injured koalas and details for WIRES Rescue Line (1300 094 737);

Walker Corporation is to install signage, and to collate this information into an information brochure, and it will be distributed to all residents.

4.2 Allens Creek Corridor and broader region

The following outlines the management and mitigation actions recommended for implementation within the broader Allens Creek Corridor region to seek to reduce potential threats and/or impacts to koalas. These recommended actions are outside of the South East Wilton Precinct and as such are not a requirement of this KPoM or Walker Corporation. However, the Deed of Agreement did identify that recommendations for koala management should be made for the broader Allens Creek Corridor (Figure 1.5).

The mix of land ownership throughout the Allens Creek Corridor presents some challenges and opportunities for management. Where possible, a coordinated approach will provide the best outcome for the conservation of koala habitat and koala population in the region. Some areas of the corridor are already managed as conservation areas or biobanking sites, such as the Bingara Gorge conservation land and the Missionaries of the Sacred Heart biobanking site at the northern end of the corridor (Figure 1.6). There are areas of privately-owned residential land, crown land, and land owned by companies such as Walker Corporation and South32, all of which present different opportunities for management.

4.2.1 Habitat loss, degradation and fragmentation

Primary objectives for the Allens Creek Corridor and broader region are to have:

- no net loss of koala habitat;
- to improve the condition of koala habitat; and
- to facilitate the safe movement of koalas through this area.

These objectives will be achieved through measures such as protection of existing trees and bushland, revegetation of cleared land, and restoring degraded areas through restoration activities such as weed management, feral animal management and fire management. Weed management measures and specific performance criteria are detailed in the VMP (Ecoplanning 2020).

Based on the current vegetation mapping the Allens Creek Corridor has 353.7 ha of shale influenced native vegetation, 188.5 ha of other native vegetation, and 33.3 ha of cleared land. Whilst the percentage of koala food trees fluctuates and varies within the Allens Creek Corridor, overall the native vegetation is considered to provide potential koala habitat.

To achieve these performance outcomes the following actions are recommended:

- zoning land and managing any future proposed development in a way that requires the retention of existing native vegetation (or a no net loss of native vegetation is achieved in the Allens Creek Corridor) and maintenance of connectivity;

- consider widening the Allens Creek Corridor to the east to the south of Picton Road, beyond the Allens Creek study area investigated in this report, as per Wilton 2040 (DPE 2018);

- encouraging those landholders that own land within Allens Creek Corridor to establish their land as a Biodiversity Stewardship site. By placing the lands under a Biodiversity Stewardship Agreement, it would ensure these koala habitats are being legally secured and actively managed including revegetation, weed management, feral animal management and fire management;

- Council to look at voluntary acquisition of key properties in Allens Creek Corridor and place them into the conservation estate;

- revegetation of cleared lands where possible. Revegetation is planned for the southern side of Picton Road, where the Allens Creek Corridor crosses Picton Road as part of the South East Wilton Precinct (Section 4.1.1) This will enable continued koala passage through the corridor and maintain connectivity between the Upper Nepean State Conservation Area and the Allens Creek Corridor. The revegetation should be comprised of a mix of koala feed trees and non-feed trees from the area, which are favoured during the day for shelter and protection (Colman 2016); and

- weed management should be encouraged across the corridor. This will occur within the southern portions of the corridor in South East Wilton Precinct, the existing conservation reserves and Crown Land. Therefore, the gaps between these sites is where emphasis should be placed on encouraging landowners to undertake weed management activities and as mentioned above encourage some of these important bushland areas to be protected and managed as biodiversity offsets where funding will be provided for weed management to occur.

4.2.2 Connectivity and vehicle strike

A combination of management strategies will help to maintain connectivity between areas of koala habitat in the region. Protecting the Allens Creek Corridor will allow the continued passage of koalas through the corridor, connecting the Upper Nepean State Conservation Area with the Nepean River corridor to the north.

The following management recommendations apply to maintaining connectivity:

- a combination of wildlife friendly fencing and koala exclusion fencing across the corridor is needed to ensure safe koala passage and connectivity. For example, if large fences are erected on private property prohibiting koala movement this will reduce the value of the broader corridor. A targeted education campaign with key landholders is required to identify the importance of their land to koala movement and discuss ways they can assist such as through type of fencing they have on their property;

- koala exclusion fencing is recommended where the corridor crosses Picton Road, Wilton Road and at the northern end adjacent to the Hume Highway, to reduce potential vehicle strikes. Fencing should be constructed to prevent koalas accessing the busy roads and to direct them to underpasses as shown in Figure 4.3;

- one culvert has been assessed as capable of facilitating koala crossings on Wilton Road, and a further two have been identified along Picton Road. Further works are recommended to be carried out to improve the

likelihood of koalas using these and other culverts, such as revegetation to connect the entrances of the culverts to nearby habitat and the installation of 'fauna furniture' such as horizontal logs. Liaison with RMS will be required in the finalisation of the design and installation. Signage is also recommended to advise motorists of the reason for the koala exclusion fencing;

- where proposed koala exclusion fencing crosses property driveways then liaison with those landowners will be required, and it is anticipated that koala grids will need to be installed across access driveways to make the koala exclusion fencing functional;

- revegetation to the south of Picton Road will bolster the narrow section of the corridor (refer to Figure 4.1); and

- zoning land and managing any future proposed development in a way that provides for the conservation of native vegetation and maintenance of connectivity. Management recommendations for protection of existing vegetation and restoration is discussed in Section 4.2.1.

4.2.3 Predation by dogs

Dog/koala interactions within the broader Allens Creek corridor should be limited where possible, but due to the range of ownership exclusion fencing is unlikely to be viable, and thus limiting dog access to bushland outside of the South East Wilton Precinct via changing owner behaviour is proposed via following measures:

- a community education and awareness program for responsible dog ownership which explains why allowing dogs off leash or unsupervised access to bushland creates issues for koalas; and

- the implementation of fenced off-leash dog areas in active open space areas in locations isolated from conservation areas encouraging residents that these locations are more appropriate for walking their dogs and giving them exercise.

4.2.4 Disease

It is suggested that non-local koalas should not be brought into the Allens Creek Corridor, such as release of rehabilitated koalas that were injured outside of the region. Monitoring of disease within the local koala population is recommended, including:

- future monitoring events detail any instance of chlamydia infection within the population and re-evaluate the level of risk in the area; and

- community education and awareness regarding the identification, care and reporting of sick animals (refer to Section 4.1.8).

4.2.5 Bushfire

The following recommendations from Section 4.1.5 regarding fire management are also recommended for the Allens Creek Corridor. For clarity these are:

- using roads as a fire break to the conserved bushland areas in the eastern portion of the precinct;

- seek to locate asset protection zones outside of good quality native vegetation;

- make NSW Rural Fire Service aware of koala habitat, and coordinate with them during any fire management activities;

- coordinate with local wildlife carers and rehabilitators to ensure appropriate care for koala's post-fire; and
- make community aware of not lighting fires.

Checks for koalas shall be conducted prior to any hazard reduction burn commencing, and shall implement actions for koala risk areas where there is koala presence and canopy scorch risk, as Appendix C.

4.2.6 Heat stress and severe weather conditions

As for the South East Wilton Precinct, the Allens Creek Corridor includes Allens Creek itself, which will provide shelter and a cooler environment to koalas during heatwaves, and potential access to pools of water along Allens Creek. Therefore, specific management actions for this matter are not proposed.

4.2.7 Swimming pools

Within the Allens Creek Corridor (outside of South East Wilton Precinct) there is the possibility a koala could enter into areas with housing, and could potentially encounter a property with a swimming pool. In these areas the community can be made aware of the things they can do if they have a swimming pool to prevent koalas drowning.

Drownings can be prevented through a number of measures including:

- use a pool cover that is tight, secure and will not sink if a koala walks on it;
- appropriate fencing to keep koalas out of the pool area;
- the installation of a fixed thick rope that drapes into the pool at all times; and
- incorporate pool features that allow koalas to climb out (eg large steps, ladders, shallow access areas).

Residents with, or installing, swimming pools should be made aware of these management techniques.

4.2.8 Community engagement and awareness

Where there are existing residential areas abutting koala habitat there needs to be a targeted community awareness/education program, with a focus on landholders with properties that directly back onto the vegetated areas of the corridor and creek line. The community awareness and education campaign may include:

- mailbox drop of information on the importance of the local koala population and what they can do to help. Similar information to the South East Wilton Precinct would be used including dog management, pools, reporting koala sightings, etc (refer to Section 4.1.8),
- displays in local shops and shopping centres with maps of koala sightings in the local area and representatives being able to answer community questions; and
- implementing a type of 'Land for Wildlife' program with those landholders who back directly onto the vegetated parts of the corridor. This program could provide more directed information about the importance of keeping their dogs in at night or in a smaller enclosed area near house, retaining trees in their backyard to provide habitat for koalas and other native wildlife, managing weeds on their property so they don't escape into adjacent bushland and reporting koala sightings, etc. This program may also be able to provide incentives for their participation such as rate rebates, rebate for weed control, sign on their front gate etc. This program has been very successful in other local government areas.

Table 4.1 Summary of management actions - South East Wilton Precinct (delivers objective 1 of this document – provide a KPoM for the South East Wilton Precinct)

Section reference	Management action	Performance measure	Responsible entity	Timeframe	Aim 1: Improve Habitat*	Aim 2: Reduce threats*	Aim 3: Connectivity*
4.1.1	Implement Vegetation Management Plan (VMP, Ecoplanning 2020)	Implementation of VMP and performance measures within the VMP are met	Walker Corporation	As specified in the VMP	X		
4.1.1/ 4.1.2	Ensure that there is no public access to the designated 'link corridor' lands.	Any landscape plans to identify that no public access within the link corridor lands is to occur, and any paths to encourage alternative access outside of the link corridor	Walker Corporation	Ongoing		X	X
4.1.1	Active management of bushland within 'link corridor' area	Reduced weed load in Environmental Conservation area (as detailed in the VMP) Revegetation of area south of Picton Road (Figure 4.1) as detailed in the VMP, and which meets the performance criteria specified in the VMP All lands within the link corridor to achieve >30% native tree species cover >1.5m in height within three years of approval of the KPoM. Should this not be achieved supplementary planting of Forest Red Gum (a koala food tree) using locally sourced seed or plant stock is to occur and be maintained until such time as the native tree cover objective is achieved across the entirety of the link corridor	Walker Corporation	Three years from approval of this KPoM	X		X
4.1.1	Koala preclearance surveys	No koalas injured by clearing activities. If any koalas are detected they are to be left and allowed to move	Suitably qualified ecologist engaged by clearing contractor	Adopted into CEMP, and implemented prior to any vegetation clearance		X	
4.1.1/ 4.1.2	Koala exclusion fencing	Modify fence location from draft Wilton DCP to reflect locations proposed in this KPoM, rather than passing through the centre of vegetation Installation of fencing as per section 4.1.2 and Figure 4.1	Walker Corporation in conjunction with RMS where required	Within two years from approval of this KPoM (note internal fencing for road bisecting the finger of bushland would	X	X	X

Table 4.1 Summary of management actions - South East Wilton Precinct (delivers objective 1 of this document – provide a KPoM for the South East Wilton Precinct)

Section reference	Management action	Performance measure	Responsible entity	Timeframe	Aim 1: Improve Habitat*	Aim 2: Reduce threats*	Aim 3: Connectivity*
		Monitoring and maintenance of fencing as per section 5.3		only be installed with construction of the road).			
4.1.2/ 4.1.3	Signage and gates for koala exclusion fence	Installation of signage and gates as per section 4.1.2 and Figure 4.1. Monitoring and maintenance of signage as per section 5.3	Walker Corporation	As per koala exclusion fencing		X	
4.1.2	Culverts with koala crossing furniture	Design and installation of fauna furniture within culverts, and ensure that koala exclusion fencing directs koalas to the culverts Monitoring of koala crossings though culverts as per section 5.4	Walker Corporation in conjunction with RMS	Develop detailed plans within two years of approval of the KPoM, and installation within four years of approval. Monitoring refer to Table 5.1			X
4.1.2	Design and construction of a koala crossing for the road that will bisect the conservation lands	Design and installation of road that incorporates koala crossing, with exclusion fencing to direct koalas to crossing structure. Elevated bridge preferred if possible or koala-friendly culvert at a minimum.	Walker Corporation	Design for koala crossing to occur together with road design. Koala crossing to be open for koala use in as short a timeframe as possible from construction commencement , and prior to road being open to public traffic.			X
4.1.3	Fenced off-leash dog areas	Designation of appropriate areas and appropriate signage.	Walker Corporation in conjunction with Council	Off-leash park areas released as part of each stage (where relevant to that stage)		X	
4.1.3	Community education and awareness program for responsible	Material on importance of local koala population as part of lot purchase documentation Displays in local shops and shopping centres	Walker Corporation in conjunction with Council	Throughout the development. Provided to residents shortly after the stage		X	

Table 4.1 Summary of management actions - South East Wilton Precinct (delivers objective 1 of this document – provide a KPoM for the South East Wilton Precinct)

Section reference	Management action	Performance measure	Responsible entity	Timeframe	Aim 1: Improve Habitat*	Aim 2: Reduce threats*	Aim 3: Connectivity*
	dog ownership			becomes available and before they move into their dwellings.			
4.1.5	Develop Bushfire Management Plan (BMP)	Implementation of BMP	Walker Corporation	As part of detailed design for stages adjacent to E2 zoned vegetation in the east		X	
4.1.8	Community engagement – significance of koalas	Material on importance of local koala population as part of lot purchase documentation Displays in local shops and shopping centres	Walker corporation in conjunction with Council	Throughout the development. Provided to residents shortly after the stage becomes available and before they move into their dwellings.		X	

* The aims are a shortened version of those presented in section 1.1 , with aim 1 being to improve koala habitat quality within the site, aim 2 being reduce threats to koalas from development, and aim 3 being to seek to provide connectivity to the broader Allens Creek Corridor. A cross in the box indicates that the management action is relevant to that aim.

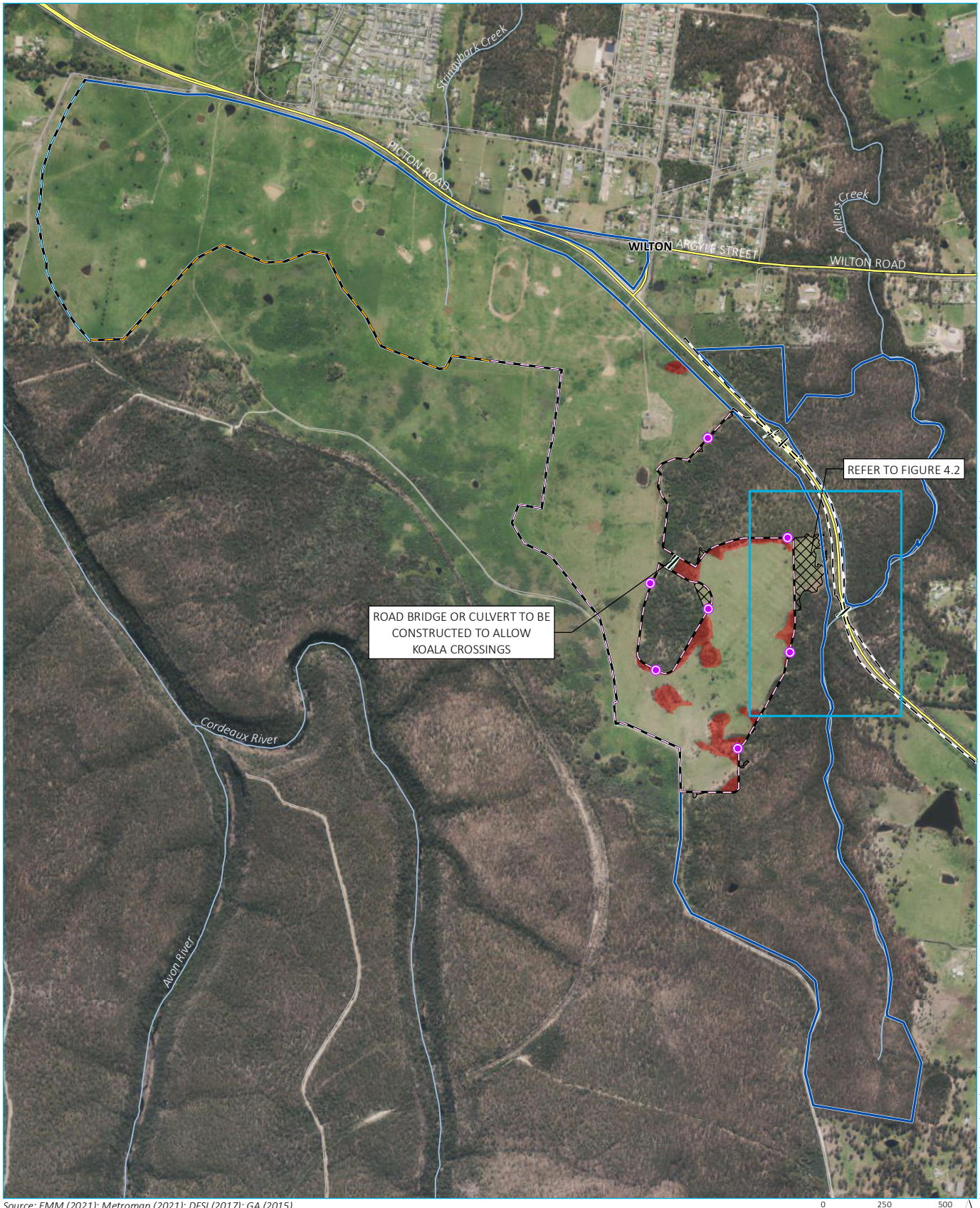
Table 4.2 Summary of management actions - Allens Creek Corridor and broader region 5 (delivers objective 2 of this document – provide guidance on koala management within the Allens Creek Corridor)

Section reference	Management action	Performance measure	Responsible entity	Timeframe	Aim 1: Improve Habitat*	Aim 2: Reduce threats*	Aim 3: Connectivity*
4.2.1	Zoning land and management of future development	– Protection of existing trees and bushland – Revegetation of cleared land – Restoration of degraded areas	Council	5 years from approval of KPoM	X	X	
	Establish Biodiversity Stewardship sites with existing landholders	– Additional areas placed under Biodiversity Stewardship Agreements adjacent to Allens Creek Corridor.	Council	2-10 years from approval of KPoM	X	X	
	Consider widening the Allens Creek corridor to the east to the south of Picton Road, beyond the Allens Creek study area, as per Wilton 2040 (DPE 2018).	– Consideration given by Council to opportunities	Council	5 years from approval of KPoM		X	X
4.2.2	Koala road crossings	– Design and install koala fencing along Picton Road and Wilton Road to direct koalas to culvert crossings – Liaison with landholders where koala exclusion fencing crosses property driveways and installation of koala grids – Design and install koala furniture to culverts 1, 3 and 4 where possible and where it will enhance koala passage	Walker Corporation in conjunction with Roads and Maritime Services	Designs completed within 2 years from approval of KPoM Installation completed within 4 years from approval of KPoM			X

Table 4.2 Summary of management actions - Allens Creek Corridor and broader region 5 (delivers objective 2 of this document – provide guidance on koala management within the Allens Creek Corridor)

Section reference	Management action	Performance measure	Responsible entity	Timeframe	Aim 1: Improve Habitat*	Aim 2: Reduce threats*	Aim 3: Connectivity*
4.2.3	Fenced off-leash dog areas	– Designation of appropriate areas and appropriate signage.	Council	5 years from approval of KPoM		X	
4.2.3	Community education and awareness program for responsible dog ownership	– Appropriate signage. – Mail box drop	Council	Ongoing		X	
4.2.3	Signage – koala exclusion fence and gates	– Installation of signage – Maintenance of signage	Council	3 years from approval of KPoM		X	
4.2.4	Koala monitoring	– Chlamydia infection level of risk	Walker Corporation	As part of future monitoring		X	
4.2.5	Bushfire management	– Regional bushfire management plan	Council	2 years from approval of KPoM		X	
4.2.5	Check for koalas prior to any hazard reduction burn, and implement actions for koala risk areas where there is koala presence and canopy scorch risk, as per chapter 4 of Baker (2016).	– Koalas not injured by hazard reduction burns	Council	Ongoing		X	
4.2.8	Community engagement and awareness	– Mailbox drop – importance of local koala population – Displays in local shops and shopping centres – 'Land for Wildlife' program	Council	Ongoing		X	

* The aims are a shortened version of those presented in section 1.1 , with aim 1 being to improve koala habitat quality within the site, aim 2 being reduce threats to koalas from development, and aim 3 being to seek to provide connectivity to the broader Allens Creek Corridor. A cross in the box indicates that the management action is relevant to that aim.



Source: EMM (2021); Metromap (2021); DFSI (2017); GA (2015)

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KEY

- South East Wilton precinct (431.30 ha)
- Gate access
- Existing Koala fence
- Wildlife under pass
- Assisted natural regeneration and protection
- 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (8.41 ha to be removed)
- Main road
- Local road
- Watercourse/drainage line

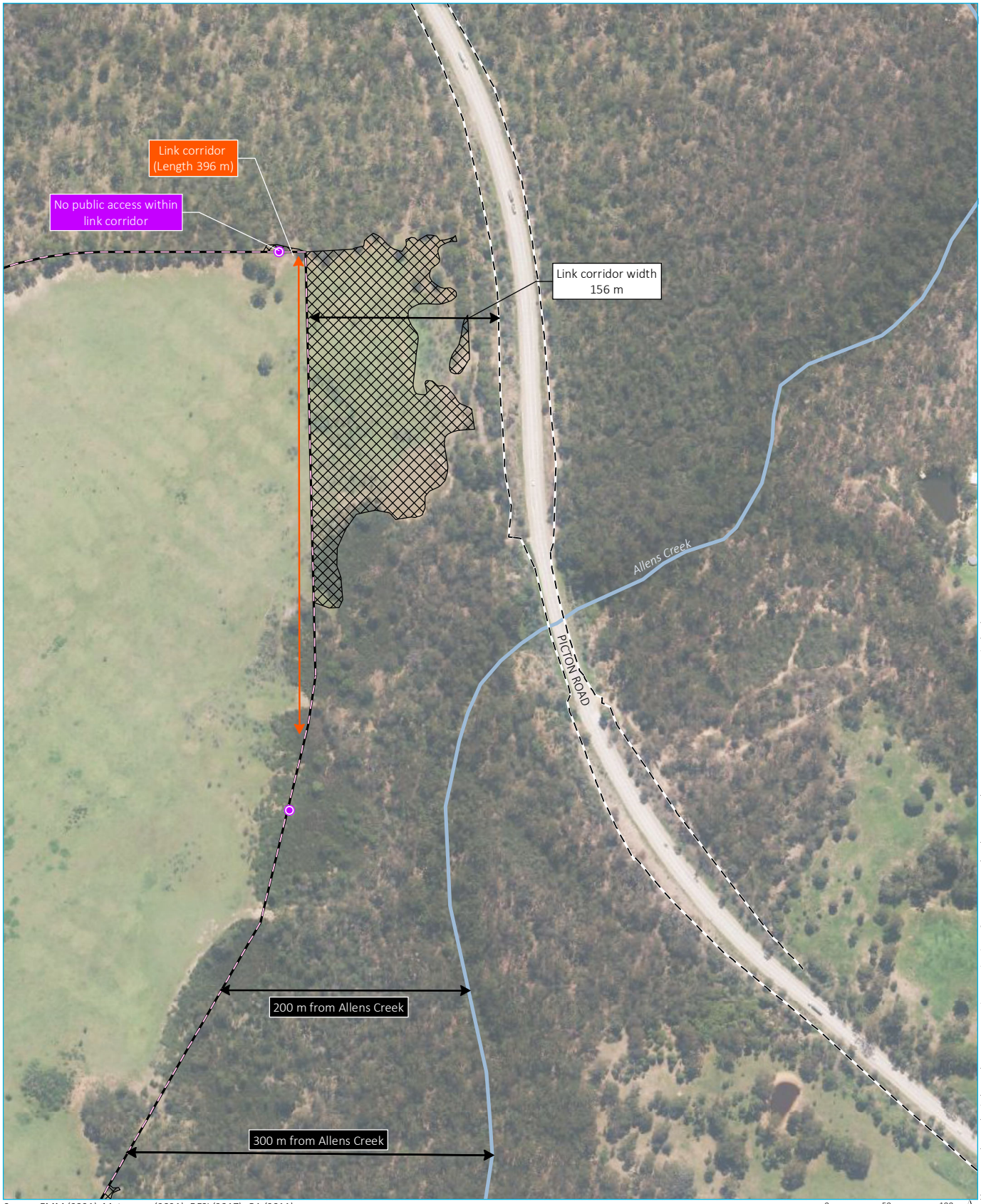
Proposed koala fence

- Stage 1
- Stage 2
- Stage 3 - 5

Management recommendations for South East Wilton precinct

Walker Corporation
Wilton Koala plan of management
Figure 4.1

EMM
creating opportunities



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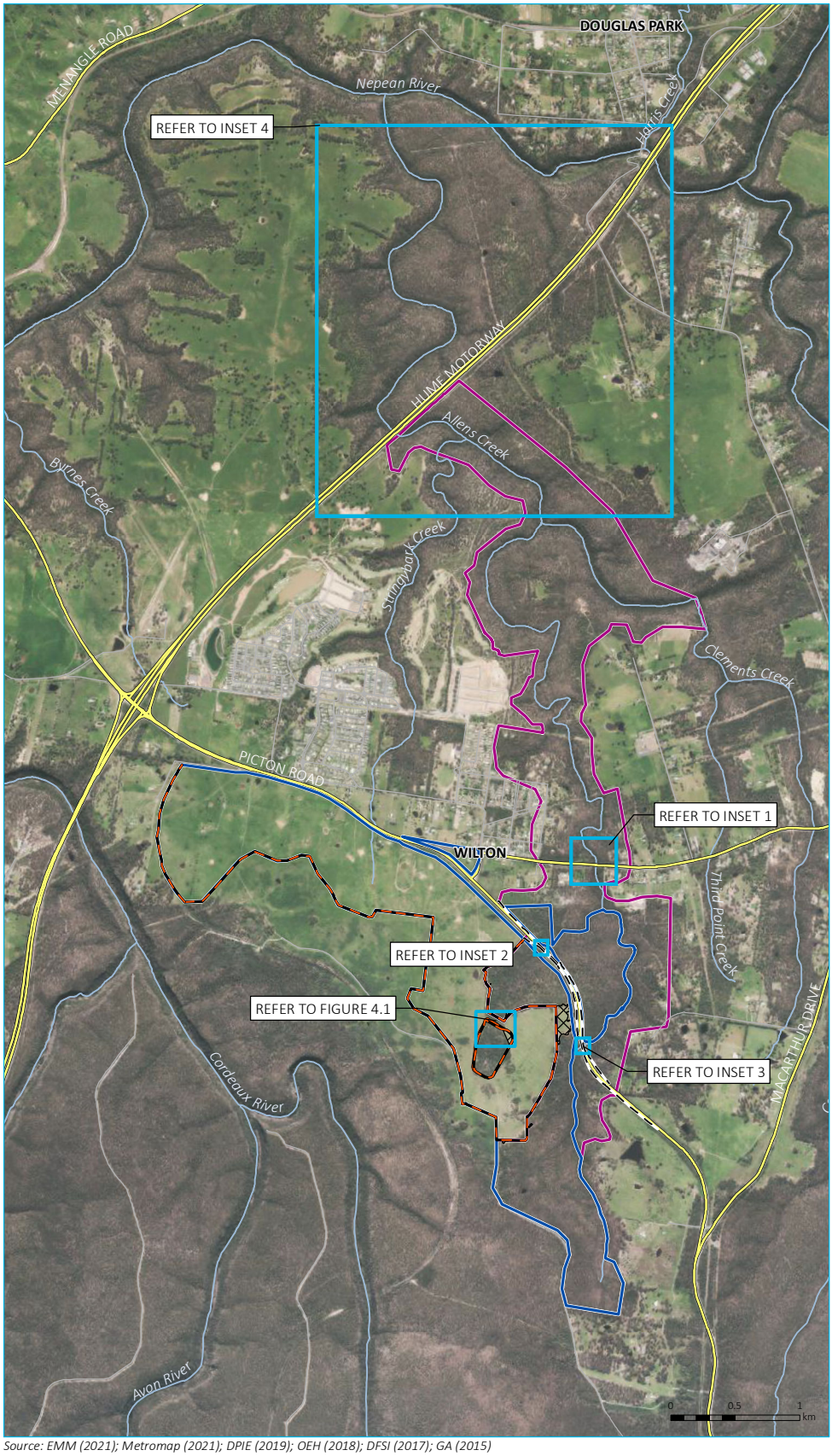
KEY

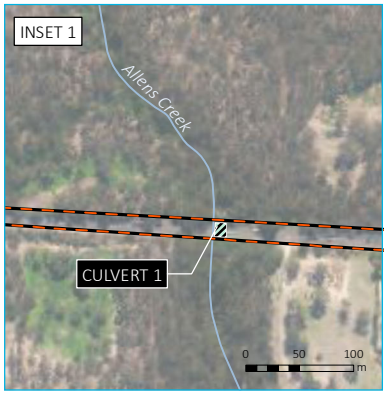
- Gate access
- Proposed koala fence
- Existing koala fence
- Allens Creek
- Assisted natural regeneration and protection

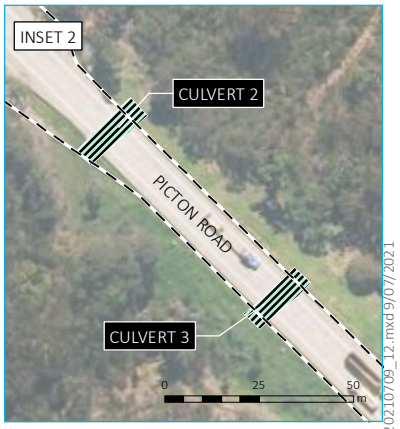
Koala link corridor for South East Wilton precinct

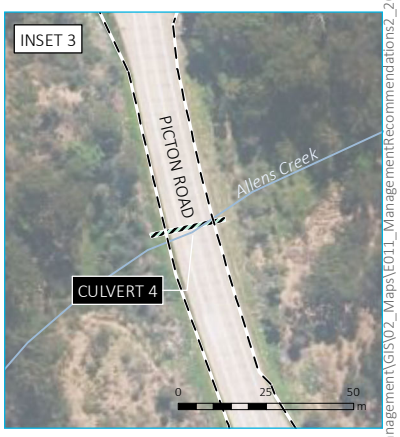
Walker Corporation
Wilton Koala plan of management
Figure 4.2

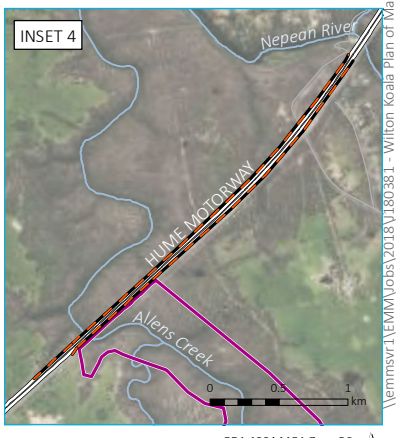
EMM
creating opportunities











Source: EMM (2021); Metromap (2021); DPIE (2019); OEH (2018); DFSI (2017); GA (2015)

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KEY

- Allens Creek corridor study area (576.33 ha)
- South East Wilton precinct (431.30 ha)
- Proposed boundary fence
- Existing Koala fence
- Main road
- Local road
- Watercourse
- Wildlife under pass
- Assisted natural regeneration and protection

Management recommendations for Allens Creek corridor

Walker Corporation
Wilton Koala plan of management
Figure 4.3

EMM creating opportunities

5 Monitoring

The following chapter details ongoing monitoring strategies for the koala population both within the South East Wilton Precinct and the larger Allens Creek Corridor.

5.1 Key monitoring objectives

The key monitoring objectives are:

- continued or increased use of habitat within the Allens Creek Corridor by koalas (Section 5.2 for monitoring methods);
- maintenance of koala exclusion fencing (Section 5.3);
- maintenance or increase in koala road crossings (Section 5.4):
  - koalas are using culverts to safely traverse (cross) road; and
  - no vehicle strike incidents reported;
- within the South East Wilton Precinct:
  - revegetation of the target area which meets the performance criteria specified in the VMP (Ecoplanning 2020);
  - community awareness of the presence of koalas and measures they can take to reduce impacts on koalas;
  - no vehicle strikes on koalas;
  - no encounters with Koalas within urban areas; and
  - no attacks on koalas by domestic dogs.

5.2 Koala monitoring methodology

5.2.1 Biennial surveys

Surveys are to be undertaken every two years (ie year two and year four) within the Environmental Conservation areas of South East Wilton Precinct and the Allens Creek Corridor. Surveys are to be completed across the South East Wilton Precinct and Allens Creek Corridor study area at sites spaced 500 metres apart. The 24 sites are identified in Figure 3.1 (noting that access to 18 occurred in the baseline survey in 2019).

Previous survey efforts including spotlighting and SAT surveys have provided limited detection of koalas. Furthermore, given that koalas were not detected during the spotlight surveys which were undertaken to inform the preparation of this KPoM, it is proposed that the following survey methods be implemented to increase likelihood of koala detection. Additionally, this strategy will allow for the comparison of koala detection methodologies success at the five year review of this KPoM (refer to Section 5.8). The comparison of these detection methodologies will inform the most appropriate method to utilise moving forward.

The following methodologies are to be utilised during monitoring events:

- spotlighting surveys with two ecologists walking a 200m transect and surveying 50m either side of the transect with spotlights, covering a 2 ha survey area (DPIE 2019);
- Song Meters are to be deployed at each site over three consecutive nights; and
- Koala detection dog surveys surveying for both koala scats and koala individuals.

The results from the year 2 and year 4 rounds of monitoring are to be utilised to form a baseline level of koala activity for comparison to in future years. Thus, at the first 5 year review period there will be selection of the survey method(s) which give the best likelihood of koala detection, and the data available will be utilised to form a baseline of koala activity within the South East Wilton Precinct and Allens Creek Corridor. It is noted that this is proposed as it is understood that development staging will move from the western parts of the South East Wilton Precinct where low density scattered paddock trees only are present, towards the east where some disturbed native vegetation will be impacted. Thus, it is understood that there will be time to generate baseline data prior to impacts occurring. However, should development of the eastern portion of the South East Wilton Precinct occur sooner than the 5 year period, then the review of the KPoM should occur prior to approval such that appropriate baseline koala activity can be agreed with Council.

The data collected at these sites will be utilised to monitor koala activity within the site. Koala activity will be assessed statistically utilising t-test to determine if koala activity has increased or declined, using alpha set at 0.10, rather than the standard 0.05, due to difficulties in detecting statistically significant changes in koala activity.

5.2.2 Citizen science initiative

Through community awareness (Sections 4.1.8 and 4.2.8) encourage the local community to monitor broader koala activity within the Allens Creek Corridor.

In this regard there is the Wollondilly Koala Hotline – 4677 1100. There is also the NSW Government “I Spy Koala” mobile app: https://koala.nsw.gov.au/2019/08/26/new-koala-app-launched-i-spy-koala/. The community can utilise these resources to report koala sightings, and reporting (Section 5.7) is to access the latest koala sighting information via the NSW Government Bionet database. Promotion of these resource in the local area will increase the reporting of koala observations in a consistent manner.

5.3 Fencing monitoring and maintenance

Ongoing maintenance of fencing is essential for the effective long-term exclusion of koalas and other animals. Damage can result in breaks in fencing that animals can exploit to access the road. This damage can result from general wear, vandalism or overgrown vegetation (AMBS Consulting 1997).

As per condition of consent 3.3.1 of development application 010.2018.00000339.001 Walker Corporation is to prepare a plan of management for the maintenance of the WaterNSW boundary protection koala fence to be approved by WaterNSW and Council.

Responsibility for ongoing maintenance of exclusion fencing around E2 zoned lands within the South East Wilton Precinct will be the responsibility of Walker Corporation until such time as a Stewardship Site Agreement is entered into, at which point it will become the responsibility of the landholder, under the Stewardship Site Agreement which should contain adequate funding for the maintenance of the fencing.

Once erected all exclusion fencing and gates are to be checked monthly for any breaks. Any reports of koala roadkill or koalas within the urban portion of the South East Wilton Precinct, or on Picton Road within 100 m of the South East Wilton Precinct shall also trigger an immediate (within 48 hours) inspection of the fencing. Any break or damage to koala exclusion fencing, gates, or signage is to be repaired expeditiously (within two weeks of the inspection).

5.4 Road crossing monitoring

Deployment of remote camera traps to monitor koala crossings in culverts (to be confirmed with RMS) is recommended. The cameras are to be deployed every 2 years for a period of 8 weeks during the months of September and October when koalas are most mobile. The deployment of cameras will seek to quantify the movements of koalas through the culverts. Should movements of koalas not be detected in the first monitoring event then additional monitoring events and durations would be desirable.

5.5 Disease and injured koalas

Future monitoring of koalas will seek to gather observations of the incidence of chlamydia where possible. This would involve noting of any signs of chlamydia in koalas observed (wet bottom or red eye), or if possible, using either laboratory testing or koala detection dogs to ascertain the prevalence of chlamydia (Cristescu et al. 2019). As the prevalence of chlamydia is believed to be low, specific monitoring every 10 years is recommended. Observations of chlamydia will also be conducting during koala population surveys in Section 5.2.1.

Should injured koalas be observed or come into care as a result of vehicle strikes etc, it is recommended that they are passed on to WIRES for treatment. Health inspections by the Sydney University 'Koala Health Hub' for veterinary inspections or treatment where needed is recommended.

5.6 Koala monitoring after fire

Koala monitoring is recommended to be undertaken immediately following any bushfire events within the Environmental Conservation areas of South East Wilton Precinct or Allens Creek Corridor. These post-fire monitoring events are to be undertaken by a suitably qualified ecologist utilising methodologies consistent with this KPoM. The data collected during these monitoring events will detail any impacts of fire on the local koala population and inform future monitoring events.

5.7 Reporting

A Koala Monitoring Report is to be prepared after each monitoring event discussing the findings against the Key Monitoring Objectives (Section 5.1) and the Performance Criteria for management actions as specified in Table 4.1 for the South East Wilton Precinct, as well as management actions within that are fully or partially the responsibility of Walker Corporation as specified in Table 4.2. The information provided in the Koala Monitoring Report should include:

- review of online databases, in particular, the resources identified in Section 5.2.2;
- review of local and broader area changes to koala habitat that may impact the local koala population (ie adverse climatic/weather events, additional development of koala corridors, increase residential habitation, new/upgraded roads, protection of koala habitat (such as stewardship agreements, acquisition), other development that impedes koala movement, etc);
- details of monitoring event survey methodology, site condition and results;
- compliance with key monitoring objectives;
- compliance with Monitoring Performance Criteria;
- koala usage of Environmental Conservation areas;
- changes in local koala population ie increased utilisation of areas and corridor, increased sightings/reporting;

- documentation of any reported koala injuries and/or mortalities;
- evaluation of maintenance of exclusion fencing, and the amount of koala road crossings using culverts;
- comparison of results with previous monitoring events and baseline assessments; and
- any recommendations regarding ongoing monitoring or management strategies to improve long-term outcomes for the local koala population.

5.8 Review

This KPoM, prepared for the South East Wilton Precinct, was developed with the aim to provide a framework for the ongoing monitoring, management and conservation of the local koala population. The KPoM is to be reviewed every five years in conjunction with Council and Walker Corporation. Should performance criteria not be achieved then management actions occurring are to be adjusted as necessary.

5.9 Funding

Walker Corporation is to be responsible for the funding of all management and monitoring activities identified in this KPoM until one year after the final lot is sold.

However, the recommended conservation actions for the Allens Creek Corridor study area are outside of the South East Wilton Precinct and as such cannot be enacted by Walker Corporation.

If additional actions are undertaken by bodies or agencies (such as Wollondilly Shire Council's koala radiotracking) then these would be at the time or cost of those parties.

Table 5.1 Summary of monitoring strategies (delivers objective 3 of this document – identify monitoring actions to be implemented)

Section reference	Monitoring action	Performance criteria	Responsible entity	Timeframe	Aim 1: Improve Habitat*	Aim 2: Reduce threats*	Aim 3: Connectivity*
5.2.1	Biennial surveys: Spotlight surveys Deployment of song meters Koala detection dog surveys	Continued or increased use of habitat within the Allens Creek Corridor by koalas	Walker Corporation	Year 2, and every 2 years thereafter until close off of the KPoM	X	X	X
5.2.1	Comparison of koala detection methodologies	Determine baseline koala activity level for comparison for future years, and selection of specific monitoring methodology for comparison to the baseline	Walker Corporation	Year 5	X	X	X
5.2.2	Citizen science initiative	Increased data points on map-based websites	Council	Ongoing	X	X	X
5.3	Fence monitoring and maintenance – all exclusion fencing and gates	Any exclusion fence damage identified repaired within 2 weeks of inspection No koalas accessing roads or development areas within the South East Wilton Precinct	Walker Corporation in conjunction with RMS	Monthly; or Within 48 hours of report of koala or koala roadkill		X	
5.4	Road crossing monitoring Remote camera trap deployment	Continued or increased koala road crossings using culverts Continued or increased use of habitat within the Allens Creek Corridor by koalas	Walker Corporation in conjunction with RMS	Every 2 years for 8 weeks (September-October)			X
5.5	Monitoring chlamydia in koalas: Laboratory testing Koala detection dogs	Determine rate of chlamydia infection within the Allens Creek koala population	Walker Corporation	Every 10 years		X	
5.5	Care/treatment of injured koalas	Expedient (within 24 hours) access to care for injured koalas	Walker Corporation in conjunction with WIRES and Sydney University 'Koala Health Hub'	As required		X	

Table 5.1 Summary of monitoring strategies (delivers objective 3 of this document – identify monitoring actions to be implemented)

Section reference	Monitoring action	Performance criteria	Responsible entity	Timeframe	Aim 1: Improve Habitat*	Aim 2: Reduce threats*	Aim 3: Connectivity*
5.6	Koala monitoring after fire	Identify impacted individuals Detail impacts on local koala population	Walker Corporation in conjunction with Council	Immediately after fire event		X	
5.7	Koala Monitoring Report	Compliance with key monitoring objectives Compliance with Monitoring Performance Criteria Continued/increased koala usage of Environmental Conservation areas Detail changes in local koala population Documentation of any koala injuries/mortalities Documentation of maintenance of koala exclusion fencing and koala road crossings via culverts Comparison of previous monitoring events Recommendations regarding ongoing monitoring or management strategies	Walker Corporation	Year 2 Year 4	X	X	X
5.8	Review of KPoM	Improve monitoring and management strategies, ie utilisation of most effective strategies and best industry practice Update in accordance with any update local, state or federal legislation or guidelines.	Walker Corporation	Every 5 years, and upon completion of works	X	X	X
5.9	Funding	Management and monitoring of activities identified in this KPoM relating to the South East Wilton Precinct.	Walker Corporation	N/A	X	X	X

* The aims are a shortened version of those presented in section 1.1 , with aim 1 being to improve koala habitat quality within the site, aim 2 being reduce threats to koalas from development, and aim 3 being to seek to provide connectivity to the broader Allens Creek Corridor. A cross in the box indicates that the monitoring is relevant to that aim. Some monitoring actions are linked to all aims as they could all influence the results obtained.

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Appendix A

Fauna observed in Allens Creek Corridor

No koalas were observed during the spotlight transect surveys carried out in May 2019. A range of other fauna were observed (Table A.1).

Table A.1 Fauna species observed during spotlighting surveys in Allens Creek Corridor

Common name	Scientific name	Spotlighting sites observed
Common Brushtail Possum	*Trichosurus vulpecula*	G7, H7, J7, M6
Common Ringtail Possum	*Pseudocheirus peregrinus*	E7, H7, L7
Sugar Glider	*Petaurus breviceps*	C7, D7, K6, M6, N7, O7
Grey-headed Flying-fox	*Pteropus poliocephalus*	O7
Eastern Yellow Robin	*Eopsaltria australis*	J7
Laughing Kookaburra	*Dacelo novaeguineae*	K7
Tawny Frogmouth	*Podargus strigoides*	K7, M7
Magpie Lark	*Grallina cyanoleuca*	K7
Common Bronzewing	*Phaps chalcoptera*	B6
Bibron's toadlet	*Pseudophryne bibronii*	L7
Peron's tree frog	*Litoria peronii*	E7, F7, J8, K7, L7
Tree frog (unknown species)	*Litoria* sp.	D6

Appendix B

Koala food tree data

Table B.1 Koala food tree results from surveys within Allens Creek Corridor

							Preferred Koala Food tree		Secondary Koala Food tree						Other trees												
Site ID	Easting	Northing	Easting[1]	Northing[1]	Number of Feed Trees (/30)	Percentage Koala Feed Tree (%)	*Eucalyptus punctata*	*E. tereticornis*	*E. moluccana*[2]	*E. globoidea*[2]	*E. agglomerata*[2]	*E. piperita*	*E. pilularis*	*E. longifolia*	*E. crebra*[3]	*E. fibrosa*[3]	*E. sclerophylla*	*Angophora floribunda*	*Angophora bakeri*	*Corymbia gummifera*[4]	*Allocasuarina littoralis*[5]	*Allocasuarina torulosa*[5]	*Melaleuca stypheliodes*	*Acacia parramattensis*	*Acacai decurrens*	*Exocarpus cupressiformis*	Unidentified
EMM Spotlight Survey (2019)							Percentage of each tree species																				
B5	No access				-	-	-	-	-			-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
B6	288077	6211959	287875	6212027	-	5%	5	-	-			-	-	-	-		5	-	80	-	10	-	-	-	-	-	-
C7	288471	6211583	288453	6211386	-	35%	15	-	20			-	-	-	-		-	-	60	-	5	-	-	-	-	-	-
D6	281998	6210889	288041	6211086	-	90%	40	-	35			15	-	-	-		10	-	-	-	-	-	-	-	-	-	-
D7	288411	6211000	288640	6210998	-	45%	15	-	30			-	-	-	30		5	-	-	-	20	-	-	-	-	-	-
D8	288845	6211087	289045	6211048	-	50%	25	-	25			-	-	-	-		-	-	50	-	-	-	-	-	-	-	-
E6	No access				-	-	-	-	-			-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
E7	288516	6210602	288446	6210405	-	85%	30	-	10			45	-	-	-		5	-	-	-	10	-	-	-	-	-	-
E8	No access				-	-	-	-	-			-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
F7	288534	6210085	288423	6200986	-	50%	10	5	20			15	-	-	-		50	-	-	-	-	-	-	-	-	-	-
G6	No access				-	-	-	-	-			-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
G7	288549	6209499	288514	6209710	-	95%	20	-	-			25	50	-	-		-	-	-	-	5	-	-	-	-	-	-
H7	288657	6209154	288756	6208997	-	75%	45	-	5			25	-	-	10		-	-	-	5	10	-	-	-	-	-	-
I7	No access				-	-	-	-	-			-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
J7	288495	6208000	288498	6208209	-	15%	5	-	5			5	-	-	20		-	-	-	-	30	-	-	-	-	-	-
J8	288900	6208137	289080	6208031	-	65%	25	10	30			-	-	-	25		-	-	-	-	10	-	-	-	-	-	-
K6	288010	6207542	288027	6207768	-	85%	-	40	40			5	-	-	-		-	-	-	-	15	-	-	-	-	-	-
K7	288498	6207615	288490	6207668	-	65%	-	50	10			-	-	5	5		-	-	-	-	5	-	-	-	-	-	-
K8	No access				-	-	-	-	-			-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
L7	288511	6207001	288527	6206794	-	45%	20	-	5			-	10	10	-		-	-	-	-	50	-	-	-	-	-	-
M6	287992	6206493	288212	6206487	-	60%	-	20	40			-	-	-	5		-	-	-	-	35	-	-	-	-	-	-
M7	288499	6206603	288575	6206400	-	55%	10	-	20			-	25	-	-		-	-	-	20	25	-	-	-	-	-	-
N7	288484	6206096	288566	6205870	-	65%	20	-	20			-	10	15	35		-	-	-	-	-	-	-	-	-	-	-
O7	288541	6205694	288489	6205446	-	70%	-	10	30			-	-	30	30		-	-	-	-	-	-	-	-	-	-	-
Cumberland Ecology (2017) spot assessment technique survey							Number of each tree species																				
1	0288250	6208250	-	-	10	33%	-	9	1	-	-	-	-	-	-	-	-	10	-	-	-	-	7	1	2	-	-
2	0288764	6208250	-	-	8	27%	3	-	-	-	-	5	-	-	-	-	9	-	-	12	-	-	-	-	-	-	1
3	0288246	6208006	-	-	18	60%	6	-	-	12	-	-	-	-	-	-	-	7	-	-	3	1	-	-	-	-	1
4	0288500	6208000	-	-	10	33%	10	-	-	-	-	-	-	-	10	5	-	1	-	-	3	-	-	-	-	-	1
5	0288749	6208000	-	-	12	40%	5	-	-	7	-	-	-	-	2	2	-	1	-	-	6	-	-	-	-	-	7
6	0289000	6208000	-	-	16	53%	3	-	-	-	2	10	1	-	-	-	-	-	-	10	4	-	-	-	-	-	-

Table B.1 Koala food tree results from surveys within Allens Creek Corridor

							Preferred Koala Food tree		Secondary Koala Food tree						Other trees												
Site ID	Easting	Northing	Easting[1]	Northing[1]	Number of Feed Trees (/30)	Percentage Koala Feed Tree (%)	*Eucalyptus punctata*	*E. tereticornis*	*E. moluccana*[2]	*E. globoidea*[2]	*E. agglomerata*[2]	*E. piperita*	*E. pilularis*	*E. longifolia*	*E. crebra*[3]	*E. fibrosa*[3]	*E. sclerophylla*	*Angophora floribunda*	*Angophora bakeri*	*Corymbia gummifera*[4]	*Allocasuarina littoralis*[5]	*Allocasuarina torulosa*[5]	*Melaleuca stypheliodes*	*Acacia parramattensis*	*Acacai decurrens*	*Exocarpus cupressiformis*	Unidentified
7	0288002	6207748	-	-	16	53%	-	4	-	12	-	-	-	-	-	-	-	13	-	-	1	-	-	-	-	-	-
8	0288250	6207750	-	-	6	20%	-	-	4	2	-	-	-	-	6	1	-	-	-	-	17	-	-	-	-	-	-
9	0288500	6207750	-	-	12	40%	-	10	2	-	-	-	-	-	-	-	-	-	-	-	18	-	-	-	-	-	-
10	0288750	6207750	-	-	24	80%	-	2	-	22	-	-	-	-	2	4	-	-	-	-	-	-	-	-	-	-	-
11	0288997	6207750	-	-	19	63%	1	-	-	-	-	2	16	-	-	-	-	1	-	6	4	-	-	-	-	-	-
12	0288000	6207500	-	-	20	67%	-	20	-	-	-	-	-	-	1	-	-	4	-	-	4	-	-	-	-	1	-
13	0288723	6207511	-	-	15	50%	1	-	-	12	-	-	2	-	-	-	-	10	-	-	5	-	-	-	-	-	-
14	0287924	6207258	-	-	24	80%	-	13	-	8	-	-	-	3	1	-	-	4	-	-	-	-	-	1	-	-	-
15	0288499	6207250	-	-	12	40%	10	-	-	2	-	-	-	-	2	-	-	2	-	-	5	7	-	-	-	-	2
16	0288500	6207000	-	-	19	63%	5	-	-	3	-	-	11	-	-	-	-	5	-	-	6	-	-	-	-	-	-
17	0288250	6206750	-	-	29	97%	-	24	-	5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
18	0288499	6206750	-	-	20	67%	15	-	-	-	-	-	5	-	-	-	-	3	-	-	6	-	-	-	-	-	1

[1]EMM spotlight survey location of transect end point.
[2]EMM spotlight survey combined “Stingybarks” *E. globoidea*, *E. moluccana* and *E. agglomerata* into one group.
[3]EMM spotlight survey combined "Ironbark" *Eucalyptus crebra* and *E. fibrosa* into one group.
[4]EMM spotlight survey only identified "Bloodwood", as such, all records have been recorded as *Corymbia gummifera*.
[5]EMM spotlight survey combined "She-oaks" *Allocasuarina littoralis* and *A. torulosa*.

Appendix C

Fire Burn Guidelines for Koala Habitat

These fire burn guidelines are an adaptation of guidelines (section 4.4) within the *Hazard reduction Burn Guidelines for Koala Habitat on the Tweed Coast* (Baker 2016), with text in italics from these guidelines

They are intended as guidance for bushfire hazard reduction burns conducted within the Allens Creek Corridor area, and for ecology burns within vegetation retained within the South East Wilton Precinct. It is noted that a South East Wilton Precinct Bushfire Management Plan will be prepared and will supersede these guidelines for fire management within that region.

C.1 Koala risk areas

Koala risk areas are those areas where:

1. *the canopy is likely to be scorched during a burn, and*
2. *koalas are present at the time of burning.*

C.2 Pre-burn treatments

Identify koala risk areas by undertaking overall fuel hazard assessments & pre-burn koala survey.

Where necessary manage risk in koala risk areas through:

- *manual fuel reduction, including raking surface fuels and trimming of elevated fuels away from the bases of active trees,*
- *wetting down around the bases of active trees prior to the burn, and/or*
- *exclusion of area from burn using containment lines or sprinkler lines*

When establishing or maintaining Asset Protection Zones (APZs):

- *preferred koala food trees should be preferentially retained.*
- *trees to be lopped or removed are to be checked for koalas prior to works. If present, the works must be postponed until the koala has moved on of its own accord.*

Treat environmental weeds which may be advantaged by the burn.

C.3 Fire interval

Burn within any recommended ecological parameters recommended for the fire vegetation group.

PCTs 1081 and 1181 are likely to align to the Dry sclerophyll shrub forest fire vegetation group with recommended fire intervals of 7 to 30 years, and PCT 1395 is likely to align to the Sclerophyll grassy woodland fire vegetation group with recommended fire intervals of 5–40 years (Bushfire Research Unit 2003).

C.4 Season and other conditions for planned fires

Season for planned fires is March–September. Burns should avoid koala breeding season (September to January).

Forest fire danger index (FFDI) ≤11 (Low - Moderate).

Good soil moisture is desirable to reduce scorch height and limit leaf drop post fire.

C.5 Fire Intensity

Avoid high intensity fires that consume or scorch tree canopies.

Within koala risk areas - low and occasionally moderate intensity, and if flame height reaches 20% of height to base of canopy fire must be suppressed.

Outside koala risk areas - low to moderate intensity fires with occasional high intensity.

C.6 Burn Tactics

The following burn tactics should be considered in koala risk areas as appropriate.

- *Test burn the site to ensure canopy will not be scorched.*
- *Avoid a running-fire toward the koala risk area.*
- *Where the koala risk area occurs in low lying areas, utilise the surrounding topography to create a low-intensity backing fire that travels down the slope towards the area.*
- *Use appropriate lighting patterns along the margin of the koala risk area, to promote a low-intensity backing fire that burns away from area; such as:*
    - *commence lighting on the leeward (smoky) edge using either spot or strip lighting or a combination of both.*
    - *commencing lighting at active trees to reduce intensity and ensure that fires burn away from active trees.*
    - *spot ignition can be used to reduce intensity of a fire in or adjacent to koala risk areas. Widely-spaced spot ignition will promote a slower-moving and more manageable fire, while spots closer together will result in a line of a greater intensity (as spots merge and create hot junction zones).*
    - *use strip ignition to draw fire away from the edge of koala risk areas. When more than one line of ignition is used it can create micro wind conditions that can draw fire away from non-target areas. It is important to have safe refuges when undertaking this type of burning.*
- *Afternoon ignition can lower burn intensity, and result in fires that trickle along the edge and generally self-extinguish in the evening, particularly during winter.*

- *Consider the use of sprinkler lines or mechanical containment lines where other burn tactics are considered insufficient.*

For all the remainder of the burn area (non-koala risk areas) a running fire of a moderate intensity may be desirable in unoccupied habitat to increase fuel reduction and stimulate regeneration.

C.7 Landscape mosaic

Proactive broad-scale management of surrounding fire-prone vegetation using mosaic burning will reduce the likelihood of wildfire encroaching koala risk areas.

Habitat areas should be burned in sections to generate and/or maintain a mosaic pattern of vegetation with areas of varying age since fire.

As mosaic burning practices become well developed, the extent and abundance of canopy scorch risk areas across the landscape should diminish because as areas of prolonged fuel accumulation are progressively treated.

C.8 Post burn

The burn area should be patrolled during and after the burn to ensure that no animals have been injured. Patrols should be carried out by suitably qualified and equipped personnel. It is also important to ensure that any injured animals are promptly treated, rehabilitated and released back into their original home range.

Avoid felling koala food trees during post-burn 'mop-up'.

Undertake treatment of environmental weeds.

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