

**Arboreal
Mammal
Management
Plan**
2023/33



Acknowledgement of Country

Wagga Wagga City Council gulbali-yanhi ngurambang-gu Wiradjuri-gu walumaldhaany-galang. nganha bala mayiny Wiradjuri. yindyamali-yanhi mudyiganggalang-bu balumbambal-bu balugirbam-bu yindyamali-yanhi bagaraygan nguarambang-gawali-i yandu muran.

wigi wagga wagga-dha ngiyanhi gulbali-bu yindyamali-bu guwiinyguliyalagu buyaa-bu giilaang-galam-bu. ngiyanhi gulbali-bu yindyamali-bu guwiinyguliyalagu dhaagun-giyalam-bu bila-galang-giyalam-bu. gulbali-yanhi Wiradjui-mayiny ngurambangguwal-bu bala yarruwala-bu waluwin-bu walabangan-bu dhirrangal-bu.

Wagga Wagga City Council acknowledges the traditional custodians of the land, the Wiradjuri people, and pays respect to Elders past, present and future and extends our respect to all First Nations Peoples in Wagga Wagga.

We recognise and respect their cultural heritage, beliefs and continuing connection with the land and rivers. We also recognise the resilience, strength and pride of the Wiradjuri and First Nations communities.



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Contributions

Council would like to thank the following organisations for their contribution to this document, these include:

- Aus Wildlife - Bruce Thomson for supplying wildlife photographs
- Biodiversity Conservation Trust
- Crown Lands
- Department Planning and Environment – Biodiversity and Conservation Division
- Mawang Gaway – in particular respected Wiradjuri/Wiradyuri Elder Aunty Dot Whyman for her assistance with the cultural facts
- Murrumbidgee Landcare Incorporated
- National Parks and Wildlife Services
- Riverina Local Land Services

Key Terms

Term	Definition
Arboreal	Referred to tree dwelling, where a species spends most of its time. An arboreal species generally uses trees to forage, sleep and move throughout the landscape
Bioregion	Geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features and plant and animal communities
Camp / Roost	Tree or place where a species will congregate with other individuals
Chenopods	Any flowering plant of the family <i>Chenopodiaceae</i>
Den sites	Safe place to seek shelter, usually within a tree hollow
EEC	Endangered Ecological Community
Forbs	Non-woody plant other than a grass, sedge or rush
Fragmentation	The process by which large contiguous habitat gets divided into smaller, isolated patches of habitat
Ha	Hectares
HBT	Hollowing Bearing Tree
Hollow depend-ent	A species that is reliant on hollows to survive
Key Threatening Process	The process that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community
Marsupial	An order of mammal of whose young are born incompletely developed and are typically carried and suckled in a pouch on the mother's belly
Mortality	The state or condition of being subject to death
Nocturnal	Active at night
Riparian	Relating to or living or located on the bank of a natural watercourse (such as a river, lake or creek)
Remnant	Vegetation existing before European settlement
SEPP	State Environmental Planning Policy
Terrestrial	Living on land
Threatened Species	A species listed under the <i>NSW Biodiversity Conservation Act 2016</i> as vulnerable, endangered, or critically endangered
Tree hollow	Cavities formed in a trunk or branch of a live or dead tree, creating shelter for arboreal species. Hollows can take up to 100-150 years to form

Introduction

Aim

Since European settlement in the 1830s more than 90% of the native vegetation cover has been cleared for agriculture and urban development (Simpson 2020). The remaining 10% exists in pockets and is threatened by over clearing, isolation, grazing, climate change, inappropriate wood collection and weed and pest invasion. Very few remnants are in good condition, with most restricted to a small number of travelling stock routes, roadsides and private land.

Extensive clearing has resulted in the loss of habitat for a number of native species within the Wagga Wagga Local Government Area (LGA). This loss of habitat has decreased populations resulting in some species identified as 'threatened' under state and commonwealth legislation.

Wagga Wagga City Council (Council) adopted the Biodiversity Strategy: Maldhangilanha in 2020 aiming to increase awareness and address a wide range of key threatening processes impacting biodiversity. The Strategy's overarching target is to increase native vegetation within the Wagga Wagga LGA by 10% by 2030.

Identified as an action within the Strategy, The Arboreal Mammal Management Plan (the Plan) aims to protect, enhance, increase target arboreal habitat, and manage Key Threatening Processes (KTPs) in the Wagga Wagga LGA, in turn increasing population numbers.

“Managing the impacts on these threatened species will also benefit other threatened species including Glossy Black Cockatoo (Calyptorhynchus lathami), Superb Parrot (Polytelis swainsonii), Swift Parrot (Lathamus discolor), Grey-crowned Babbler (Pomatostomus temporalis) and numerous other non-threatened species including the common brushtail possum, common ringtail possum and many more.

It is recognised that protecting threatened species is the responsibility of all levels of government and the community. The Plan identifies a number of stakeholders other than Council, which includes government and non-government agencies that have biodiversity, conservation and land management as a priority.

Target Species



The Plan identifies nine arboreal species that are known to occur, are expected to occur, or have previously occurred within the Wagga Wagga LGA. All nine species have been selected due to their low population numbers and threatened species status under state and commonwealth legislation. Table 1 below details the target arboreal species along with their threatened species status.

Common Name	Scientific Name	Commonwealth Status	NSW Status
Koala	<i>Phascolarctos cinereus</i>	Endangered	Endangered
Squirrel Glider	<i>Petaurus norfolcensis</i>	-	Vulnerable
Squirrel Glider in the Wagga Wagga LGA	<i>Petaurus norfolcensis</i> – endangered population	-	Endangered
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Vulnerable	Vulnerable
Microbats			
Little Pied Bat	<i>Chalinolobus picatus</i>	-	Vulnerable
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	-	Vulnerable
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	-	Vulnerable
Southern Myotis	<i>Myotis macropus</i>	-	Vulnerable
Corben's Long-eared Bat	<i>Nyctophilus corbeni</i>	Vulnerable	Vulnerable
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	-	Vulnerable

Table 1: Target arboreal species and threatened species status.

Although the Plan details only target arboreal mammals, managing these threatened species will also benefit other threatened species including Glossy Black Cockatoo, Superb Parrot, Swift Parrot, Grey-crowned Babbler and other non-threatened species including Brush-tailed Possum, Ring-tailed Possum and other woodland birds.



Wagga Wagga Landscapes

The Wagga Wagga LGA (LGA) is located on the western fall of the New South Wales (NSW) southern tables within the NSW South Western Slopes bioregion, occupying approximately 482,000 Hectares (Ha). The commercial and urban center is located roughly in the center of the LGA on the banks of the Murrumbidgee River, which winds through Wagga Wagga in an east-west direction (Priday. S and Mulvaney M 2005).

Terrestrial

Wagga Wagga varies from moderately tall, open forest in the higher rainfall areas of southeast which share many elements with open forest communities of the southern tablelands, to sparsely timbered woodlands with a ground cover of grasses, chenopods and forbs in the lower rainfall areas of the far west (Priday. S and Mulvaney M 2005).

In the slightly higher rainfall eastern hill country, woodland and open grassy woodlands of White Box (*Eucalyptus albens*) are dominant. To the west these give way to vegetation communities dominated by Grey Box (*Eucalyptus microcarpa*), Yellow Box (*Eucalyptus melliodora*), Blakely's Red Gum (*Eucalyptus blakelyi*) and White Cypress Pine (*Callitris glaucophylla*). Other tree species characteristic of the bioregion includes Red Stringybark (*Eucalyptus macrorhynca*) on higher slopes, with Black Cypress Pine (*Callitris endlicheri*), Kurrajong (*Brachychiton populneus*) and Red Ironbark (*Eucalyptus sideroxylon*) occupying the lower slopes. Valley flats and riparian areas are dominated by River She-oak (*Casuarina cunninghamiana*) and River Red Gum (*Eucalyptus camaldulensis*) (Priday. S and Mulvaney M 2005).

Vegetation Communities

The Wagga Wagga LGA hosts 22 native vegetation communities, occupying an area of approximately 61,188 Ha. The listed vegetation communities include remnant vegetation, mature vegetation as well as recent plantings. Each vegetation community type provides various habitat for the native species including feeding, shelter and breeding habitat. Figure 1 details the classification of each community type and its location within the Wagga Wagga LGA.



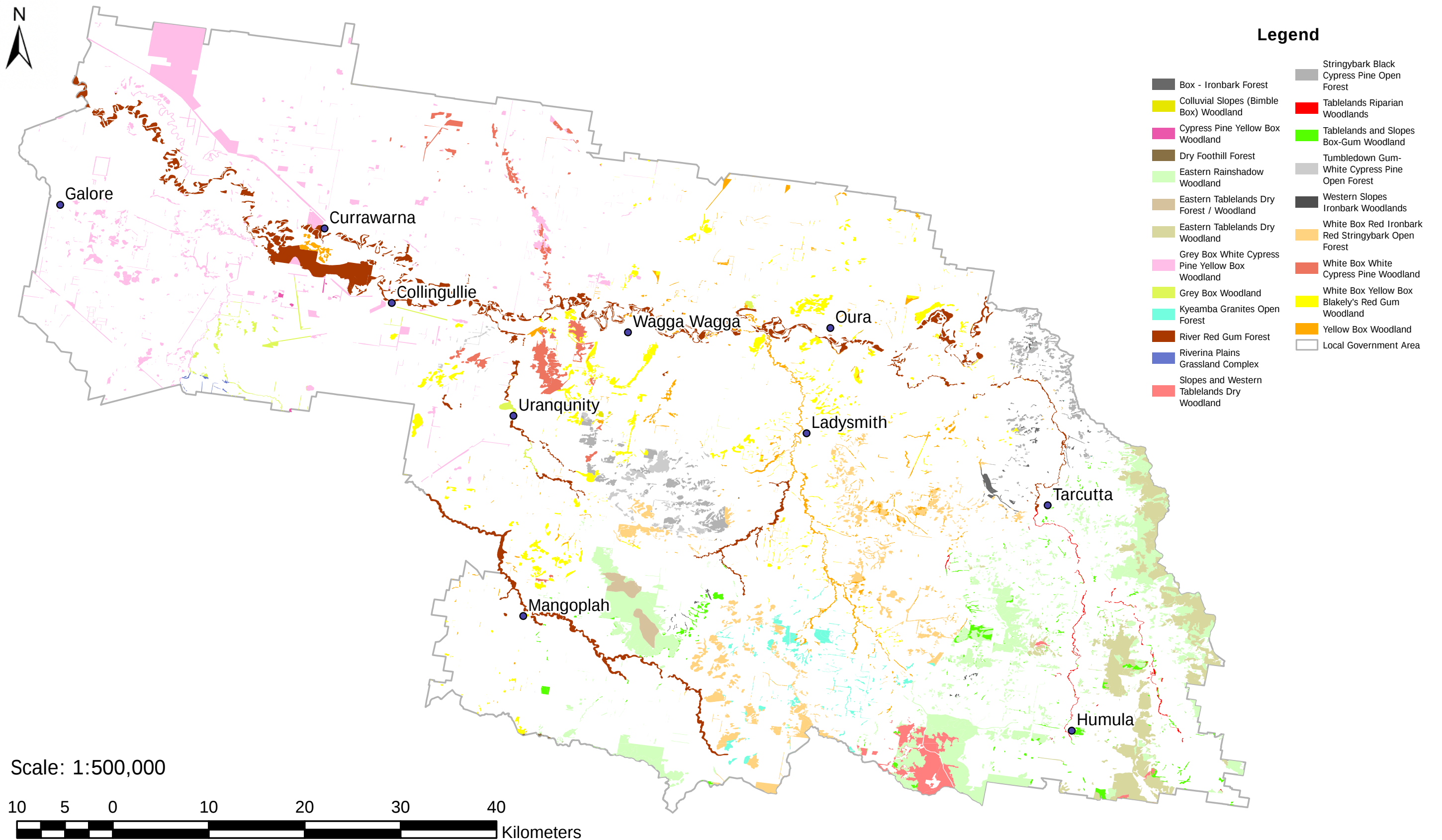


Figure 1: Vegetation Communities of the Wagga Wagga LGA (Data sourced from Seed Portal)

Significant Areas

More vegetation has been cleared from this bioregion than any other in NSW, with less than 10% of remnant vegetation remaining. Due to historic and current clearing practices, the Wagga Wagga LGA has limited remnant vegetation that provides significant hollow habitat required for the target arboreal species (Priday. S and Mulvaney M 2005).

As a result, the Wagga Wagga LGA has a total of five Endangered Ecological Communities (EEC) currently listed under state and commonwealth legislation, detailed within Table 2. Status listing includes E- Endangered and CE – Critically Endangered.

Endangered Ecological Communities

State Community Name	Commonwealth Community Name	State Status	Comm. Status
Grey Box (<i>Eucalyptus macrocarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	E	E
Weeping Myall Woodlands	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	E	E
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions	CE	CE
Aquatic Ecological Community of the Lower Murray River	-	E	-
Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	-	E	-

Table 2: Endangered Ecological Communities within the Wagga Wagga LGA

With the majority of the remnant vegetation cleared from the Riverina, the remaining 10% exists in highly fragmented patches and is threatened by over clearing, isolation, grazing, climate change, weed and pest invasion. These significant vegetated areas are located along roadside reserves, traveling stock reserves, conservation areas, reserves, and private land, with Council only managing a small portion of these remnant locations.

The vast majority of the Wagga Wagga LGA is privately owned with 95% zoned as rural land and less than 1%% zoned for environmental protection to help ensure protection against development (C1: National Parks and Nature Reserve and C2: Environmental Conservation).

Community Engagement

Community engagement is a critical conservation tool in terms of threatened species conservation. Most threatened species are found on privately owned or managed land rather than in national parks and conservation areas. Many conservation activities are based

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on a required change in human behaviour, therefore community based natural resource management activities are becoming a significant factor in management and conservation plans.

Working and engaging with the local community to promote conservation is a great way to build relationships, to gather data and monitor changes, improve habitat and also provide potential opportunities to improve assets through various on-ground natural resource management activities.

This small portion of government owned or managed land that provides habitat for the target species includes the following significant areas:

- Birramal Conservation Area
- Livingstone National Park
- Marrambidya Wetland and Wiradjuri Reserve
- Mates Gully Traveling Stock Reserve
- Murrumbidgee Valley National Park (Berry Jerry)
- Pomingarlarna Reserve
- Silvalite Reserve
- Tarcutta Hills Reserve
- Wilks Park
- Willans Hill
- Wiradjuri Reserve

A full description of each site is detailed within Appendix 1: Significant Areas.

These significant areas are a mix of public reserves, conservation areas, wetlands and lagoons, National Parks, ridgelines and riparian areas that are greater than 20 hectares in size. These habitats provide arboreal mammal species with the resources to feed, breed and move throughout the Wagga Wagga LGA. Locations of these areas are shown in Figure 2 below.

*95% of the
Wagga Wagga
LGA is privately
owned rural land*

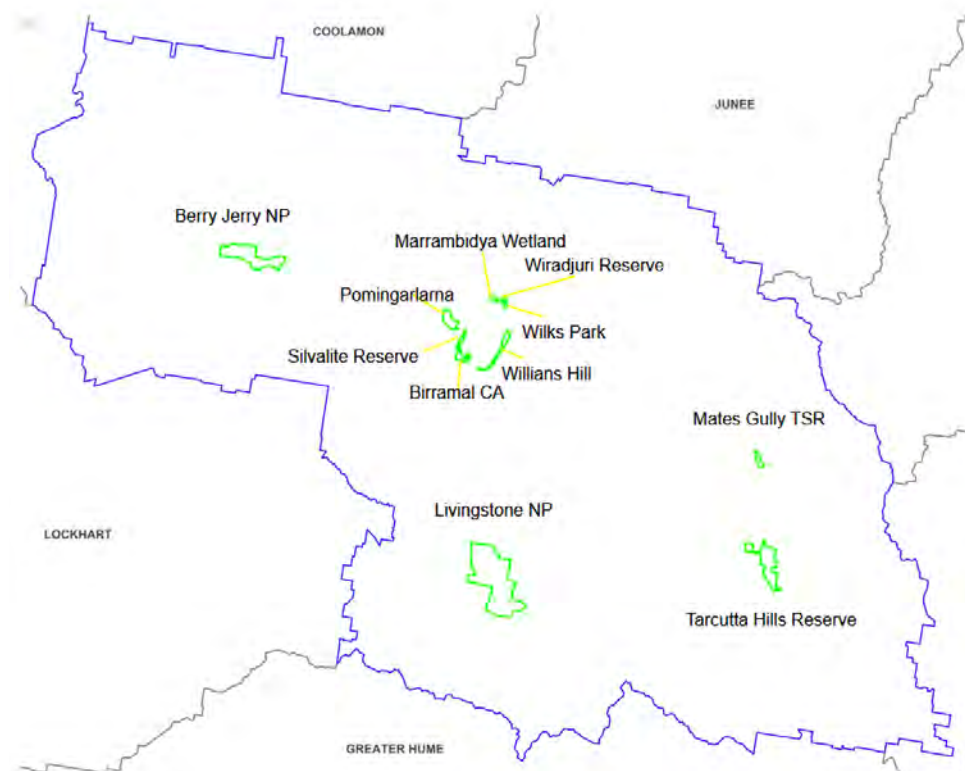


Figure 2: Location of Significant Areas

Riparian Landscapes

The Murrumbidgee River is the most prominent water course in the Wagga Wagga LGA. It provides the city centre with numerous recreational opportunities and is an important source of irrigation for various types of agricultural activities in the Riverina district. It also provides significant riparian vegetation that provides resources for our native wildlife.

As well as the Murrumbidgee River, the Wagga Wagga LGA has a number of other prominent water bodies, including:

- Bomen Lagoon
- Crooked Creek
- Flowerdale Lagoon
- Kyeamba Creek
- Lake Albert
- Marrambidya Wetland
- Stringybark Creek
- Tarcutta Creek
- Wollundry Lagoon
- Many other streams, creeks and wetlands

These water bodies (even those that do not permanently hold water) represent important riparian habitat for arboreal mammal species by providing foraging, shelter habitat and water resources. These waterbodies also act as wildlife corridors that enable the species to move throughout the LGA safely. Figure 3 details key water sources within the Wagga Wagga LGA.

The Wiradjuri/Wiradyuri community have a deep connection to the Murrumbidgee River, also known as Bila Marrambidya. For thousands of years, Bila Marrambidya provided a rich source of sustenance for the Wiradjuri/Wiradyuri community, through an abundance of fish, crayfish, and mussels. Fish were managed in tune with the rise and fall of flood waters in the billabongs like Wollundry Lagoon, Parken Pregar and Old Man Creek with the use of fish baulks (fish traps) (Go Green Services 2003).

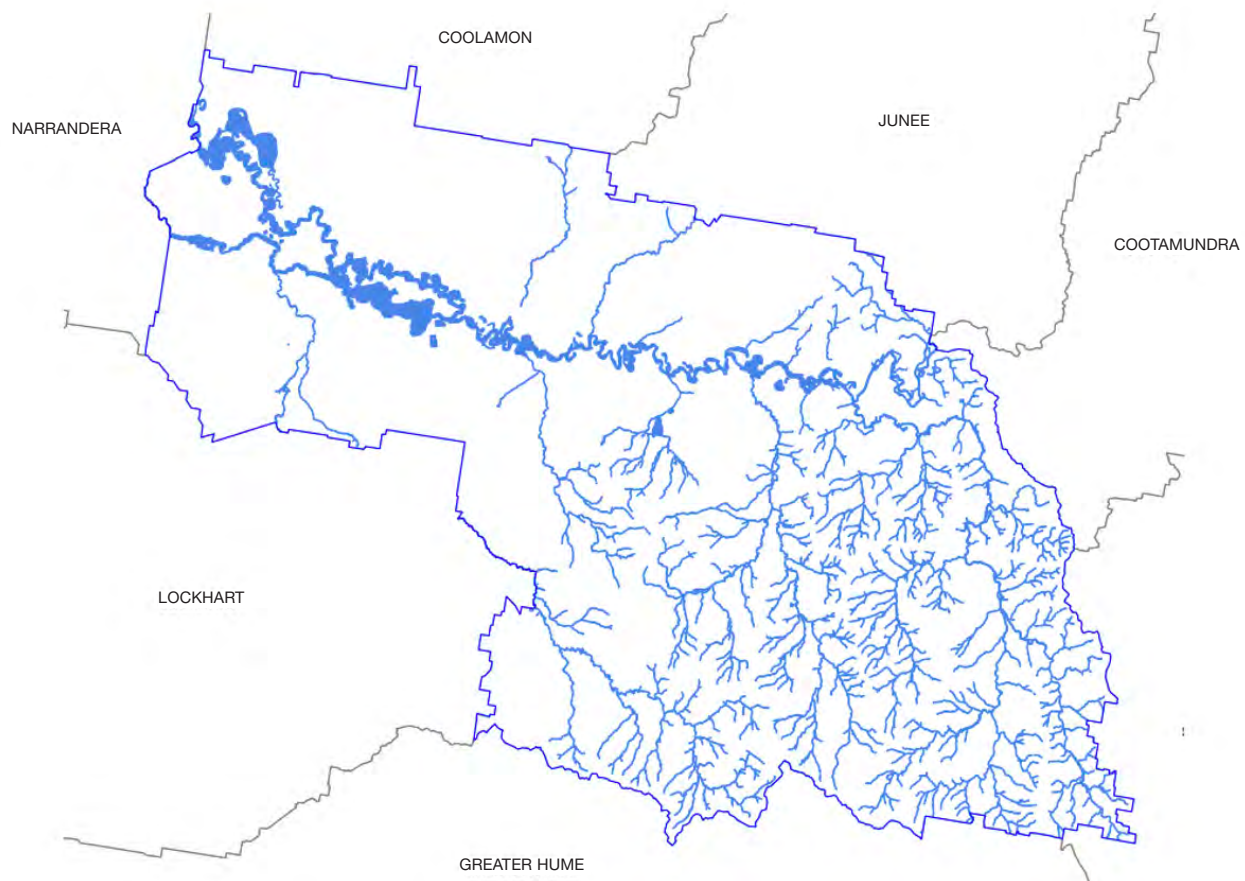


Figure 3: Key water sources within the Wagga Wagga LGA

Key Requirements

Hollow Bearing Trees

Tree hollows are cavities formed in the trunk or branch of a live or dead tree, formed as a result of wind breakage, lightning strikes, fire, termite, insect or fungal attacks which cause the branch/es to fall and create a hollow. Trees with hollows are given the term hollow bearing trees (HBTs) or habitat trees. (Office of Environment & Heritage 2020).

Hollows are a characteristic of older, mature or dead trees as it can take up to 100-150 years for a hollow to form. The presence, abundance and size of hollows is positively correlated with tree trunk diameter, which is an index of age. Hollows with large internal dimensions are the rarest and occur predominately in large old trees, which are rarely less than 200 years old (Office of Environment & Heritage 2020).

The distribution of HBTs depends on tree species composition, site conditions, competition, tree health and past management activities. Undisturbed woodlands typically contain 7-17 HBTs per hectare (Office of Environment & Heritage 2020).

Hollows vary in size, cavity opening diameter, cavity depth, cavity volume and position. This helps ensure a range of diverse hollows are available to cater for special ecological requirements of all species. Mature trees also provide more flowers, nectar, fruit and seeds than younger trees providing other valuable resources (Office of Environment & Heritage 2020).

In agricultural landscapes HBTs typically occur as isolated mature individual trees, in cleared paddocks or in small, fragmented vegetation remnants. Such trees often suffer from poor health and have a shorter lifespan than forested landscapes. These HBTs are significant in an agricultural environment as they may provide the only available shelter and breeding resource within the vicinity (Office of Environment & Heritage 2020).

HBTs are critically important for a range of animals, with 179 animal species occurring in NSW forests considered hollow dependent. Due to past and present clearing practices, it is crucial for the survival of hollow dependent fauna to retain HBTs within the landscape or they cannot breed.

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Connectivity

Fragmentation is the process by which previously continuous areas of habitat are separated into a number of smaller areas. This creates small, isolated populations with limited gene flow between populations, leading to inbreeding issues, reduced potential to adapt to environmental change and reduced resilience to climate change (Department of Infrastructure, Planning and Natural Resources 2004).

To connect these isolated areas of vegetation, wildlife corridors are used. Wildlife corridors are critical for the maintenance of ecological processes including allowing for the movement of animals and the continuation of viable populations (Department of Infrastructure, Planning and Natural Resources 2004).

Providing landscape connections between larger areas of habitat enables migration, colonisation and positive interbreeding (gene flow) of plants and animals. Wildlife corridors can consist of stepping stones across the landscape (paddock trees, wetlands and roadside vegetation), continuous lineal strips of vegetation and habitat (such as riparian strips, ridgelines and roadside vegetation), or they may be part of a larger habitat area selected for its known or likely importance to local fauna (Department of Infrastructure, Planning and Natural Resources 2004).

Figure 4 illustrates how private plantings (green dotted lines) and vegetation along creek lines (blue dotted lines) can link together to provide connectivity of larger areas of habitat, enabling fauna to move throughout the landscape. Although the area appears to have a high number of trees, they are not fully connected, so species like the Squirrel Glider who typically glide between 20-40m and require continuous connected vegetation cannot move far to forage and breed. Corridors of at least 30m in width are needed to connect habitats.

It is important to note that wildlife corridors are used for connectivity and are rarely used to support a healthy population because most animals require larger areas of vegetation.

While planting native vegetation for wildlife corridors is important, it is also critically important to plant larger areas of vegetation to support these significant populations.

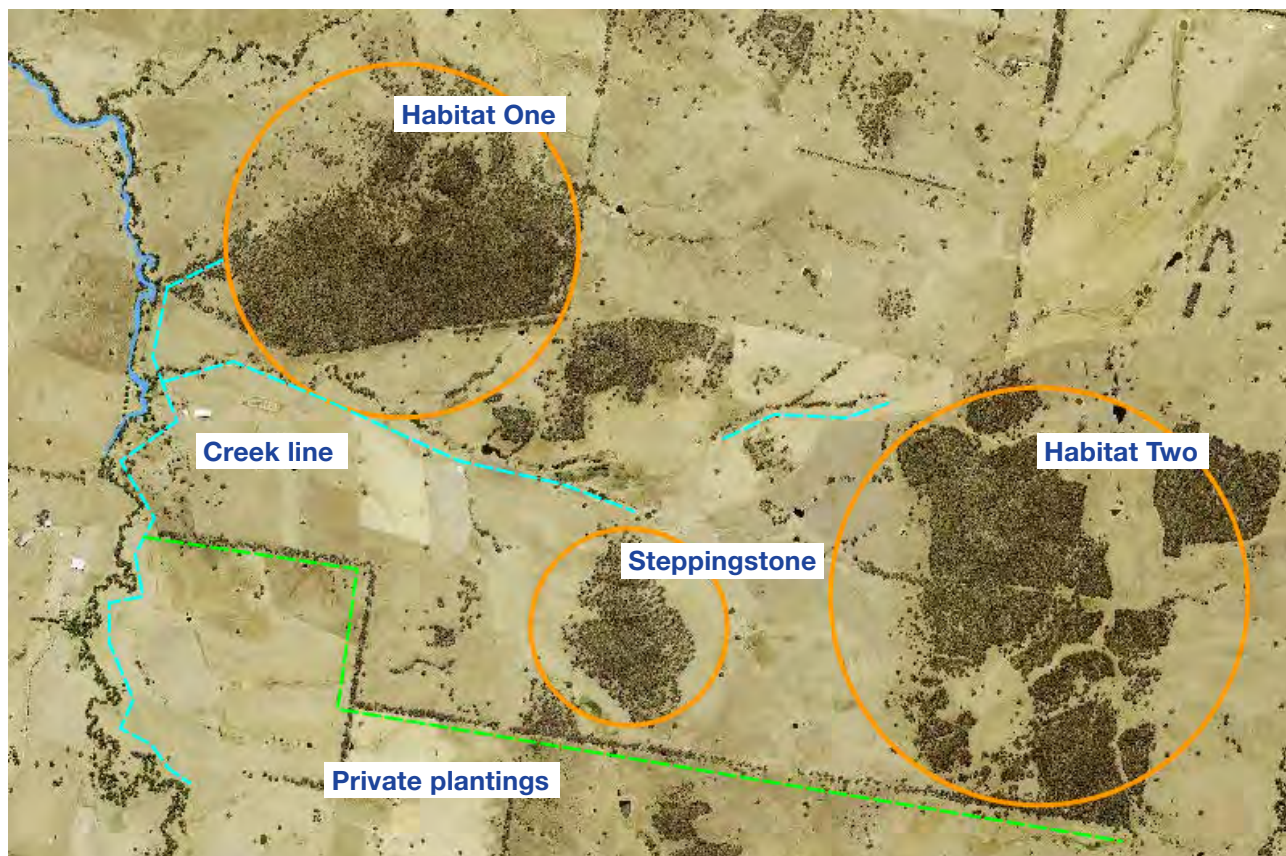


Figure 4: Types of wildlife corridors and how they connect patches of habitat.

Foraging Habitat

Foraging habitat is a key requirement for native wildlife as it provides a food resource for the species to feed on. Different layers in native vegetation provide different types of foraging habitat. Some species search for food in the canopy foliage, on tree trunks and branches, in shrubs and groundcovers or the insects that inhabit this vegetation.

Rural plantings for wind breaks and shelter belts generally consist of limited species selection, containing one vegetation layer. This limits potential foraging habitat for not only arboreal mammal species but others including woodland birds, ground dwelling mammals and reptiles.

Arboreal Mammal species generally have a diet that relies on a selection of eucalyptus leaves, pollen, flowers and fruits as well as tree sap and insects. Providing multi layered vegetation from ground covers, mid storey shrubs and canopy cover from larger trees increases the variety of available foraging habitat. This ensures the species have a reliable food source year-round and can control insect outbreaks.

Species Profiles

Species occurrence data plays a significance role in improving and enhancing biodiversity outcomes within NSW. Data is used to determine species distribution and track any changes to their movements. These changes are used to determine impacts that may be affecting their habitat or breeding cycles.

Image: Chloe Smith



Species Profiles

Species Occurrence Data

Species occurrence data plays a significance role in improving and enhancing biodiversity outcomes within NSW. Data is used to determine species distribution and track any changes to their movements. These changes are used to determine impacts that may be affecting their habitat or breeding cycles.

There are a number of databases used to determine occurrence of species within NSW. Professionals and community members are able to record their sightings, which are then uploaded to the database. As there are a number of databases, not all records are uploaded to the same databases, but often spread across multiple platforms.

Databases used for the Arboreal Mammal Management Plan are NSW BioNet Atlas and Atlas of Living Australia. NSW BioNet Atlas is the repository for biodiversity data and is managed by the Department of Planning and Environment. The Atlas of Living Australia is a collaborative, digital, open infrastructure that pulls together Australian biodiversity data from multiple sources.

It is important to acknowledge the limitations of species occurrence databases, as they rely on actual sightings of the species. Some species are not readily identified by sight, requiring specialised recording devices, or expert knowledge. The majority of these records are sighted on public or easily accessible land as seeking permission to enter private property can be difficult.

Databases do not usually reflect the true occurrence of a species, as the species could occur on land that has not been surveyed or where sightings are unrecorded.

Therefore, the species records detailed within this document doesn't necessarily represent the true species occurrence.

Suitability Mapping Data

Suitability mapping in this Plan was developed using the NSW Planning and Environment State Vegetation Mapping sourced from the NSW Seed Portal. This vegetation was then edited to show suitable vegetation communities for each species. The suitability mapping does not take into consideration the quality of vegetation communities, only the presence.

Koala (*Phascolarctos cinereus*)

barrandhang • gurabaan • naagun • ginaagun



Description

The iconic Australian species is predominately grey in colour, has large furry ears, a black nose, and an absent tail. The Koala has a particularly hard bottom that enables them to wedge comfortably in tree forks for long periods. The Koala has long sharp claws adapted for climbing, where it spends most of its time. Adult males weigh between 6-12 kg with females weighing 5-8kg (Office of Environment and Heritage 2022).

Koalas are a type of mammal called marsupials that give birth to an undeveloped young which are then raised in the mothers pouch. The closest relative to the Koala is the Wombat sharing a number of characteristics including a backward-facing pouch (NSW Department of Planning and Environment 2022).

Cultural Fact

For some First Nations Peoples, the hunting and eating of Koalas was forbidden due to their spiritual significance, describing importance in the supply and safeguard of water, and encouraging protection over consumption.

Distribution

The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to South Australia. In NSW, Koala populations are predominantly found on the central and north coast, southern highlands, southern and northern tablelands, Blue Mountains, southern coastal forests, with smaller populations on the plains west of the Great Dividing Range (Office of Environment and Heritage 2022).

Habitat and Ecology

The Koala inhabits eucalypt woodlands and forests, feeding on more than 70 species of eucalypts and 30 non eucalypt species, with preferred species in different locations (Office of Environment and Heritage 2022). The State Environmental Planning Policy (Koala Habitat Protection) 2021 identifies 22 eucalypt species and one non-eucalypt feed tree species that commonly occur within the Wagga Wagga LGA, meaning that our area is considered to be suitable Koala habitat.

Inactive for most of the day, feeding and moving is done at night, where the Koala will spend most of the time in trees. Eucalyptus leaves contain many toxic compounds, which most animals cannot eat. Koalas have specialised digestive systems that enables them to break down the toxic oils. This process requires a large amount of energy, leaving the Koala with low energy levels allowing them to sleep up to 20 hours a day (Office of Environment and Heritage 2022).

The home range of a Koala will differ with quality of habitat, ranging from a few hectares to several hundred hectares if tree cover is continuous. Population densities are usually less than 1 Koala per hectare but can also vary greatly (Advice to the Minister for the Environment and Heritage from the Threatened Species 2006). Generally solitary, Koalas have complex social hierarchies based on a dominant male with a territory overlapping several females and subordinate males on the periphery. On average Koalas live for 10-12 years in the wild, with females living longer. (Office of Environment and Heritage 2022)

Females breed at two years of age and produce one young per year. The gestation period of a female Koala is 35 days, after which she gives birth to a single joey. Birth usually takes place between November and February. The young stays in the mother's pouch for the next

six months before emerging for the first time. The joey will then spend between 6-12 months riding on its mother's back. When the young Koala is about one year old, its mother is able to mate again (Office of Environment and Heritage 2022).

Often, young male Koalas will be driven off by older males. To survive, they must find a suitable area which is not occupied by other dominant male Koalas. With their limited mobility and fragmented habitat, it becomes very difficult for young males to survive and find new territory (Office of Environment and Heritage 2022).

Wagga Wagga Population

A healthy Koala population has been absent from the Wagga Wagga LGA for a number of decades, however isolated sightings have been recorded as recently as 2004. The Koala's decline within the Riverina is believed to be due to practices following European settlement that resulted in loss and fragmentation of suitable habitat and predation from exotic species such as foxes and dogs. Figure 5 shows scattered Koala recording across the Wagga Wagga LGA dating back to 1964.

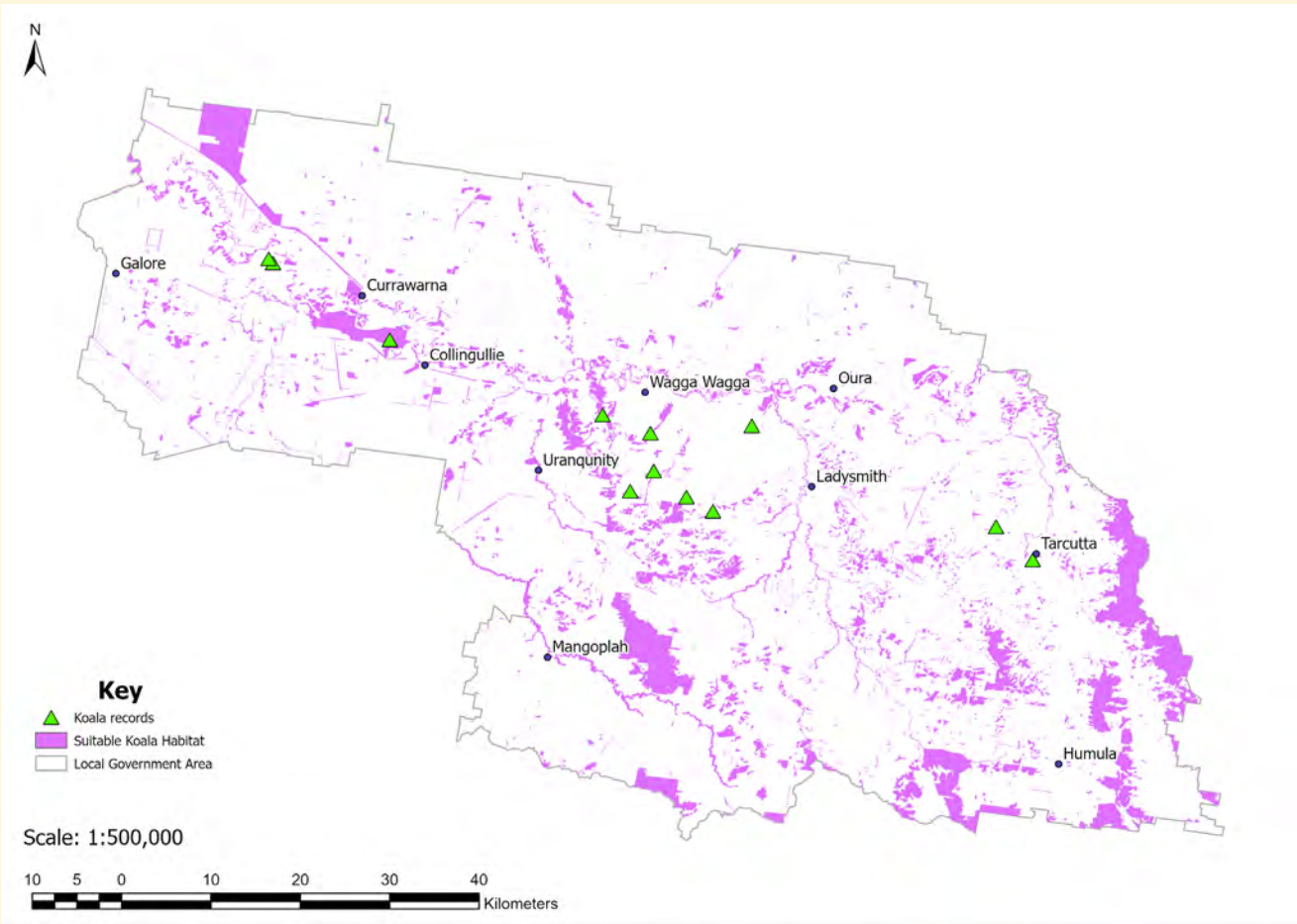


Figure 5: Scattered Koala records and suitable habitat within the Wagga Wagga LGA (Bio Atlas and Seed Portal)

Suitable Habitat

Although Koalas have not been recorded within the Wagga Wagga LGA since 2004, there are a number of areas that have been identified as suitable habitat. Figure 5 details suitable habitat across the Wagga Wagga LGA shown in purple. The suitable habitat occupies approximately 57,714 Ha of the Wagga Wagga LGA.

In addition to this mapping the NSW Koala Strategy developed a Koala Habitat Suitability Model, classifying the probability of the suitable habitat. The mapping indicates the Wagga Wagga LGA's north-western corner as moderate and the south-eastern corner has a moderate to high probability of suitable habitat in comparison to the state as a whole.

As shown in Figure 6, the majority of suitable habitat is within Primary Production and Rural landscape landuse zones, indicating these areas are privately owned and most likely used for farming purposes. Only 6% of land that is 'suitable habitat' is zoned for conservation purposes.

Suitable Koala habitat occurring within the LEP zones

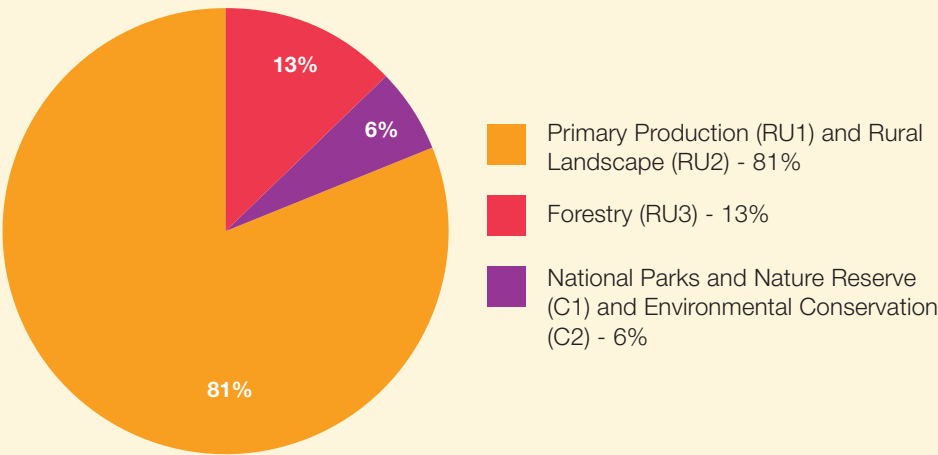


Figure 6: Suitable Koala habitat occurring within LEP zones

Narrandera Population

A translocated Koala population was established in Narrandera, approximately 100km west of Wagga Wagga in 1972. Three females and one male were translocated first, with a further 19 adults over the next 25 years. This population has survived with the current population numbers at approximately 200 individuals (Narrandera Visitor Information Centre 22).

The Narrandera population is within the Koala Reserve located on the banks of the Murrumbidgee River, occupying approximately 45 Ha with vegetated areas extending up and down the river. The Koala Reserve consists of:

- River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW, and
- River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.

The Narrandera Koala Reserve is approximately 70km from Berry Jerry National Park in the Wagga Wagga LGA, which is considered one of the suitable Koala habitats in the Wagga Wagga LGA.

Threats

The Koala has suffered a dramatic decline in numbers and distribution since European settlement in the 1800s. Surveys in NSW indicate that since 1949, populations of Koalas have been lost from many localities, with most populations in NSW living within fragmented and isolated locations (NSW Department of Planning and Environment 2022).

Habitat loss, modification and fragmentation is a significant threat to the Koala population. Poorly planned clearing has left habitats divided and isolated, which increases pressure on already limited resources such as shelter and feed tree species. This also forces Koalas to seek resources in other parts of the landscape. This may require dangerous behaviour such as crossing roads, that can lead to injury or fatality.

Remaining Koala habitat is often in close proximity to urban areas. Although Koalas spend most of their time in trees, there are instances where they are required to walk on the ground. This increases their risk of predation from foxes, wild dogs and domestic dogs causing injury and/or fatality (Queensland Government 2021).

Another significant threat is Chlamydia, which is a highly infectious bacterial disease that is sexually transmitted. The infection weakens the immune system and can cause blindness and reproductive tract disease which may render a female infertile. As the infection weakens the system, the risk of other threats including predation and severe weather conditions increases the likelihood of mortality. (NSW Department of Planning and Environment 2022).

In 2022 the Koala's Commonwealth Conservation status was upgraded from Vulnerable to Endangered, largely due to recent bushfires that caused further habitat loss, and at least 5,000 individuals killed in the 2019-2020 bushfires. A NSW Parliamentary inquiry reported climate change is severely impacting Koalas and their habitat by exacerbating the impact of other threats such as bushfires and drought (Portfolio Committee No. 7 – Planning and 2020). The inquiry reported an estimated 24% of Koala habitat on public land has been severely impacted across the State, but in some parts, there have been a devastating loss of up to 81% and without urgent government intervention the Koala will become extinct by 2050 (Portfolio Committee No. 7 – Planning and 2020).

Response Action

Federal Action

The Federal Government has developed the National Recovery Plan for the Koala. The document identifies national level strategic actions that aligns with State and Territory planning, programs and strategies. The draft document identifies three key objectives including:

- **Objective 1a:** The area of occupancy and size of populations that are declining, suspected to be declining and predicted to decline are increased
- **Objective 1b:** The area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased
- **Objective 2:** Metapopulation processes are maintained or improved
- **Objective 3:** Communities and individuals have a greater role and capability in Koala conservation and management

The three objectives of this recovery plan are underpinned by four supporting strategies and two on-ground (direct) strategies, or action areas, as a way of organising and implementing coordinated action:

Species Profile: Koala

- **Strategy 1:** Build and share knowledge
- **Strategy 2:** Engage and partner with the community in listed Koala conservation
- **Strategy 3:** Increase the area of protected habitat for the listed Koala
- **Strategy 4:** Integrate listed Koala conservation into policy, statutory and land use plans
- **Strategy 5:** Strategically restore listed Koala habitat
- **Strategy 6:** Actively manage listed Koala metapopulations

State Action

In 2020 the NSW Parliamentary inquiry identified 16 findings and 42 recommendations, in response the State Government has developed the NSW Koala Strategy (2021-2026), which will focus targeted conservation efforts and investment where they will deliver the most effective outcomes. The strategy will build on initial investment under the previous NSW Koala Strategy (2018-2021) and will set an ambitious, long-term agenda for doubling Koala numbers by 2050.

The NSW Koala Strategy will deliver targeted investment and action under 4 pillars. These actions work together to secure habitat, support local conservation, reduce threats, and improve knowledge. Investment and key targets under each pillar include:

- **Pillar 1** – Koala habitat conservation, funding the protection, restoration, and improve management of 47,000 Ha of Koala habitat
- **Pillar 2** – Supporting local communities to conserve Koala habitat
- **Pillar 3** – Improving the safety and health of Koalas by removing threats, improving health and rehabilitation, and establishing a translocation program.
- **Pillar 4** – Building our knowledge of Koalas by filling the knowledge gaps and gain better understanding of NSW Koala populations.

Under the NSW Koala Strategy, the state government is improving knowledge of Koalas through priority research by developing the NSW Research Plan. The NSW Koala Research Plan sets out a targeted and coordinated way to increase knowledge of Koalas. It identifies and prioritises key knowledge gaps – a key knowledge gap is one that, as a result of being addressed through research, will likely increase the effectiveness of Koala conservation actions and/or their likelihood of implementation.

The Arboreal Mammal Management Plan aims to incorporate these actions within its own objectives and actions, which are detailed within the Management section of this document.

Translocation

Translocation is the intentional, human mediated movement of living organisms from one location to another. This includes reintroduction of captive bred animals or plants into natural environments or the relocation of individuals between naturally occurring populations (Department of Planning, Industry and Environment 2019).

The purpose of translocating Koalas has evolved over the decades as the conservation status of species has changed. Originally, the sole purpose was to create island safe havens known as marooning, for what was then considered to be a seriously threatened species. Once island populations had been established, the purpose changed to a reintroduction program. Since the mid-1980s, the aims of Koala translocation have been to yield a measurable conservation benefit to the flora and fauna community being degraded by an overabundance of Koalas, and to reduce the suffering of affected Koalas due to food shortage and other stressors associated with high population densities (Menkhost 2017).

In Victoria, translocation has been an important component of Koala management for more than 90 years. In that time, some 40,000 individual Koalas have been captured,

Fun Fact

Koalas can sleep up to 20 hours a day, due to their low energy diet and the intense amount of energy required to break down toxic leaves.

transported and released at an unfamiliar location and often into a novel vegetation community. Despite the decades-long history of Koala translocation in southern Australia, only seven studies document the outcomes of Koala translocation (Menkhost 2017).

Each Koala translocation project methodology is different. Generally, a koala translocation project will source individual Koalas from an overabundant population and translocate them to a site with an existing Koala population. However, projects can consist of translocating Koalas to an area without an existing Koala population like the Narrandera population (Menkhost 2017).

Potential Wagga Translocation Project

The NSW Koala Strategy identifies up to eight translocation projects will be implemented throughout NSW. NSW National Parks and Wildlife Services will be implementing these projects, with the help of local councils and First Nations Peoples and community members.

Within the Wagga Wagga LGA, the Murrumbidgee Valley National Park (Berry Jerry Precinct) is one potential site that could accommodate habitat requirements that is not privately owned. Berry Jerry is located along the Sturt Highway, approximately 30km west from the city centre.

Berry Jerry is 1,020 Ha in size and consists of River Red Gum tall open forest on inner floodplain, with a permanent water source that runs across the reserve, known as Beavers Creek. Located to the north of Berry Jerry is the Murrumbidgee River that feeds Beavers Creek from the east. This allows future movement throughout the Wagga Wagga LGA via the river corridor. The site is categorised as 'moderately suitable' according to the NSW Koala Habitat Information base. NPWS will be considering investigating the site as part of various site investigations across NSW to determine a final eight translocation sites.



Squirrel Glider (*Petaurus norfolcensis*)

niyambaa • yandhang • bangu

Photo credit: Chris Coombes



Description

The Squirrel Glider is a nocturnal marsupial that is blue-grey in colour, with a distinctive black stripe between the eyes that extends down to the lower back. It has a large dark bushy tail that averages 27cm. As the name suggests there is a membrane between the front and back limbs that enables them to glide through the air from tree to tree (Office of Environment and Heritage 2017).

Distribution

The Squirrel Glider occurs throughout eastern Australian from northern Queensland to western Victoria, however, is sparsely distributed throughout these areas. The Squirrel Glider inhabits mature or old growth Box, Box-Iron woodlands and River Red Gum Forest west of the Great Dividing Range and Blackbutt-Bloodwood Forest with heath understory in coastal areas. The Squirrel Glider prefers wet and dry sclerophyll forests and woodlands, with the most common vegetation areas characterised by one or more species of iron bark eucalyptus (Australian Museum 2020).

Cultural Fact

Squirrel Glider and Possum fur was used as cloaks for warmth, baby carriers and coverings at night.

Habitat and Ecology

Squirrel Gliders will spend the majority of their time within trees and can typically glide up to 20-40 meters, moving up to 1km in a night. Being able to glide allows them to minimise their time spent on the ground avoiding potential predators, such as foxes and cats (Murray Local Land Services 2017). They move along branches in small bounds and have been known to freeze or hide when detected by a spotlight (Australian Museum 2020).

They are reliant on hollow bearing trees where they shelter during the day and come out to feed at night. These hollows are referred to as den trees/sites. Squirrel Gliders use a variety of den sites in different parts of their territory and have been recorded using hollows in 19 different trees in a season. They often use den sites close to where they are feeding, typically within 300 metres (Murray Local Land Services 2017).

The Squirrel Glider has a home range of 0.7-12 Ha where it forms a strong connection. If clearing does affect the area, gliders are known to stay within the affected area and not move to other suitable vegetation. Den trees are often found in areas with remnant vegetation such as forests, creek lines and along roadsides (Murray Local Land Services 2017). Squirrel Gliders will commonly select hollows with tight-fitting entrances to prevent entry from potential predators.

Their diet varies seasonally and consists of Acacia gum, eucalyptus sap, nectar, honeydew and manna with insects and pollen, providing them with protein. Insects include caterpillars, cicadas and beetles. Squirrel Gliders may play an important role in controlling outbreaks of insect pests, which attack eucalyptus leaves. When eucalypt nectar is scarce, sap from Acacia species such as Silver Wattle (*Acacia dealbata*) and Golden Wattle (*Acacia pycnantha*) are favoured by the species (Murray Local Land Services 2017).

Squirrel Gliders do not like to venture far to find vital resources that they require to survive. In areas where habitat is poor and vegetation is sparse, gliders may be forced to move large distances and take greater risk to find the resources they need (Murray Local Land Services 2017).

Squirrel Gliders live in family groups of a single male, one or more adult females and offspring. Typically living between 3-5 years, breeding usually begins in August with each female producing two young. The young newborns will remain in the pouch for approximately 70 days, where they consume milk from the mother's teat. After this period, they will leave the pouch and enter the nesting hollow, where they forage for food with the adults. By four months of age, the young are ready to leave the nest and establish their own territories (Australian Museum 2020).

Members of the same social group are often marked with a scent by the dominant male in the group, who also mark certain points within the territory. This marking establishes territories that the group will defend from neighbouring groups to prevent them from using important resources (Murray Local Land Services 2017).

Squirrel Glider vs Sugar Glider

Squirrel Gliders are commonly mistaken for Sugar Gliders because they have similar markings; however, the Squirrel Glider is twice the size, and their facial markings are more distinct. Their tails are also fuller, making it harder to determine where their body ends, and their tail begins (Office of Environment and Heritage 2017).



Image: Squirrel Glider
Australiannature.com © Pavel German



Image: Sugar Glider
Australiannature.com © Pavel German

Species Profile:
Squirrel Glider

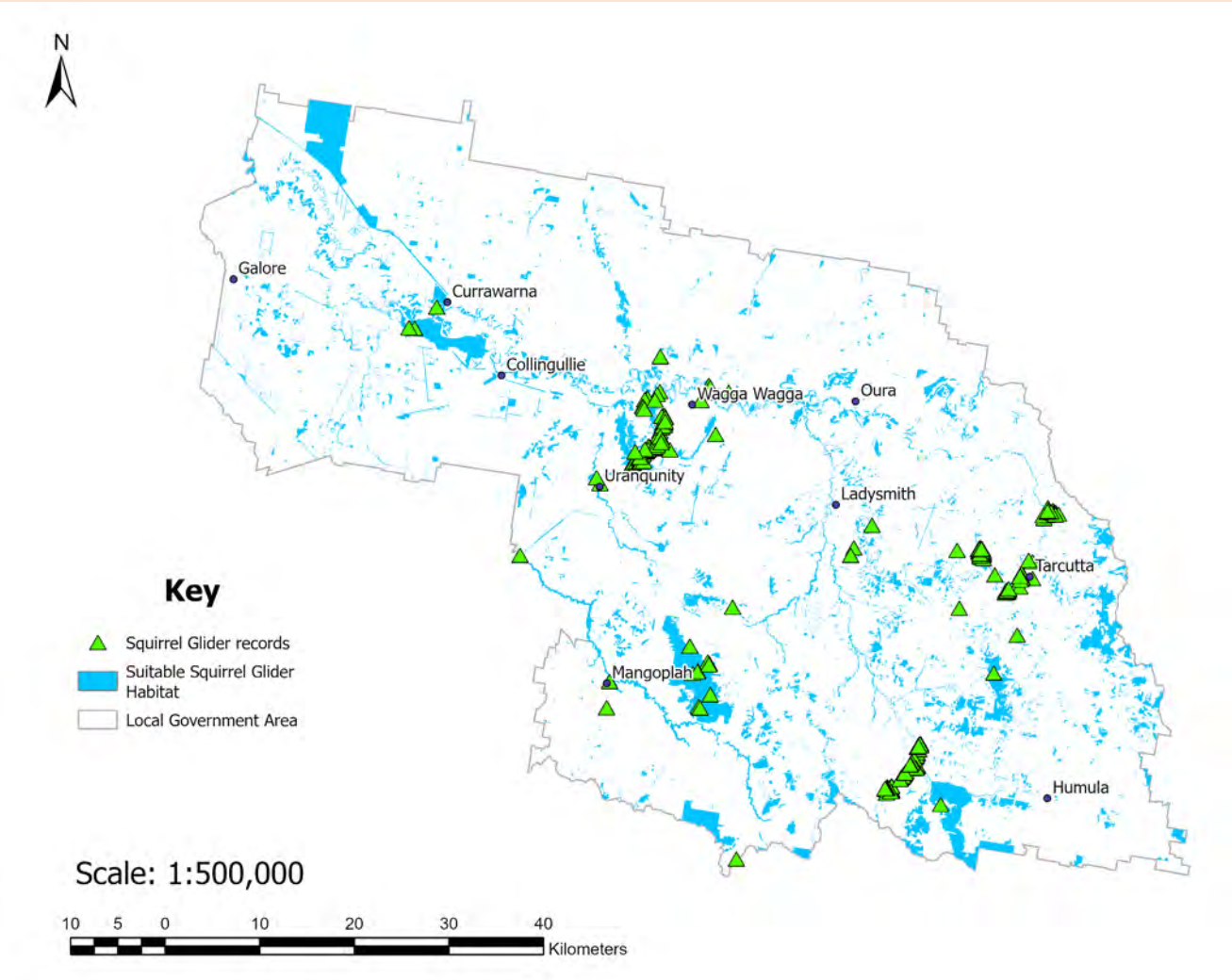


Figure 7: Squirrel Glider sighting records and suitable habitat within the Wagga Wagga LGA (Bionet Atlas and Seed Portal)

Wagga Wagga Population

Between 2003 and 2022 there have been 525 recorded sightings of Squirrel Gliders within the Wagga Wagga LGA, shown in Figure 7. The recorded sightings occur within small clusters of the LGA, including Wilks Park, Lloyd, Kyeamba and Tarcutta, with isolated sightings within Murrumbidgee (Berry Jerry) National Park, Livingstone National Park and urban areas.

The Lloyd locality that extends from Pomingalarna, through Silvalite reserve, Birramal Conservation Area and along the Olympic Highway to Kapooka has had 153 sightings. The Kyeamba locality includes 112 sightings located along the Hume Highway. The Tarcutta locality recorded the most sighting of a total of 203 sightings from Tarcutta and Mates Gully reserve located 4km west of Tarcutta. Several sightings have been recorded within urban area, with Wilks Park identified as a favoured location.

As shown in Figure 7, the localities are isolated with limited access between the sites. Minimal corridors do occur, however are modified with extensive weeds, and often occur along roadsides. This increases the risk of vehicle strike for Squirrel Gliders that could result in injury or fatality.

Suitable Habitat

There is approximately 57,925 Ha of suitable Squirrel Glider habitat in the Wagga Wagga LGA. Figure 7 outlines the suitable habitat throughout the LGA in blue, suggesting species have not been recorded to date within all suitable habitat areas. This could indicate that the species are there but has not been recorded or there is a barrier preventing the species from occupying the habitat.

Barriers could occur for a number of reasons including limited HBTs, competition for resources or limited connectivity. Figure 8 identifies the suitable habitat with Wagga Wagga's Landuse zones. The data indicates that over 80% of the habitat occurs within Primary Production or Rural Landscapes Landuse zones. This indicates these areas are used for farming practices and are most likely privately owned.

Suitable Squirrel Glider habitat within LEP zones

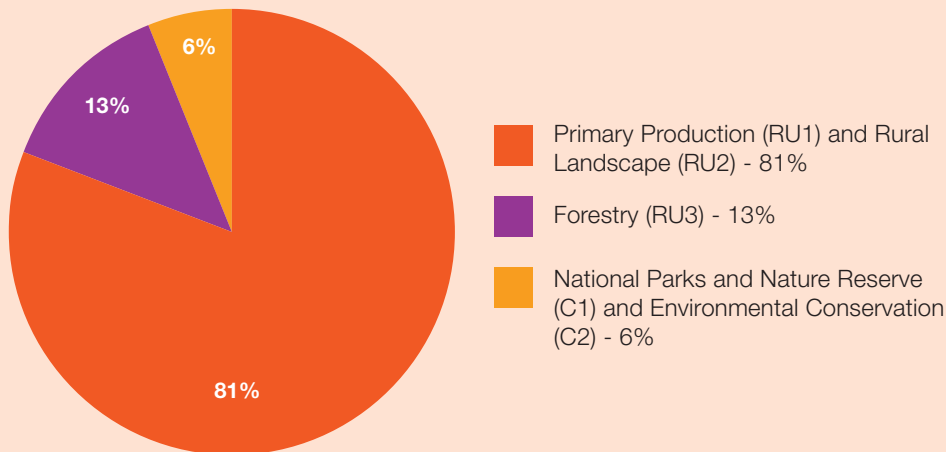


Figure 8: Suitable Squirrel Glider habitat within LEP zone

Threats

A significant threat for the Squirrel Glider population is habitat loss including loss of hollow bearing trees. Squirrel Glider habitat is often degraded and unlikely to sustain glider populations in the long term. Extensive clearing of native vegetation has left existing vegetation in small, isolated patches. This limits movement and reduces opportunities for feeding and breeding (Murray Local Land Services 2017).

Squirrel Gliders are known to frequent remnant stands of vegetation, which commonly occur on rural land, along creek lines and within roadside reserves. Clearing paddock trees and clearing for roadside widening significantly affect the species survival. Removal of hollow bearing trees increases pressure on already limited resources, encouraging risky behaviour such as crossing roads and traveling on the ground (Office of Environment and Heritage 2017).

While Squirrel Gliders glide from tree to tree, in some cases where vegetation is sparse, they may need to travel along the ground. This increases their risk of predation by exotic predators such as cats and foxes. Both animals hunt at night and gliders are conveniently sized prey.

Another major threat for the Squirrel Glider is barb wire fencing. When foraging for food at night, Squirrel Gliders can often become entangled in the barb wire resulting in injury or death.

The Squirrel Glider is currently classified in legislation as Vulnerable across NSW legislation and as an Endangered Population in the Wagga Wagga LGA.

Response Actions

State Action

To minimise the threats to Squirrel Gliders and other threatened species, the NSW government has developed the Saving Our Species Strategy which is aimed at increasing the number of threatened species that are secure in the wild in NSW for 100 years by:

- Optimising investment in management of threatened species and communities through the identification of priorities
- Engaging the community and aligning efforts across NSW in the effective management of threatened species and communities
- Making decisions about on-going management of threatened species and communities based on best available evidence and evaluation of outcomes.

The Arboreal Mammal Management Plan aims to incorporate actions within its own objectives and action table, detailed within the Management section of this document.

Local Action

Under the Saving Our Species Program, the Squirrel Glider is classified as a 'Landscape managed species'. Squirrel Gliders are generally managed at a landscape scale level as they are often widely distributed and affected by landscape scale threats (NSW Department of Planning, Industry and Environment 2019).

A number of projects have been completed to increase Squirrel Glider numbers within the Riverina. Riverina Local Land Services (RLLS) received funding from the NSW Environmental Trust in 2017 aiming to improve breeding and foraging habitat through the planting of new corridors and further protection of core breeding habitat.

The project worked with landowners around Livingstone National Park and Nest Hill Reserve to restore existing vegetation and created new corridors that provided new and improved foraging and nesting habitat. The project also coordinated pest control activities for foxes via baiting that reduced numbers and the impact of predation of Squirrel Gliders.

RLLS received funding in 2022 to implement a Local Area Management Plan approach to Squirrel Glider conservation with surveys conducted within the Tarcutta area. The project also worked with landholders to restore existing vegetation and create new corridors.

Council has delivered several projects that aim to increase and enhance habitat for the Squirrel Glider. In 2019 Council in partnership with NSW Environmental Trust and Origin Energy, installed 27 strategically placed Glider Poles to provide a corridor for the Squirrel Glider to move safely throughout the Birramal Conservation Area. In addition, National Tree Day 2019 was held within the Birramal Conservation Area, where over 1500 native seedlings were planted to help connect fragmented vegetation, providing vital future movement corridors and a reliable food resource for the threatened species.

In 2016 Transport NSW (previously known as Roads and Maritime Services) realigned the Olympic Highway and replaced the existing bridge over the main southern railway line at Kapooka. To mitigate impacts on these threatened species a number of glider poles, rope bridges, and nest boxes were installed along the Olympic highway to provide safe access across the highway and an additional 9,000 trees and shrubs were planted to enhance existing vegetation.

As a way of increasing habitat, Council has installed a number of nest boxes targeting Squirrel Gliders throughout the Wagga Wagga LGA. Nest box locations include Wilks Park, Birramal Conservation Area, and the Marrambydia Wetland. Nest boxes provide shelter habitat for the threatened species when there is a lack of hollows. In addition to providing nest boxes, Council has provided augmented hollows at Wilks Park by carving hollows into existing tree branches creating.

Fun Fact

The Squirrel Glider has a membrane between their front and back feet, allowing them to glide up to 40m.

Grey-headed Flying-fox

(*Pteropus policephalus*)

budharu



Description

The Grey-headed Flying-fox is Australia's largest bat, averaging 23-29cm in length and a wingspan of 1 meter. Their body is dark grey, with a lighter grey head and a reddish-brown collar around the neck. The distinguishing feature that tells them apart from other flying foxes is the leg fur that extends to the ankle (Office of Environment and Heritage 2020).

Distribution

The Grey-headed Flying-fox has historically occupied forests and woodlands in the coastal lowlands, tablelands and slopes of eastern Australia from Bundaberg in Queensland to Geelong in Victoria, with isolated camps and rare sightings outside this range. More recently, camps have been established in South Australia, ACT and inland areas of central and southern NSW and Victoria (National Recovery Plan for the Grey-headed Flying Fox Department of Agriculture, Water and the Environment).

Habitat and Ecology

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. They feed on nectar and pollen of native trees, in particular Eucalyptus, Melaleuca, Banksia, and fruit of rainforest trees and vines (Australian Museum 2020).

They spend most of their time hanging from branches of trees in forests or mangroves. At night they search for food and may travel up to 50km to their feeding areas, returning to their roost in one night (Australian Museum 2020). Grey-headed Flying-foxes feed on over 100 species of flowering trees and fleshy fruited trees. In doing so they interact with numerous plant communities and assist with seed dispersion making them a valuable pollinator species. (National Recovery Plan for the Grey-headed Flying Fox Department of Agriculture, Water and the Environment).

Grey-headed Flying-foxes roost in large aggregations, known as camps, in the exposed branches of trees. Roosting camps are generally located within 20km of a regular food source and are commonly found in gullies, close to water or on vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating and for giving birth (Office of Environment and Heritage 2020).

Camps provide nesting habitat, sites of social interactions and refuge from animals during significant phases of their annual cycle, including births, lactation and conception. Camps are used as day refuges by animals that forage in surrounding areas over several weeks, as maternity camps and as short term stop over site by migrating animals (National Recovery Plan for the Grey-headed Flying Fox Department of Agriculture, Water and the Environment).

Grey-headed Flying-foxes are usually born from September to October and are carried by the mother for the first three weeks. They cling to her teat with their special milk teeth and grip to her fur with their strong claws. As they grow, they become too heavy to be taken on feed expeditions, so they are left behind in a special 'creche' in the maternity camp. After three months the young are able to fly and by six months begin to feed independently (Office of Environment and Heritage 2020).

Cultural Fact

The Flying Fox has significance to First Nations Peoples as a food resource, clan totem, art subject and indicator of seasonal and climatic change, both annually and dreaming cycle.

Species Profile:
Grey-headed Flying-Fox

Wagga Wagga Population

Between 2010 and 2022 the Wagga Wagga LGA has 45 records of Grey-headed Flying-fox. As shown in Figure 9, records are scattered across the Wagga Wagga LGA, mostly occurring within the town centre. A roosting camp is located within the urban area on two islands in the Murrumbidgee River, where the Flying Foxes congregate. The flying-foxes feed on flowering and fruiting trees in parks, reserves, street trees and in private gardens. On a seasonal basis, there are also influxes of the Little Red Flying Fox (*Pteropus scapulatus*).

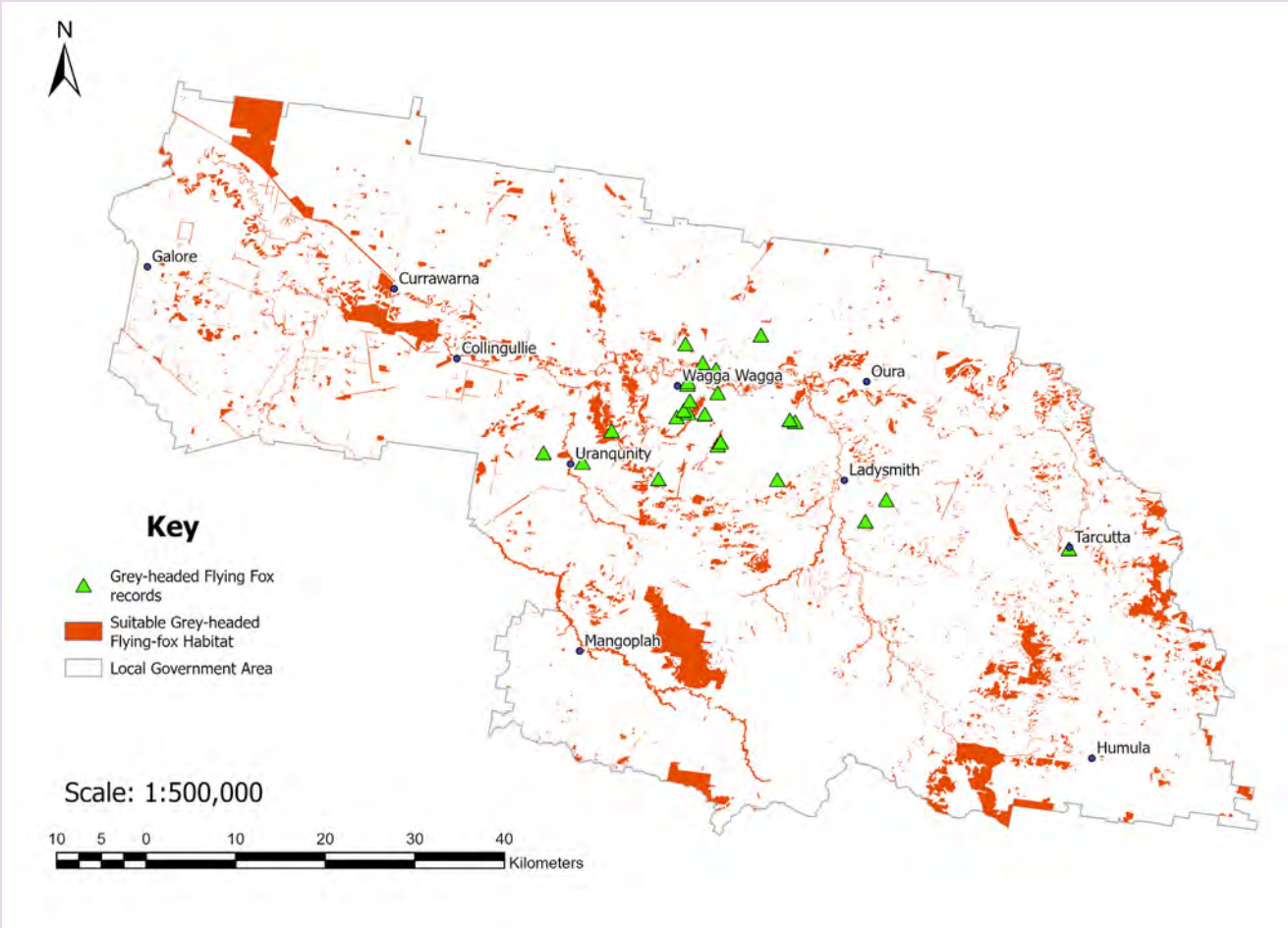


Figure 9: Recorded Grey-headed Flying-fox sightings and suitable habitat within the Wagga Wagga LGA (Bio Atlas and Seed Portal)

Suitable Habitat

There is approximately 56,795ha of suitable Grey-headed Flying-fox habitat in the Wagga Wagga LGA. Figure 9 outlines the suitable habitat throughout the LGA in orange, suggesting species have not been recorded within all suitable habitat areas. This could indicate that the species are there but have not been recorded or there is a barrier preventing the species from occupying the habitat.

Barriers could occur for a number of reasons including limited foraging resources, limited roosting habitat, and limited connectivity. Figure 10 identifies the percentage of suitable habitat within landuse zones. The data indicates that 80% of the suitable habitat occurs within primary production, mostly privately owned with 13% within forestry and 7% in National parks and areas of conservation.

Suitable Grey-headed Flying-fox habitat within LEP Zones

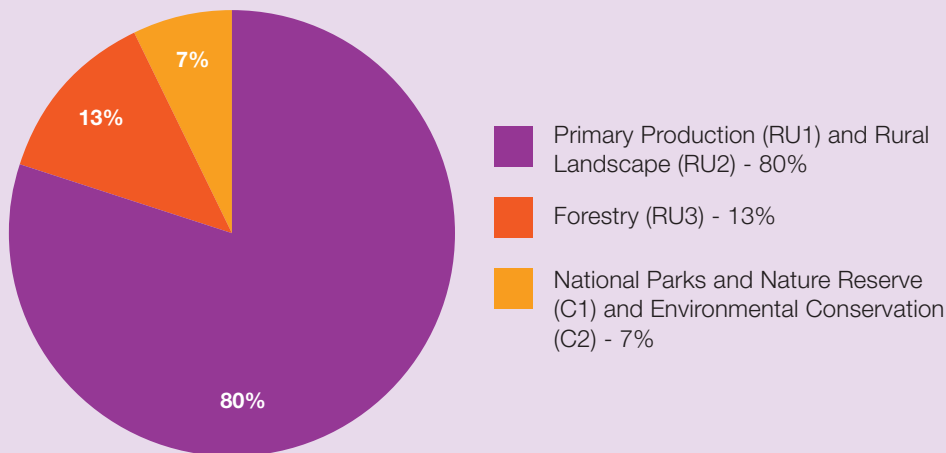


Figure 10: Suitable Grey-headed Flying-fox habitat occurring within LEP Zones

Threats

The Grey-headed Flying-fox is classified as Vulnerable under NSW legislation and is currently facing a number of threats including heat stress, and entanglement. However, the primary threat is considered to be loss and degradation of foraging and roosting habitat.

The species has complex habitat requirements, requiring multiple populations of food trees dispersed over a large area. This makes it difficult to protect foraging habitats solely within conservation reserves such as national parks, leaving the species vulnerable to land-uses that may clear native vegetation or degrade habitat (National Recovery Plan for the Grey-headed Flying Fox Department of Agriculture, Water and the Environment).

In NSW, less than 15% of potentially suitable habitat occurs in conservation reserves and only 5% of roost sites are protected by some form of conservation status (National Recovery Plan for the Grey-headed Flying Fox Department of Agriculture, Water and the Environment).

Exposure to high temperatures can result in heat stress causing mortality in Grey-headed Flying-foxes. High temperatures accompanied by low humidity and hot dry winds form the unbearable conditions for this arboreal mammal. Rates of mortality increase rapidly at temperatures above 43.5°C (National Recovery Plan for the Grey-headed Flying Fox Department of Agriculture, Water and the Environment).

Species Profile: Grey-headed Flying-Fox

Currently, up to 5 flying-fox die-offs occur per year, but these events are expected to increase in frequency under climate change. During 2019-2020, 85 flying-fox die-offs were recorded in NSW, ACT, Victoria and South Australia, resulting in at least 54,000 Grey-headed and Black Flying-fox deaths (National Recovery Plan for the Grey-headed Flying Fox Department of Agriculture, Water and the Environment).

Barbed wire is a major hazard for Flying Foxes with thousands of animals each year facing death or permanent injury from entanglement on barbs located on the top strand. Entanglement can also happen on powerlines and netting loosely draped over fruit trees (National Recovery Plan for the Grey-headed Flying Fox Department of Agriculture, Water and the Environment).

Response Actions

In 2021 a National Recovery Plan for the Grey-headed Flying-fox was developed to improve the national population trend; identify, protect and increase key foraging and roosting habitat; improve the community's capacity to coexist with flying-foxes; and increase awareness about flying-foxes, the threats they face and the important ecosystem services they provide as seed dispersers and pollinators.

The Plan consist of 9 objectives that includes:

- Identify, protect and increase native foraging habitat that is critical to the survival of the Grey-headed Flying-fox
- Identify, protect and increase roosting habitat of Grey-headed Flying-fox camps
- Determine trends in the Grey-headed Flying-fox population so as to monitor the species' national distribution, habitat use and conservation status
- Build community capacity to coexist with flying-foxes and minimise the impacts on urban settlements from new and existing camps while avoiding interventions to move on or relocate entire camps
- Increase public awareness and understanding of Grey-headed Flying-foxes and the recovery program and involve the community in the recovery program where appropriate.
- Improve the management of Grey-headed Flying-fox camps in areas where interaction with humans is likely
- Significantly reduce levels of licenced harm to Grey-headed Flying-foxes associated with commercial horticulture.
- Support research activities that will improve the conservation status and management of Grey-headed Flying-foxes
- Reduce the impact on Grey-headed Flying-foxes of electrocution on power lines, and entanglement in netting and on barbed-wire.

The Arboreal Mammal Management Plan aims to incorporate these actions within its own objectives and action table, detailed within the Management section of this document.

Fun Fact

Like Bats, the Grey-headed Flying-fox hangs upside down when hanging from tree branches during the day.

Microbats

bydyaan • dyibiny • dibilany

Little Pied Bat (*Chalinolobus picatus*)

Image: Bruce Thomson

Description

The Little Pied Bat is a distinctive black and white bat that weighs four to eight grams. The head and body are approximately 4.5cm in length and the tail 3.5cm. The fur is glossy black on the back, grey on the belly, with white fur along the flanks forming a 'V' in the pubic area (Office of Environment and Heritage 2017).

Distribution

The Little Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria (Office of Environment and Heritage 2017).

Habitat and Ecology

The Little Pied Bat occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimil Box Woodlands. The microbats are nocturnal where they spend their day roosting in caves, rock outcrops, tree hollows, mine shafts, tunnels, bridges and buildings (Office of Environment and Heritage 2017).

Roosting together in small groups of 20-40 bats, they prefer dry climates with temperatures of up to 40 degrees but require access to nearby open water (Australian Museum 2020). During the night the microbats emerge from their roosting sites to feed on moths and other flying invertebrates (Office of Environment and Heritage 2017).



Large Bent-winged Bat (*Miniopterus orianae oceanensis*)

Image: Australiannature.com © Pavel German

Description

The Large Bent-winged Bat has chocolate to reddish-brown fur on its back and slightly lighter coloured fur on its belly. It has a short snout and a high 'domed' head with short round ears. The wing membrane is attached to the ankle, not to the base of the toe. The last bone of the third finger is much longer than the other finger-bones giving the "bent wing" appearance. It weighs up to 20 grams, has a head and body length of approximately 6 cm and a wingspan of 30 - 35 cm (Office of Environment and Heritage 2019).

Distribution

The Large Bent-winged Bat occurs along the east and north-west coasts of Australia (Office of Environment and Heritage 2019).



Species Profile: Microbats

Habitat and Ecology

The Large Bent-winged Bat occurs in tall timbered forest to open grasslands. In forested areas, they are known to forage on flies, cockroaches and beetles above the tree canopy, while in grasslands they tend to forage on moths and other insects a few meters above the ground.

These microbats primarily roost in caves but also use derelict mines, stormwater tunnels, buildings and other human made structures. They form discrete populations centered around a maternity cave that is used annually in spring and summer for the birth and rearing of young. Breeding or roosting colonies can number from 100 to 150,000 individuals. (Office of Environment and Heritage 2019).



Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

Image: Australiannature.com © Pavel German

Description

The Eastern False Pipistrelle is relatively large for a microbat with a head-body length of approximately 65 mm and weighing up to 28 grams. It has a dark to reddish-brown back and paler grey on its underside. It has long slender ears set well back on the head and some sparse hair on the nose (Office of Environment and Heritage 2017).

Distribution

The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (Office of Environment and Heritage 2017).

Habitat and Ecology

The Eastern False Pipistrelle prefers moist habitats with trees taller than 20m, where it feeds on beetles, moths, weevils and other flying insects above or below the tree canopy. The females are pregnant in late spring to early summer and generally roost in eucalyptus hollows but have also been found under loose bark on trees, or in buildings (Office of Environment and Heritage 2017).



Southern Myotis (*Myotis macropus*)

Image: Australiannature.com © Pavel German

Description

The Southern Myotis, previously known as the Large-footed Myotis has disproportionately large feet; more than 8 mm long, with widely-spaced toes which are distinctly hairy and with long, curved claws. It has dark-grey to reddish brown fur above and is paler below. It weighs up to 15 grams and has a wingspan of about 28cm (Office of Environment and Heritage 2020).

Distribution

The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers such as the Murrumbidgee River (Office of Environment and Heritage 2020).

Habitat and Ecology

The Southern Myotis forages over streams and pools catching insects and small fish by raking their feet across the water surface. During the winter months these microbats use their roosts as they go into hibernation (Office of Environment and Heritage 2020).

The Southern Myotis generally roosts in groups of 10-15 individuals, close to water in caves, mine shafts, hollow bearing trees, stormwater channels, buildings, under bridges and in dense foliage. In NSW females have one young each year usually in November or December. (Office of Environment and Heritage 2020).

Corben's Long-eared Bat (*Nyctophilus corbeni*)

Image: [Australiannature.com](https://www.australiannature.com) © Pavel German

Description

The Corben's Long-eared Bat is uniformly dark grey-brown with a head and body length of 5-7cm. Their ears are about 3cm long and larger than their head. There is a low ridge of skin that runs between the eyes and across the nose. They were previously known as the Greater Long-eared Bat and the Eastern long-eared Bat (Office of Environment and Heritage 2017).

Distribution

The distribution of the south eastern form coincides approximately with the Murray Darling Basin, with the Pilliga Scrub region being the distinct strong hold for this species (Office of Environment and Heritage 2017).

Habitat and Ecology

The Corben's Long-eared Bat inhabits a variety of vegetation types, including mallee, Bulloke (*Allocasuarina leuhmannii*) and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress pine vegetation that occurs in a north south belt along the western slopes and plains of NSW and southern Queensland (Office of Environment and Heritage 2017).

The Corben's Long-eared Bat roosts in hollows, crevices and under loose bark. Females form small maternity colonies in hollows, whereas males are typically roost under exfoliating bark in summer. They usually forage within several kilometers of their roosting site. This slow flying and agile microbat uses the understory to hunt non-flying prey, especially caterpillars and beetles. They will occasionally descend to the ground to hunt on the ground (Atlas of Living Australia 2022).

Mating takes place in autumn with one or two young born in late spring to early summer. Usually, pregnant females gather together in maternity colonies a few weeks prior to giving birth. The female has two teats and suckles their young from 1-5 months. The young are born approximately 3-5 months after mating during the time of greatest food accessibility (Atlas of Living Australia 2022).



Species Profile:
Microbats



Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*)

Image: Bruce Thomson

Description

The Yellow-bellied Sheath-tail Bat has long, narrow wings, a glossy, jet black back and a white to yellow belly extending to the shoulders and just behind the ear. They have a flattened head and a sharply pointed muzzle. Their tail is covered with an extremely elastic sheath that allows variation in the tail-membrane area (Office of Environment and Heritage 2022).

Distribution

The Yellow-bellied Sheath-tail Bat is widespread across northern and eastern Australia. Occurring mostly within Victoria, south-western NSW and South Australia. There are also scattered records across New England Tablelands and North West Slopes (Office of Environment and Heritage 2022).

Habitat and Ecology

The Yellow-bellied Sheath-tail Bat forages in most habitats across its wide range. Foraging on flying insects including beetles, this microbat flies high and fast over the forest canopy and low in open country (Office of Environment and Heritage 2022).

The Yellow-bellied Sheath-tail Bat roosts singly or up to a maximum of 30 individuals, in tree hollows or buildings and are known to occupy other animals abandoned nests- including sugar gliders and mammal burrows. Mating occurs in August and a single offspring is born between December and March (Office of Environment and Heritage 2020).



Wagga Wagga Population

Five out of the six threatened microbat species have been recorded within the Wagga Wagga LGA. Figure 11 indicates that the majority of the records are within Silvalite Reserve, Birramal Conservation Area and along Willans Hill, with scattered records in the villages of Tarcutta and Currawarna. There are no records of the Little Pied Microbat within the Wagga Wagga LGA however it is considered as likely to occur here

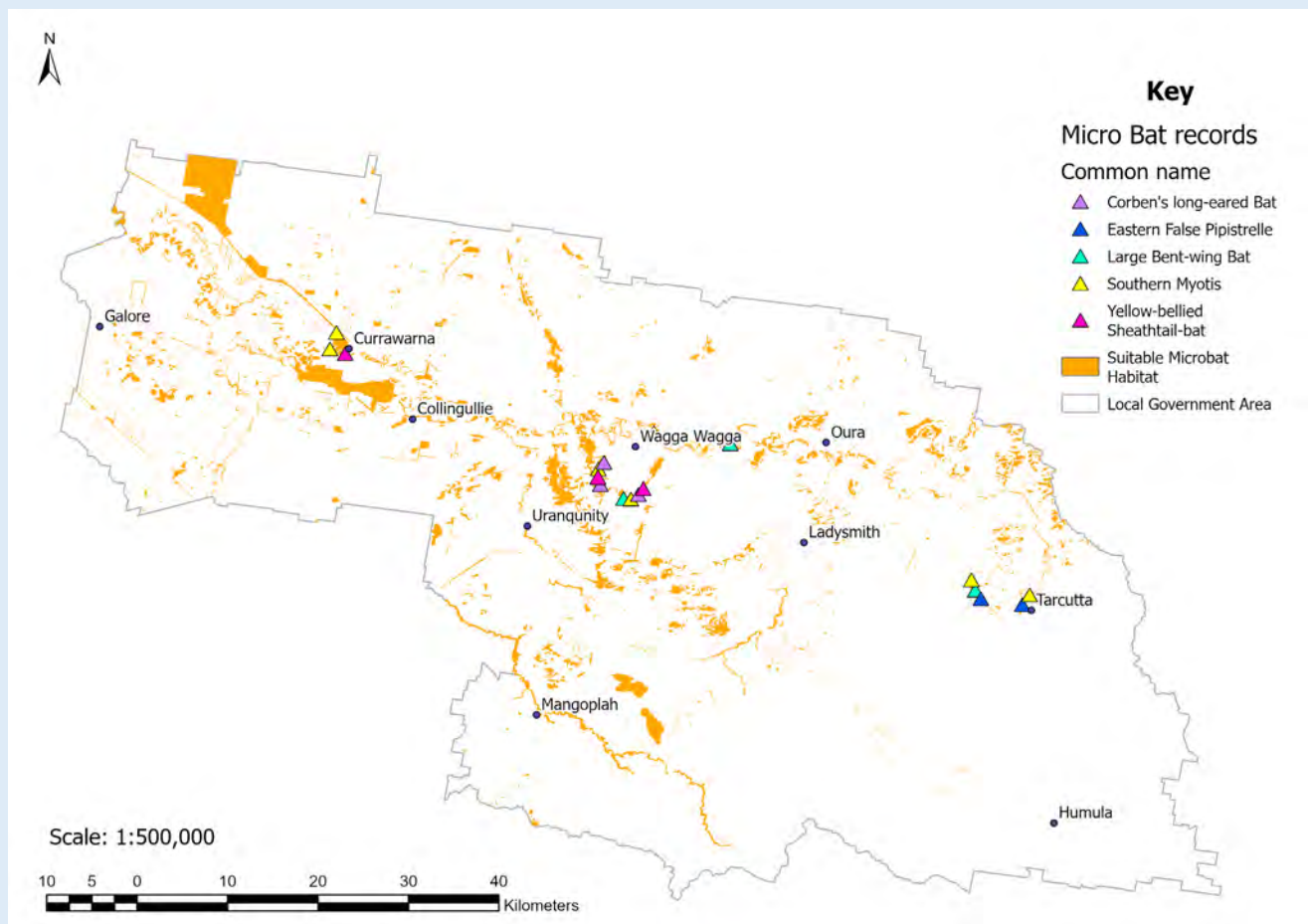


Figure 11: Microbat records and suitable habitat within the Wagga Wagga LGA

Suitable Habitat

The suitability of habitat present within the Wagga Wagga LGA is detailed within Figure 11, indicating a larger area of suitable habitat than the available records. There is approximately 51,276 Ha of suitable habitat for the six Microbat species in the LGA.

This could indicate the species are using the suitable habitat, but sightings have not been recorded. Microbats do not rely on sight to find their food, they use a form of radar called echolocation. Echolocation occurs by the microbat creating a sound that bounces off objects and the echo is detected by the micro bat (Murray-Darling Basin Authority 2022).

Due to the small size of Microbats it is very difficult to identify them opportunistically, therefore ecologists generally rely on trapping or acoustic detection methods such as an anabat. An anabat records the frequency of the call, which can identify the species. This could potentially explain the limited records within areas of suitable habitat.

**Species Profile:
Microbats**

Cultural Fact

Microbats were important to First Nations Peoples as they provided pollination of native plants, which is used for food and other resources.

Fast Fact

All Microbats use echolocation, where they send out sound waves which are then reflected back to the bat to determine the orientation of an obstacle or food source.

Other barriers could also contribute to the limited records within the Wagga Wagga LGA. This may include limited roosting or breeding habitat, resources taken up by another species or limited connectivity. Figure 12 identifies the percentage of suitable habitat with LEP zones. The data indicates that 80% of the suitable habitat occurs within primary production and is most likely privately owned.

Suitable Mircobat habitat within LEP zones

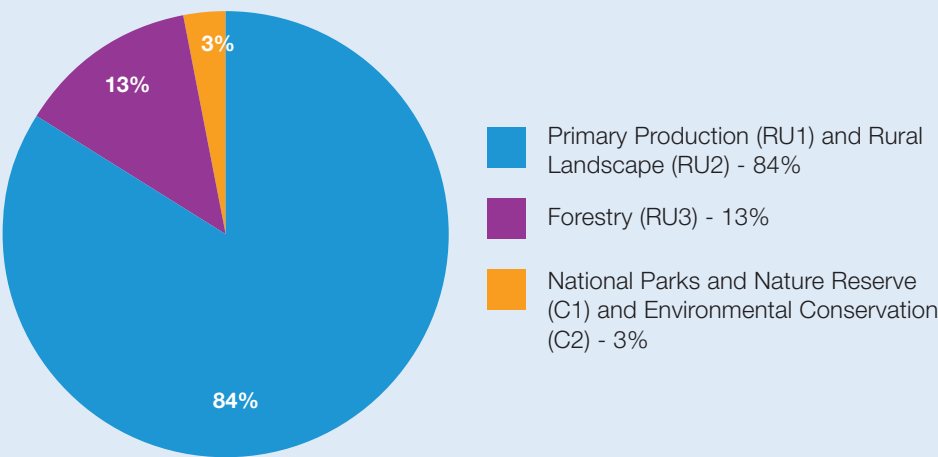


Figure 12: Suitable Microbat habitat within LEP zones

Threats to Microbats

Microbats face a number of threats that impact their population throughout Australia. The microbats described in this Plan are listed as Vulnerable under NSW legislation with Corben's Long-eared Bat also listed as Vulnerable under Commonwealth legislation.

Disturbance of roosting sites is a major threat to Microbat populations due to breeding cycle interruption, injury and death. Roost sites can vary depending on microbat species, ranging from caves, mines, tree hollows, logs, under bridges, and in roof cavities and buildings.

Due to the variety of roosting locations, disturbance of these sites can easily occur through various daily activities, including mine activity collapse, recreational caving, hollow bearing tree removal, bridge maintenance and upgrades, and building renovations.

Habitat loss and fragmentation that occurs NSW wide from urban and commercial development and recent bushfires and floods have had a major impact on population numbers. Although the species are highly mobile, habitat loss places pressure on already limited habitat, foraging and breeding resources. This can result in overcrowding and food shortages.

Microbats feed on various insects and invertebrates. Loss of insects due to the application of pesticides has also impacted Microbat populations by limiting available food resources.

Response Action

To minimise the threats for microbat species, the NSW government has developed the Saving Our Species Strategy aimed at increasing the number of threatened species that are secure in the wild in NSW for 100 years by:

- Optimising investment in management of threatened species and communities through the identification of priorities
- Engaging the community and aligning efforts across NSW in the effective management of threatened species and communities

- Making decisions about on-going management of threatened species and communities based on best available evidence and evaluation of outcomes.

The Microbat species that are listed in this Plan are all classified as 'Landscape Managed Species' within the Saving Our Species Program. They are required to be managed at a landscape scale as they are generally widely distributed, highly mobile or dispersed, and are affected by landscape scale threats (NSW Department of Planning, Industry and Environment 2019).

The Arboreal Mammal Management Plan aims to incorporate these actions within its own objectives and action table, detailed within the Management section of this document.



Management

Objectives and Actions

The objectives and actions identified within Table 3 outlines how Council in partnership with government agencies and community groups will address the issues impacting the targeted arboreal mammal species highlighted in this Plan.

Table 3: Objectives and actions, address five main objectives of the Plan:

- Educate and inspire the community
- Increase data gathering and sharing
- Manage pest and weed species
- Enhance the quality of existing habitat
- Increase the extent of habitats and populations

There are a number of key stakeholders that also work within the biodiversity, conservation and land management sphere. This includes:

- Biodiversity Conservation Trust (BCT)
- Crown Lands (Crown)
- Department Planning and Environment – Biodiversity and Conservation Division (DPE)
- First Nations Peoples
- Local landholders
- Murrumbidgee Landcare Incorporated and Local Landcare Groups
- National Parks and Wildlife Services (NPWS)
- Riverina Local Land Services (RLLS)
- RSPCA

The actions listed below are consistent with the objectives and actions from the NSW Department of Planning and Environment's 'Saving our Species' program. The actions outline broad, practical and meaningful actions for controlling critical threats and securing threatened species populations on the ground.

The actions are designed to guide stakeholders investing in species and habitat management. While these actions listed below are broad to cover the entire Wagga Wagga LGA, studies show that smaller scale Local Area Management Plans (LAMPs) yield the best outcomes and Council encourages the Plan's stakeholders to take this approach.

Council's main role will be to manage its own land effectively and promote key government programs to the general public and key landholders.

Council's role in each action has been separated into four categories including:

- **Continue** – Continue or update existing action/task that Council currently completes
- **Develop** – Develop and implement actions with support of other stakeholders
- **Promote** – Support other agencies work by promoting initiatives to the public
- **Support** – Provide support through sharing existing data and equipment, educational resources, and staff time

Table 3 identifies a number of actions spanning a 10-year period. The majority of actions are currently funded through Council's Long Term Financial Plan (LTFP) for the environment program. It should be noted though that the allocated money does not address all initiatives simultaneously but is prioritised for different projects year to year.

A number of the actions listed could involve multiple subsets of activities. These may be implemented by different stakeholders at different locations over different time scales.

Where actions are not funded, Council will endeavor to seek federal and state grant funding opportunities or collaborate with local stakeholders.

Council's potential funding sources includes:

- Council approved funded programs – as part of Council's Long Term Financial Plan
- Council in-kind contributions – staff time and salaries already accounted for in Council's budget
- Grants and stakeholder support – granting funding and other agencies support
- Stakeholder funding – other agencies funding

Objective: Educate and inspire the community				
Action item	Actions	Stakeholders	Council's role	Potential funding source
EC01	Develop and implement education and awareness campaigns specific to each target species	DPE Landcare NPWS RLLS	Implement	• Council approved funded programs • Council in-kind contributions • Grants and stakeholder support • Stakeholder funding
EC02	Promote the importance of retaining remnant vegetation	BCT DPE Landcare RLLS	Promote Support	• Council in-kind contributions • Stakeholder funding
EC03	Host guided tours targeted at known locations, educating on the importance of each target species	BCT Landcare RLLS	Continue Promote	• Council in-kind contributions • Stakeholder funding
EC04	Develop and implement an education campaign on the importance of responsible pet ownership	RSPCA	Continue	• Council In-kind contributions • Grants and stakeholder support • Stakeholder funding
Objective: Increase data gathering and sharing				
Action item	Actions	Stakeholders	Council's role	Potential funding source
DG01	Gather and monitor data of target species within the Wagga Wagga LGA	BCT DPE Landholders RLLS	Continue	• Council approved funded programs • Council in-kind contributions • Grants and stakeholder support

DG02	Partner with other agencies to share target species data	BCT DPE NPWS RLLS	Support	• Council in-kind contributions • Stakeholder funding
DG03	Develop citizen science programs that enable community members to capture and monitor data	DPE Landcare RLLS	Develop Support	• Council approved funded programs • Council in-kind contributions • Grants and stakeholder support
Objective: Manage pest and weed species				
Action item	Actions	Stakeholders	Council's role	Potential funding source
PW01	Implement targeted pest control activities	Crown Lands Landcare Landholders RLLS	Continue	• Council approved funded programs • Stakeholder funding
PW02	Erect feral proof fencing in priority targeted areas	Crown Lands Landholders RLLS	Promote	• Stakeholder funding
PW03	Implement weed control activities	Crown Lands Landcare Landholders RLLS	Continue	• Council approved funded programs • Council in-kind contributions • Stakeholder funding
Objective: Enhance the quality of existing habitat				
Action item	Actions	Stakeholders	Council's role	Potential funding source
EH01	Avoid and minimise removal of remnant vegetation	Crown Lands Landholders RLLS	Continue	• Council in-kind contributions
EH02	Install artificial habitat structures, augmented hollows and crossing structures	DPE Landcare Landholders RLLS	Continue	• Council approved funded programs • Council in-kind contributions • Grants and stakeholder support • Stakeholder funding
EH03	Increase mid-storey and groundcover habitat	RLLS Landcare Landholders	Continue	• Council approved funded programs • Council in-kind contributions • Grants and stakeholder support • Stakeholder funding

EH04	Retrofit barbed wire fencing in priority locations	Crown Lands DPE Landcare Landholders RLLS	Develop	• Council approved funded programs • Stakeholder funding
Objective: Increase the extent of habitats and populations				
Action item	Actions	Stakeholders	Council's role	Potential funding source
IH01	Plant additional native species near existing habitat that will increase foraging and shelter habitat	Crown Lands Landcare Landholders RLLS	Continue	• Council approved funded programs • Council in-kind contributions • Grants and stakeholder support • Stakeholder funding
IH02	Investigate opportunities to acquire new land to increase habitat	BCT Landholders	Develop Support	• Council in-kind contributions • Grants and stakeholder support • Stakeholder funding
IH03	Encourage rural land holders to plant native vegetation on private land	BCT Landholders RLLS	Support	• Council in-kind contributions • Stakeholder funding
IH04	Investigate feasibility of a koala relocation project within the Wagga Wagga LGA	NPWS	Support	• Council in-kind contributions • Stakeholder funding
IH05	Establish native seedling plantings to enhance corridors connection from Narrandera LGA and Berry Jerry National Park	Landholders NPWS	Develop Support	• Grants and stakeholder support • Stakeholder funding

Table 3: Objectives and actions

Implementation

Monitoring and Reporting

The Arboreal Mammal Management Plan was identified as an action from Council's Biodiversity Strategy: Maldhangilanha and has clear linkages with key corporate documents, including Council's Community Strategic Plan and Council's Local Strategic Planning Statement. The identified actions will be reported for the relevant financial years as part of the Integrated Planning and Reporting framework and the Annual Report. Other key stakeholder agencies will also report on their identified actions through their own annual reporting mechanisms.

Regular analysis of actions within the Arboreal Mammal Management Plan will be conducted to make sure individual actions remain relevant and responsive to community needs throughout the plan's duration. The Plan will undergo a major review prior to 2033, however circumstances may occur where minor administrative changes to this document may occur.



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Appendix

Significant Areas

Birramal Conservation Area

The Birramal Conservation Area (BCA), located within the suburb of Lloyd, features a great diversity of fauna and flora. Rezoned as C2 for Environmental Conservation in 2010, Council took ownership of 127Ha to manage the important habitat to threatened species. 'Birramal' in local Wiradjuri/Wiradyuri language means 'the bush' and reflects the important connect between Wiradjuri/Wiradyuri peoples and connection to country.

The BCA is becoming increasingly more important as a remnant piece of natural environment given the extensive loss of natural landscapes on the southwest slopes (Priday, S and Mulvaney M 2005). The C2 zone is considered to have high conservation value as a number of threatened species have been recorded within the site including the Superb Parrot, Swift Parrot, Diamond Firetail, Brown Treecreeper, Grey-crowned Babbler, Squirrel Glider, Yellow-bellied Sheath-tail Bat and the White Box, Yellow Box and Blakely's Red Gum Woodland.

The vegetation contains a mixture of dry eucalypt and grassland communities with some artificial wetland areas. Most of the woodland vegetation within the BCA is described as White Box, Yellow Box, Blakely's Red Gum Woodland (Box-Gum Woodland) which is an Endangered Ecological Community (EEC) listed under the Biodiversity Conservation Act 2016.

It contains approximately 165 plant species including 53 introduced species, 91 species of birds, five species of native mammals and an extensive number of amphibians and reptiles (Murphy 1999). Located on a ridgeline, the BCA forms an important part of the landscape, forming part of a wildlife corridor that extends from Willans Hill, through to Silvalite Reserve and Pomingalarna Reserve.

Approximately 1% of the C2 land is covered by the Wagga Wagga Hills Open Forest vegetation community which is an association of Western Grey Box (*Eucalyptus microcarpa*), Blakely's Red Gum (*E. blakelyi*) and White Cypress Pine (*Callitris glaucophylla*). This vegetation community is identified as vulnerable because it has gone from an estimated pre-1850 area of 2,030ha to a current area of 304ha (Priday, S and Mulvaney M 2005).

Since Council has taken ownership of BCA in 2010, a number of natural resource management activities have taken place. This included:

- A partnership with NSW Environmental Trust and Origin Energy to install 27 strategically placed Glider Poles to provide a corridor for the Squirrel Glider to move safely throughout the area in 2019
- Hosting National Tree Day 2019 within the BCA, where over 1500 native seedlings were planted to help connect fragmented vegetation, providing vital movement corridors and provide a reliable food resource for native animals
- Establishing a native grass seed bank occupying an area of 1 Ha consisting of Windmill, Weeping, Wallaby and Kangaroo to create a seed bank for future harvesting. Once the seeds have reached maturity, the seeds will be harvested and prepared for germination. The seeds will then be used to revegetation other areas. This ensures the local and endemic species are used, providing habitat for local native wildlife that can withstand Wagga Wagga's extreme climate.

Livingstone National Park

Located 30km south of Wagga Wagga, Livingstone National Park and nearby Livingstone State Conservation Area occupies approximately 2,500Ha of bushland. The park is protected under the *National Parks and Wildlife Act 1974* and *National Parks and Wildlife Regulation 2002*.

Livingstone National Park is on Wiradjuri/Wiradyuri Country and holds great importance to local Aboriginal spirituality and culture. Art ceremonial sites and spiritual places are throughout the national park with many plants such as grass trees and mugga ironbark, have been used to produce shields, medicine and boomerangs (NSW National Parks and Wildlife Services 2022).

Livingstone National Park was once pastoral holdings until the area was converted to a state forest in 1917. Mining activities took place within the area from 1872 to 1950 and again in the early 1980s. Majority of mining was for gold however in later times change to wolframite. Evidence of trenches and mine shafts still remain today (NSW National Parks and Wildlife Services 2022).

There are five distinctive forest ecosystems within the park including; Rough barked red box dry shrub forb open forest, Dwyer's gum healthy low open woodland, Scribbly gum-cypress pine red ironbark tussock grass heathy low woodland, remnant plateau tops currawang wattle she-oak tall shrubland, and red stringybark scribbly gum rough barked red box dry forb tussock grass open forest. There are also occurrences of White Box Woodland that is listed as an EEC under the *Biodiversity Conservation Act 2016*.

There is a significant mid storey and ground cover layer within the park consisting of Austral Indigo, Kangaroo thorn, cream-coloured grass trees and nodding blue lily. A population of Yass Daisy classified as Vulnerable under *Biodiversity Conservation Act 2016* occurs within the park.

The park contains a diverse range of native animals, including five amphibians, nine reptiles, five mammals and 185 bird species. Many threatened species have been recorded including Swift, Superb and Turquoise Parrots, Barking Owls, Hooded Robins and Diamond Firetails.

Marrambidya Wetland

The Marrambidya Wetland was transformed from the disused treatment ponds of the Narrung Street Sewerage Treatment Plant, following 5 years of planning and construction. Officially opening in June 2016, the Marrambidya Wetland provides 30Ha of habitat that includes three ephemeral wetland ponds, fringing vegetation, River Red gum forest, grassland, artificial nest boxes and purposely built refuge island. Located adjacent to the Murrumbidgee River, the wetland is designed to replicate the natural water cycle with flooding in the winter months and dryer, lower levels during summer.

'Marrambidya' was selected to reflect the importance of this site to the local Wiradjuri/Wiradyuri people and to acknowledge the traditional name of the Murrumbidgee River. The site is also located between two Aboriginal Significant Places, Gobba Beach and Wiradjuri Reserve.

The waterbody consists of three ponds that are connected via a deep-water channel. The three ponds were stocked with approximately 20,000 Murray River Rainbow Fish, Native Gudgeon, Freshwater Shrimp and Yabbies. Numerous snags located throughout the three ponds provide refuge and breeding habitat for these native fish and frog species along with turtles that have also been seen swimming within the ponds.

Aquatic vegetation is present throughout each of the three ponds including Knob Sedge (*Carex inversa*) Rush (*Juncus subsecundus*) and Common Reed (*Phragmites australis*). Purposely design floating reed beds have been constructed for two of the ponds to take up excess nutrient to maintain water quality. Fringing vegetation consists of semi aquatic vegetation and a purposely built refuge island within Pond 2. This provides refuge and foraging habitat for small dwelling mammals, reptiles, frogs, ducks, waterbirds including Spoonbills, Egrets, Darters and Cormorants.

River Red Gums are dominant throughout the Marrambidya Wetland with a mix of juvenile and mature trees including hollows, with majority of the hollow bearing trees located along

the river's edge. Located southeast of the ponds occurs a large patch of native grasses and forbs including Spiney-head Mat-rush and Spreading Flax Lily with a mix of exotics.

There are currently two Planting Community Types (PCT) including:

PCT 5 - River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion,

PCT 74 - Yellow Box - River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion, located within the carpark of the wetlands.

The River Red Gum trees provide foraging habitat for a variety of bird species including Sulphur-crested Cockatoo, Corella, and Galah. The hollow bearing trees along with the artificial nest boxes provides breeding and refuge habitat for arboreal mammals including threatened Squirrel Glider, Brushtail Possum, Ringtail Possum, Sugar Glider, and Microbats.

The grassland located at the south-eastern section of wetland occupies a mix of native and exotic Forbs and grasses, providing habitat for small ground dwelling mammals and reptiles.

Mates Gully Travelling Stock Reserve

The Mates Gully Travelling Stock Reserve (TSR) is located along Mates Gully Road, near rural village of Tarcutta. The narrow strip of remnant Box-Iron Forest is approximately 83Ha. Managed by Local Land Services, the reserve was previously used as a travelling stock reserve, however, is now used as a safe haven for threatened species.

Given the good condition of the reserve, a number of threatened species has been recorded with multiple studies conducted within the reserve. Threatened species include Squirrel Glider, Swift Parrot, Blacked-chinned Honeyeater, Brown Treecreeper, and Scarlet Robin.

The dominant canopy species are Mugga Ironbark (*Eucalyptus sideroxylon*), Red Stringybark (*E. macrorhyncha*), Red Box (*E. polyanthemos*), Grey Box (*E. microcarpa*) and Blakely's Red Gum (*E. blakelyi*). The north western section of the TSR is only sparsely treed, presumably as a product of historical clearing, and is dominated by Red Stringybark and Mugga Ironbark. Immediately adjacent to this is a large stand of Red Box.

The north western section of the reserve, though dominated by forbs and grasses, contains four wattle species and five shrub legumes, as well as the yellow rice-flower (*Pimelea curviflora*) and a New Holland daisy (*Vittadinia* sp.). The centre of the TSR is dominated by Cassinia species, sometimes to the exclusion of all else. The southeastern end possesses probably the greatest shrub diversity in the reserve, containing heaths, wattles and legumes, including *Hovea linearis*, *Dillwynia phyllicoides* and *Platylobium formosum*.

Mates Gully TSR does show some signs of clearing and degradation, and noxious weeds like St. John's wort (*Hypericum perforatum*) and Paterson's curse (*Echium plantagineum*) have infiltrated the reserve, but it is nevertheless remarkably well-preserved.

Murrumbidgee Valley National Park (Berry Jerry)

The Murrumbidgee Valley National Park comprises of a number of separate precincts spread over a few hundred kilometres along the valley of the Murrumbidgee River, mostly between Collingullie and Hay. The precincts that make up the Murrumbidgee Valley River Parks are generally quite small and narrow and collectively span a large section of river frontage. They consist of a number of former state forests (previously managed by Forestry Corporation of NSW) and as such, have been historically managed primarily for logging and grazing by domestic stock (NSW National Parks and Wildlife Service 2014).

The Murrumbidgee Valley River Parks protects part of the longest continuous tract of River Red Gum (*Eucalyptus camaldulensis*) forest in the world. Water is a fundamental value of the river red gum forests. River red gum forests are of international significance and they

support an ecosystem comprising a multitude of species. The Murrumbidgee Valley River Parks also support physiological, cultural, aesthetic and visual values (NSW National Parks and Wildlife Service 2014).

The Murrumbidgee Valley National Park (Berry Jerry Precinct) is located along the Sturt Highway, approximately 30km west from the city centre. The national park is 1,020ha in size and consists of River Red Gum tall open forest on inner floodplain, with two permanent water source that runs across the reserve, known as Beavers Creek and Oldman Creek (NSW National Parks and Wildlife Service 2014).

Riverina red gum forests have been significant to the Wiradjuri/Wiradyuri People, the traditional land owners of parts of the Murrumbidgee Valley, for thousands of years. In 2009 the Natural Resources Commission concluded that access to forests and continued practices such as collecting foods and telling stories is critical for cultural survival.

A number of threatened species have been recorded within the national park including Koala, Squirrel Glider, Brown Tree Creeper and the Superb Parrot.

Pomingalarna Reserve

Pomingalarna Reserve is a bushland park reserve that is owned by Crown Lands and is managed by Council and forms an important part of the Wagga Wagga LGA's landscape. Located on a ridgeline with the highest point at 298 metre above sea level, Pomingalarna provides a vantage point overlooking the city.

The reserve occupies 228Ha of park reserve that forms part of the Wiradjuri Walking Track which connects Willans Hill, the southern edge of Wagga Wagga's urban area, Silvalite Reserve and the Murrumbidgee River. There is a well-developed mountain bike trail network, with a 23km of single track and 12.3km of fire trails.

Aboriginal Cultural Significance encompasses identified sites indicating evidence of Aboriginal occupation and places which are of contemporary or spiritual importance according to culture or custom. The Wagga Wagga LGA has a strong Indigenous history, being located on First Nations Wiradjuri/Wiradyuri Lands. Pomingalarna is a "Gadgi Migay" or beautiful young girl in Wiradjuri/Wiradyuri language.

There are a number of Aboriginal sites in the Reserve, many of which are known to the First Nations Wiradjuri/Wiradyuri Community, who continue their strong connection to the land. The land, plants and animals of the Reserve are integral to Wiradjuri/Wiradyuri spirituality and identity and hold particular cultural significance for local First Nation Wiradjuri/Wiradyuri women.

The reserve was originally grazed from 1832 with pastoral lease being established in 1850. In 1960 the reserve was rezoned and dedicated as Public Recreation with the Wagga Wagga City Council as trustees. The majority of the Natural Area – Bushland has been disturbed by human activity since European settlement including mining, gravel excavation, munitions usage, grazing, cropping and recreational activity.

The vegetation of the reserve contains a mixture of dry eucalypt and grassland communities with some artificial wetland areas. The woodland vegetation is described as an association of Western Grey Box (*Eucalyptus macrocarpa*), Blakey's Red Gum (*E. blakelyi*) and White Cypress Pine (*Callitris glaucophylla*) described as Wagga Wagga Hills Open Forest vegetation community (Priday, S and Mulvaney M 2005). The reserve also contains White Box Gum Woodland which is an EEC under the Biodiversity Conservation Act 2016.

The Pomingalarna reserve contains a range of fauna habitats including forest areas, grasslands, wetland and hollow bearing trees. These areas have recorded a number of reptiles, amphibians, birds, marsupials and mammals. There is significant habitat for woodland birds including the threatened Superb Parrot, Diamond Firetail, Brown Treecreeper, Speckled Warbler, Hooded Robin and Gilberts Whistler.

Silvalite Reserve

The Silvalite Reserve runs parallel to the Olympic Highway located to the west of Wagga Wagga. The C2, Environmental Conservation zoned land is approximately 34Ha in size and is owned by Crown Lands and managed by Council.

During European settlement, Silvalite reserve was cleared and grazed, substantially altering its original woodland structure to a cleared paddock with scattered paddock trees. Within the last 50 years there has been considerable regeneration, with two main vegetation communities present within the reserve consisting of grassland and woodland.

Within the grassland community there are two vegetation types characterised by improved pasture and mixed pasture (mix of native and exotic species). Woodland community is dominated by White Box, and forms part of an EEC Box-Gum Woodland listed within the Biodiversity Conservation Act 2016.

The Box-Gum Woodland contains several key attributes of high-quality woodland, including hollow bearing trees, a canopy of mixed ages, native shrubs and ground covers, low weed diversity and fallen litter and timber. A number of small dams are located within the reserve, providing water access to local wildlife.

Silvalite reserve is part of significant wildlife corridor that extends from Willan Hill, Birramal Conservation Area through to the north across Pomigalarna reserve. As well as continuing south along the Olympic Highway. This corridor allows species movement throughout the landscape to access vital resources including shelter and food.

In 2016 Transport NSW (previously known as Roads and Maritime Services) realigned the Olympic Highway and replaced the existing bridge over the main southern railway line at Kapooka. Targeted fauna surveys were completed to establish presence and impacts on species. A number of threatened species were recorded including Squirrel Glider, Southern Myotis, and Yellow-bellied Sheath-tail Bat.

As result to mitigate impacts on these threatened species a number of glider poles, rope bridges, and nest boxes were installed along the Olympic highway to provide safe access across the highway and an additional 9,000 trees and shrubs were planted to enhance existing vegetation.

Other recorded threatened species within the reserve include Superb Parrot, Brown Treecreeper, Swift Parrot, and Grey-crowned Babbler.

Tarcutta Hills Reserve

The Tarcutta Hills Reserve is located approximately 15km south of Tarcutta. The reserve is owned by Bush Heritage Australia, which was purchased in 1999. Bush Heritage Australia is an independent not-for-profit that buys, manages land, and partners with Aboriginal people, to protect irreplaceable landscapes and native species. In late 2020, a 288Ha parcel of neighbouring land was purchased, extending the reserve to 738Ha in total.

Tarcutta Hills Reserve consists of Mugga Ironbark Scribbly Gum open forest, Red Stringybark open forest and critically endangered ecological community, White Box-Yellow Box-Blakey's Red Gum Grassy Woodland and Grassland. The reserve is of national significance as it protects the largest area of White Box Grassy Woodland in good condition left in Australia.

The reserve also consists of various native plants including White Cypress Pine, Small-leaf Bush Pea, Honeypot, Kurrajong and many-flowered Mat-rush. This provides habitat for a number of threatened species that occur within the reserve including Turquoise Parrot, Brown Tree-creeper, Superb Parrot, Speckled Warblers, Black-chinned Honeyeater, Hooded Robin and Diamond Firetail, and Squirrel Glider.

Bush Heritage have completed various natural resource management activities to improve habitat within the Tarcutta Hills Reserve including weed removal of Patterson's Curse and

Scottish thistles, revegetation, increasing habitat for the Australian Swift Parrot Recovery plan, rabbit surveys and Squirrel Glider surveys.

Wilks Park

Wilks Park is located along the North Wagga floodplain and is approximately 40Ha in size, zoned as Recreation (RE1). The reserve is part owned by Council and Crown Lands but is managed by Council. A designated primitive camping area that is located at the front of the reserve, allowing short stay accommodation (72 hours) for self-contained vehicles as well as an active travel route that allows safe travel to the town centre and out to the northern suburbs of Wagga Wagga.

Prior to European settlement, Wilks Park, was part of a significant wetland habitat and River Red Gum Forest, providing habitat for a number of wetland bird including pelicans, swans and cranes. During European settlement Wilks Park was cleared for farming practices, leaving only scattered trees with clearing the majority of the mid storey or groundcover vegetation.

Since Council taking ownership, a number of restoration works have been completed to return Wilks Park back to its natural state. Works include weed removal, revegetation, and installation of artificial nest boxes. These works have been aided by grants from the NSW Environmental Trust and Threatened Species network.

Today, Wilks Park represents a key rare riparian patch of remnant vegetation, due to its substantial size and strands of mature and young regrowth River Red Gum (*Eucalyptus camaldulensis*). The quality of Wilks Park contrasts with remnants generally found along the Murrumbidgee River, which usually consist of a thin line of very old River Red Gum trees.

There has been dense natural regrowth of River Red Gum Forest triggered by major floods. The combination of revegetation and natural regeneration along with remanent old growth has provided the fauna with a complex vegetation structure that is ideal for habitat.

Wilks Park is a large area of core habitat that has the potential to support viable populations of significant native species in the long term. It offers an important refuge for fauna moving throughout the area, which forms part of the river corridor that links throughout the Wagga Wagga LGA.

Several threatened species have been recorded within or within the vicinity of Wilks Park including the Superb Parrot, Swift Parrot and Barking Owl and for the endangered population of the Squirrel Glider. The reserve is also home to a number of non-threatened species including Eastern Grey Kangaroo, Swamp Wallaby, Echidna, Brushtail and Ringtail Possum, Little Red Flying Fox and microbat species.

Willans Hill

Willans Hill Park is a natural area located in the middle of the Wagga Wagga city landscape. It is surrounded by the suburbs of Turvey Park, Mount Austin, Tolland and Koorringal. There are major roads running through the Hill reserve including Lord Baden Powell Drive, Captain Cook Drive, Red Hill Road and Leavenworth Drive.

It is highly elevated and visible from most of the surrounding urban area. Willans Hill sheds water to the east into Lake Albert and to the west into Wagga Wagga and Wollundry Lagoon. The Reserve is connected to numerous council areas such as the Botanic Gardens, Music Bowl and Museum. The Willans Hill forms part of an interconnected natural corridor which connects from Willans Hill around the southern edge of the Wagga Wagga urban area to Pomingalarna Park then down to the Murrumbidgee River.

Willans Hill was named after William Willans who owned a 32 Ha farm on the north western side of Willans Hill. The current Willans Hill area was proclaimed as Willans Hill Reserve in 1887. Council was later appointed as trustee in 1928. Additional portions were added to the reserve between 1886 and 1970.

It was originally used for firewood collection and grazing. Later as Wagga Wagga developed it was cleared. It was also used for gravel and rock extraction as part of the development of Wagga Wagga. A rifle range existed on the western slopes of the Reserve in the 1920's but was soon re-located to Pomingalarna Park (Plan of Management 1990). In recent times the Park has been used as a location for municipal facilities such as water storage and communications facilities.

Between 1951 and 1957 Willans Hill was extensively replanted with trees. Contour banks were constructed in the 1960's by the Soil Conservation Service and Wagga Wagga City Council to manage soil erosion. Further tree plantings occurred in 1971. In 1958 walking tracks and some picnic areas were developed. The lookouts were developed soon after in 1960 in association with the sealing of Captain Cook Drive. Willans Hill was also used for gold extraction and mining at various times in its history.

The vegetation of the reserve contains a mixture of dry eucalypt open woodland and forest with a varied shrubby understorey. This vegetation community is identified as vulnerable as it has gone from an estimated pre-1750 extant area of 2030Ha to a current extent of 304Ha (Priday S and Mulvaney M, 2005). The dominant flora species include Western Grey Box (*E. macrocarpa*), White Box (*E. albens*), Blakely's Red Gum (*E. Blakelyi*), Red Ironbark (*E. sideroxylon*), Red Stringy Bark (*E. macrorhyncha*), White Cypress Pine (*Callitris glaucophylla*), and Kurrajong (*Brachychiton populneus*) (McCrone 2003).

The natural vegetation has been previously disturbed by grazing, fire and gravel extraction. The resultant vegetation consists of even aged stands of woodland with shrubby understorey which exist throughout much of the Reserve, with occasional larger mature trees.

Willans Hill provide habitat for a number of threatened species including Swift Parrot, Squirrel Glider, Diamond Firetail and Speckled Warbler.

Wiradjuri Reserve

The Wiradjuri Reserve is located north of the city centre along the Murrumbidgee River. The reserve is approximately 24Ha and is utilised as a recreational space for boating, fishing, swimming, off-leash dog park and walking. The reserve is owned by Crown Lands and managed by Council and has a number of facilities including a toilet block, Wiradjuri walking track, boat ramp and car parking area, a designated dog off leash area and open grass area.

The Wiradjuri Reserve to the Gobba Beach corridor of the Murrumbidgee River is a significant location for the Wiradjuri people. The reserve served as a traditional Wiradjuri/Wiradyuri camping place, meeting area used for traditional to modern times, gatherings, and corroborees.

The area is rich in resources including plants, land, water and freshwater animals. It is also the location of a traditional Wiradjuri river crossing where, according to traditional stories, the carer of the 'Nurrang gungali' or crossing place resides.

The Wiradjuri reserve is located on the Riverine floodplain and consists of River Red Gum Forest vegetation community, dominating the riparian zone of major streams and River Bottlebrush dominating shrubland that occupies the banks of the streams on the river flats. The vegetation consists of remanent and a combination of revegetation and regeneration that provides habitat for a number of local wildlife species.

There are a number of large HBTs that provide habitat for arboreal species as well as birds. The reserve is part of a significant river wildlife corridor that extends up stream to Wilks Park and Wagga Beach as well as downstream to the Marrambidya Wetlands and Gobba Beach.



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