



Wilton and Greater Macarthur Priority Growth Areas

Biodiversity Study

Prepared for
NSW Department of Planning and Environment

2017



DOCUMENT TRACKING

Item	Detail
Project Name	Wilton and Menangle Priority Growth Areas – Biodiversity Study
Project Number	15SYD - 4543
Project Manager	David Bonjer 02 8536 8650
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Approved by	David Bonjer
Status	Final
Version Number	3
Last saved on	20 June 2017
Cover photo	Eco Logical Australia 10/04/2015

This report should be cited as ‘Eco Logical Australia 2015. *Wilton and Greater Macarthur Priority Growth Areas –Biodiversity Study*. Prepared for NSW Department of Planning and Environment.’

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Department of Planning and Environment

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Template 08/05/2014

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Abbreviations

Abbreviation	Description
BCAM	Biodiversity Certification Assessment Method
CEEC	Critically Endangered Ecological Community
CPW	Cumberland Plain Woodland
DP&E	NSW Department of Planning and the Environment
EEC	Endangered Ecological Community
EPBC Act	Environment Protection and Biodiversity Conservation Act
NPWS	NSW National Parks and Wildlife Service
PGA	Priority Growth Area
SCMA	Sydney Catchment Management Authority
SSTF	Sydney Sandstone Transition Forest
TSC	Threatened Species Conservation Act

Executive Summary

The Wilton and Greater Macarthur Priority Growth Areas (PGAs) have been identified for significant land use change, including proposed uses for infrastructure, housing, employment lands, centres, open space and conservation.

The biodiversity objectives for new urban areas have been stated and re-iterated in various strategies and policies including the Plan for Growing Sydney, the draft South West District Plan and the new Biodiversity Conservation Act 2016.

Land-use and biodiversity conservation planning in the Wilton and Greater Macarthur PGAs requires particularly careful consideration due to the presence of Shale Sandstone Transition Forest and Cumberland Plain Woodland, both of which are listed as threatened communities under NSW and Commonwealth biodiversity legislation. The areas also provides habitat and connecting corridors for threatened and non-threatened native flora and fauna such as koala.

This report provides an overview of these biodiversity values based on existing literature; identifies strategic directions land use plans and makes a broad assessment of the Wilton and Greater Macarthur Land Use and Infrastructure Plans.

In terms of detailed analysis of vegetation condition, presence of threatened species and the likely impacts of development, the limitations of a study undertaken at this scale are acknowledged. However, the existing data is sufficient to inform broad land use planning directions.

Based on the potential urban areas identified in the Wilton and Greater Macarthur Land Use and Infrastructure Plans, the outcomes are that:

- Development on all vegetated Cumberland Plain ‘Priority Conservation Areas’ identified in the Cumberland Plain Recovery Plan will be avoided
- East-west and north-south habitat connectivity will be maintained.
- Finer scale precinct planning will be undertaken to determine whether vegetation within the ‘urban potential’ areas is to be retained.

This study recommends the use of Biodiversity Certification under the Biodiversity Conservation Act 2016 to ensure the biodiversity outcomes are secured. In addition to the above outcomes, the Biodiversity Certification process can also provide for:

- The streamlined approval of development on certified land.
- The establishment of a funding source for Stewardship arrangements on the proposed conservation land, noting that where such arrangements can only be entered into voluntarily by the landowners.

1 Introduction

1.1 Purpose of this document

The NSW Department of Planning and Environment has prepared Land Use and Infrastructure Plans (LUIP) for the Wilton and Greater Macarthur Priority Growth Areas. These areas have been nominated for significant future urban development.

This purpose of this study is to provide:

- an overview of the biodiversity values of the Priority Growth Areas
- an overview of the biodiversity planning context
- strategies for how to conserve biodiversity whilst delivering urban outcomes in the PGAs; and
- provide a broad assessment of the how the biodiversity values are protected in the Wilton and Greater Macarthur Land Use and Infrastructure Plans.

The document was prepared by Eco Logical Australia in consultation with the Department of Planning and Environment and the consultant team for the Wilton and Greater Macarthur LUIP.

1.2 Biodiversity Planning Context

The following plans and polices provide a strategic context for conservation outcomes in the PGAs.

Table 1 Strategic planning context

Plan or Policy	Biodiversity elements relevant to Wilton and Greater Macarthur PGAs
<p>A Plan for Growing Sydney (NSW Government, 2014)</p>	<p><i>A Plan for Growing Sydney</i> recognised the Macarthur region as an Urban Investigation Area. The Plan contains the following actions that directly relate to biodiversity outcomes:</p> <ul style="list-style-type: none"> • <i>Direction 3.2 Create a network of interlinked, multi-purpose open and green spaces across Sydney</i> <ul style="list-style-type: none"> ○ <i>Action 3.2.1 Deliver the Sydney Green Grid Project:</i> ○ <i>Action 3.2.1 Investigate options for a bushland renewal program</i> • <i>Direction 4.1 Protect our natural environment and biodiversity</i> <ul style="list-style-type: none"> ○ <i>Action 4.1.1 Protect and deliver a network of high conservation value land by investing in green corridors and protecting native vegetation and biodiversity.</i> ○ <i>Action 4.3.1 Apply urban green cover technical guidelines</i> <p>To achieve Action 4.1.1 the plan recognises the value of strategic approach to biodiversity; promotes the use of Biodiversity Certification and the BioBanking Scheme; working with private industry to manage bushland on private land where landowners can enter in voluntary agreements to protect biodiversity; and continuing to use state and local planning controls to protect high conservation value areas.</p>

<p>South West District Plan (GSC, 2016)</p>	<p>In November 2016 the Greater Sydney Commission published the draft South West District Plan which includes the Wilton and Menangle PGAs. Section 5.5 of the Plan discusses the protection and enhancement of biodiversity and includes Sustainability Priority 3: <i>Efforts to protect biodiversity values should be based on avoiding and minimising impacts to biodiversity, as far as practicable. Only when impacts cannot be avoided or minimised, should consideration be given to offsetting those impacts.</i></p> <p>The Draft Plan includes the following objectives for strategic conservation in the District:</p> <ul style="list-style-type: none"> • <i>maintain, and where possible improve, the conservation status of threatened species and threatened ecological communities</i> • <i>achieve better outcomes for biodiversity conservation than the outcomes that could have been achieved by site-by site or project-by-project efforts</i> • <i>facilitate urban growth and development in line with A Plan for Growing Sydney and this draft District Plan</i> • <i>provide an equitable model for recognising and recovering the cost of biodiversity impacts from urban growth and development</i> • <i>reduce the potential for land use conflict</i> • <i>reduce the cost and timeframes for development approvals, including approvals for infrastructure</i>
<p>Sydney Green Grid: Spatial Framework and Priority Projects (OGA, 2016)</p>	<p>The Green Grid document describes the concept as:</p> <p><i>The Green grid promotes the creation of a network of high quality open spaces that connect with town centres, public transport hubs, the river and key employment and residential areas. It is a complex network that seeks to combine hydrological, ecological and urban resilience through an interconnected network of green infrastructure.</i></p> <p>The document provides analysis of green grid opportunities and proposes priority projects.</p>
<p>Cumberland Plain Recovery Plan (DECCW, 2010)</p>	<p>The Cumberland Plain Recovery Plan (DECCW 2010) is a plan to provide for the long term survival and protection of seven threatened species, four endangered populations and nine threatened ecological communities listed on the NSW Threatened Species Conservation Act 1995. The plan acknowledges that protection and management of large, intact remnants is more effective and efficient than for smaller fragmented remnants and that recovery efforts need to aim to ensure that a representative sample of all target threatened species and populations and communities is conserved. To do this, the Recovery Plan identifies Priority Conservation Lands that <i>'represent the best remaining opportunities in the region to secure long-term biodiversity benefits for the lowest possible cost in an environment which is becoming increasingly urbanised'</i></p>
<p>BIOMap (NSW OEH, 2016)</p>	<p>In 2016 the NSW Office of Environment and Heritage released a Biodiversity Investment Opportunities Map (BioMap). The map is designed to direct investment funding to the strategic locations of greatest benefit on the Cumberland Plain. The map identifies areas that fall into three categories:</p>

	<ul style="list-style-type: none"> • Core areas • State biodiversity corridors • Regional biodiversity corridors
<p>Biodiversity Conservation Act 2016</p>	<p>In November 2016 the NSW parliament passed the Biodiversity Conservation Act 2016. The Act will repeal the Threatened Species Conservation Act 1995 and is due to commence in 2017. The purpose of the Biodiversity Conservation Act is, among other things, to conserve biodiversity at a bioregional and State scale.</p> <p>The Act makes provision for the assessment of impacts to biodiversity when undertaking development and if that development is approved, requires offsets to mitigate the impact. The Act provides for Biodiversity Certification that is proposed by developers as well as Strategic Biodiversity Certification when proposed by planning authorities.</p>

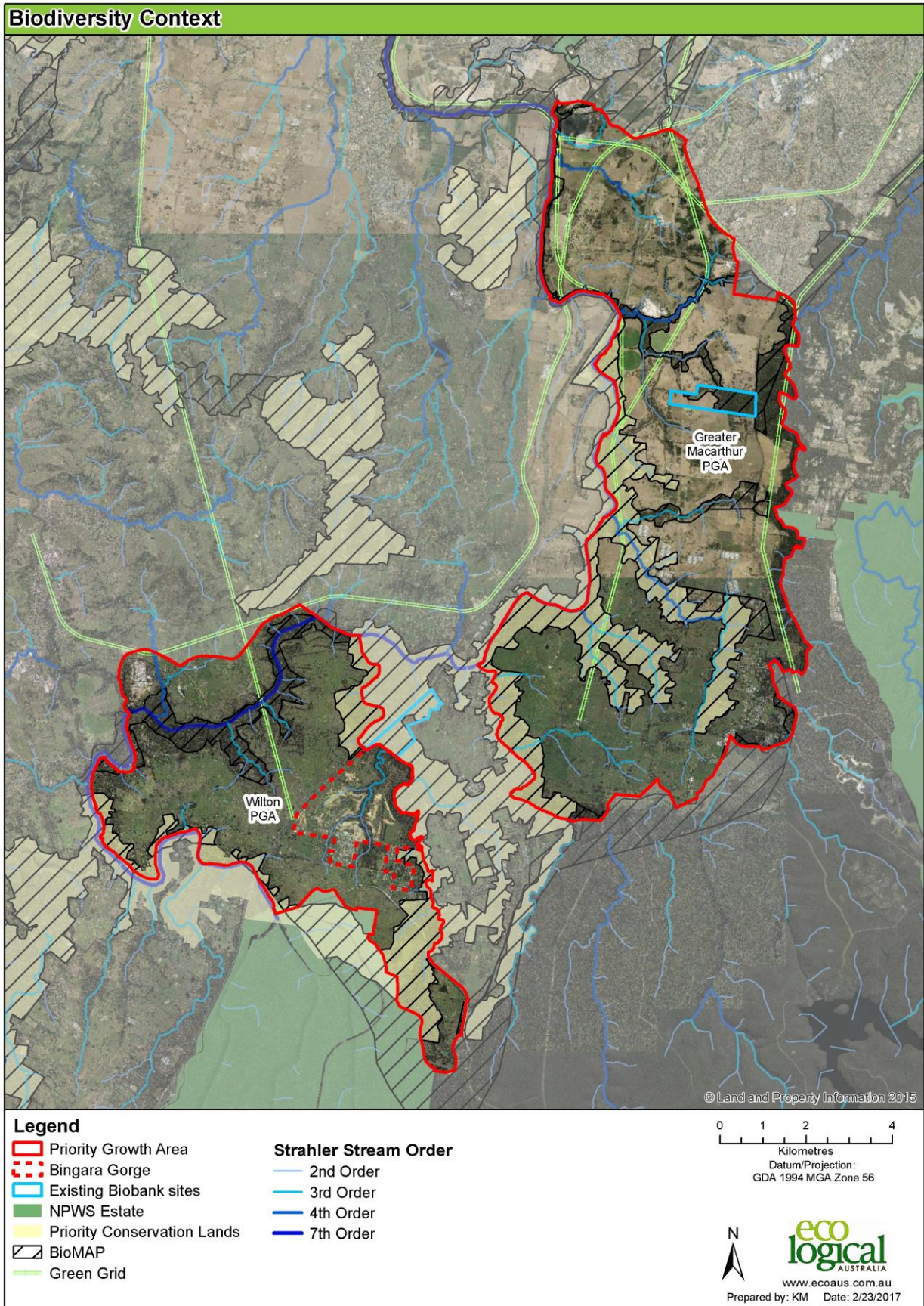


Figure 1: Biodiversity Conservation Planning Context

2 Biodiversity values in the PGAs

2.1 Vegetation

In 2013 the Office of Environment and Heritage updated the Western Sydney Vegetation Map (NPWS 2002). This updated map remains the only map that covers the entire study area. Site-specific studies have been undertaken for particular projects, such as Wilton Junction (Cumberland Ecology, 2016). The site specific ‘ground-truthed’ vegetation studies are likely to be more reliable in mapping vegetation communities, however as they use a variety of vegetation classification systems, their use in a regional scale assessment becomes problematic. For this reason the OEH (2013) vegetation map was most appropriate for this study. ‘Ground-truthed’ mapping will be necessary for the finer scale land use planning.

The PCT and its condition have not been field validated. NPWS (2002) used basic condition classification where-by vegetation is classified in A, B, C or TX condition as described in **Table 2** below. For the purposes of this regional scale study it has been assumed that vegetation in the ‘A, B and C’ category are generally in moderate to good condition, whilst TX is generally in low condition.

The OEH (2013) mapping does not map areas of derived native grasslands which are areas of native grass cover (i.e. no tree canopy) than is a remnant of a forest or woodland vegetation community.

A total of 9 Plant Community Types (PCTs) have been mapped across the PGAs, covering an area of 4453 ha. A breakdown of the vegetation communities is described in **Table 3** and mapped in **Figure 2**.

Five of the mapped PCTs in the Wilton and Greater Macarthur PGAs are likely to meet the definition of an Endangered or Critically Endangered Ecological Communities under the NSW Threatened Species Conservation (TSC) Act. These are shown in (**Figure 3 and Table 3**) with 3 of these also potentially meeting the definition of *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* or *Shale Sandstone Transition Forest of the Sydney Basin Bioregion* which are listed under the EPBC Act.

Table 2 NPWS (2002) Vegetation condition classification

Code	Area (ha)	CCPD (%)	Description
A	>0.5	>10	Relatively intact native tree canopy. Dominant canopy species and understorey characteristics identified
B	> 5	5-10	Larger areas of remnant vegetation with a low or discontinuous canopy. Often found on the disturbed edges of larger remnants. Assessed to identify the dominant canopy species only, and understorey characteristics not assessed. However, native shrub and grass layer often present, indicating understorey integrity
C	> 0.5		Areas of native vegetation that do not have a Eucalypt canopy cover. Understorey appears dominated by native vegetation, and codes were applied to identify patches of Melaleuca, Casuarina etc
Tx	>0.5	<10	Areas of native trees with very discontinuous canopy cover. Boundaries difficult to define from API due to low densities. Surrounding land use predominantly agricultural. Most have dominant canopy species assessed.

CCPD = the Crown Cover Projection Density

Table 3: Vegetation Communities in the Wilton and Greater Macarthur PGAs

PCT	Name	EEC or CEEC	Hectares
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	163.25
1292	Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion		62.36
830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Moist Shale Woodland in the Sydney Basin Bioregion (EEC)	11.17
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)*	186.12
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)*	151.71
1395	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Shale/Sandstone Transition Forest (CEEC)*	2797.40
1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion		176.56
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion		803.93
1253	Sydney Peppermint - White Stringybark - Smooth-barked Apple forest on shale outcrops, Sydney Basin Bioregion		8.42
		Total	4360.03

**Potential critically endangered community under the EPBC Act*

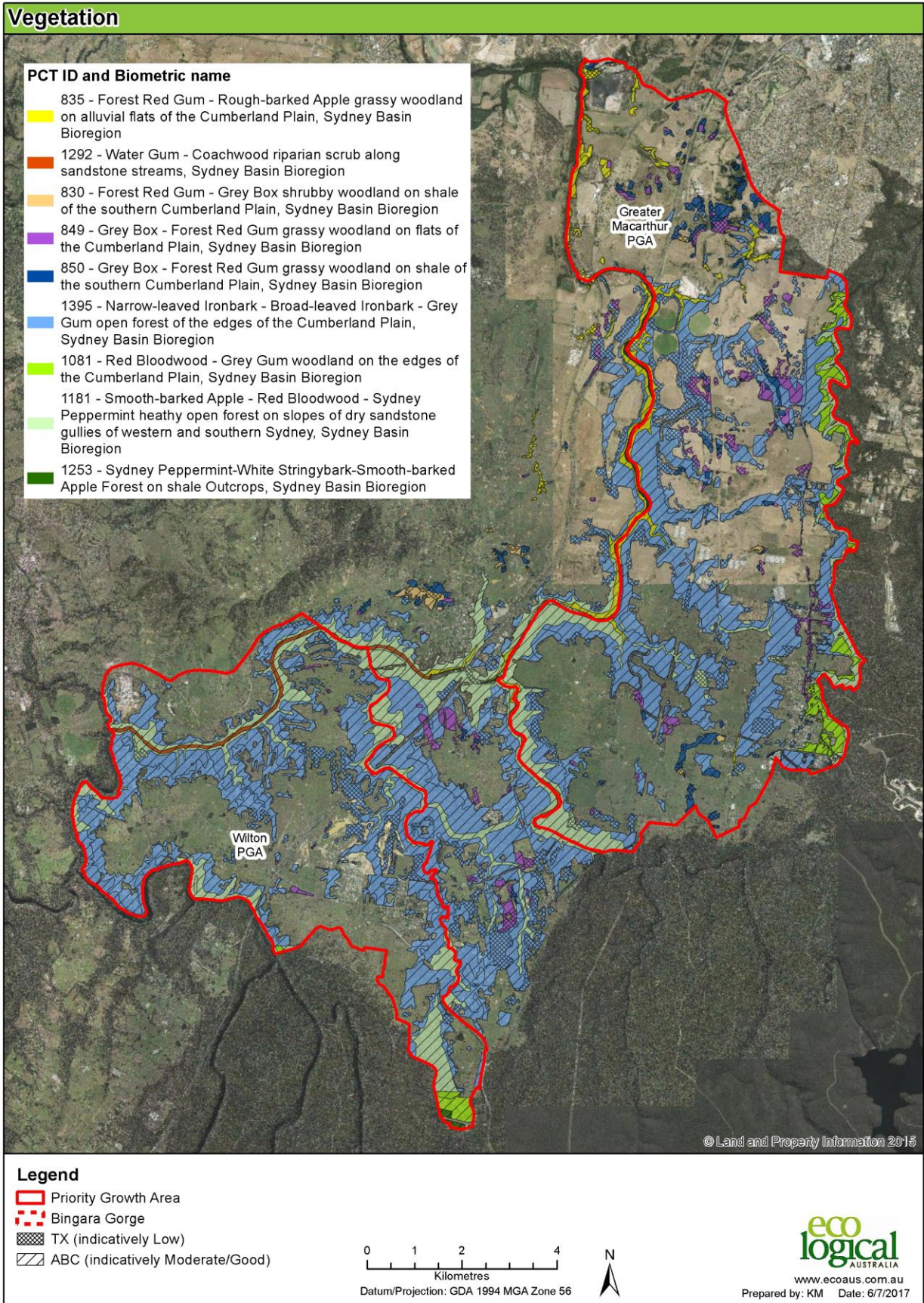


Figure 2: Plant Community Types / Zones

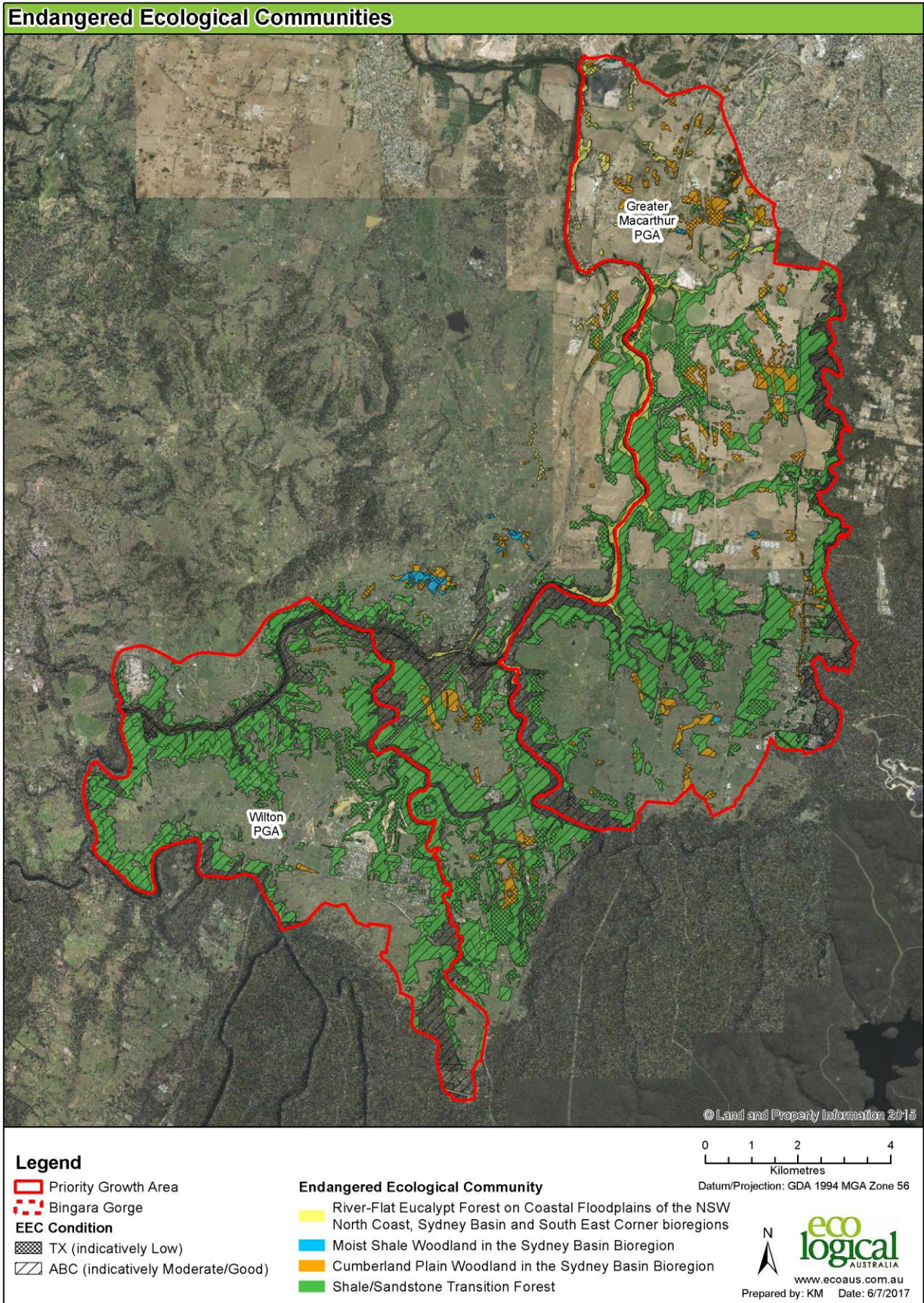


Figure 3: Endangered Ecological Communities

2.2 Patch size and Habitat Connectivity

Patch size refers to the size of a patch of vegetation. As described in the Cumberland Plain Recovery Plan (DEC 2011) '*protection and management of large, intact remnants is more effective and efficient than for smaller fragmented remnants*' because larger patches generally have greater diversity and have less influence from 'edge effects' such as weed invasion and uncontrolled access.

Habitat connectivity refers to the way in which patches of vegetation are linked so that fauna can move across a landscape in search of resources, shelter and breeding. Fragmenting a population can lead to decline of the species not only due to lack of access to resources, but also by limiting the ability of animals to avoid threats such as bushfire and by limiting exchange of genetic material. The connectivity required varies significantly depending on the mobility of a species. For example, birds and bats are highly mobile and do not require 100% connectivity to move through a landscape where-as ground-dwelling mammals, reptiles and amphibians generally require much greater connectivity.

The minimum viable patch size for vegetation depends on many factors such as its condition, species present, ability to recruit individuals and new genetic material from near-by patches and the management regime that is applied. **Figure 4** shows the patch size of vegetation in the PGAs in three broad categories:

- 0-4ha
- 4-20ha
- 20+ ha

There is currently good connectivity in a north-south direction within the Nepean River gorge and the Georges River area, with the latter being partially outside of the study area. Connectivity in an east-west direction is more fragmented due to roads, urban areas and cleared grazing lands.

2.3 Aquatic habitat

The two PGAs contain the Nepean River and its tributaries. The Nepean River is a 7th order watercourse, whilst most tributaries are 1st and 2nd order streams. The first order streams are typically located in open paddocks of grazing lands where there are little to no aquatic habitats. The NSW DPI-Fisheries have mapped several watercourses as Key Fish Habitat including the two major rivers and several small tributaries – see **Figure 4**.

The DPI-Water (2012) *Guidelines for Riparian Corridors on Waterfront Land* recommend a riparian zone of 10m either side on a first order watercourse, 20m on a second order, 30m on third order and 40m on 4th order and above.

2.4 Threatened Species

The PGA's contain habitat for a number of threatened flora and fauna species. **Table 4** and **Table 5** below show the predicted threatened species most likely to occur in the area. The list is not exhaustive and other threatened species may be present.

For the Hawkesbury-Nepean area:

- Red highlight indicates Species Credit Species – these are species which require individual assessment under the biodiversity certification process as they are not closely related to a particular Plant Community Type.
- Green highlight indicates Ecosystem Credit Species which are species that are closely related to a PCT.
- Blue highlight indicates both Species and Ecosystem Credit Species depending on whether it is breeding habitat or foraging habitat.

Koala are known to be present within the study area and are a key species for conservation planning. A draft Comprehensive Koala Plan of Management has been prepared by Campbelltown Council and koala habitat assessment within the study area is currently being undertaken by Wollondilly Council and OEH.

The study area does not include any Key Biodiversity Areas (KBAs) identified by BirdLife Australia (<http://www.birdlife.org.au/projects/KBA>)

Table 4: Potential Threatened Flora

Botanical Name	Common Name	TSC Status	EPBC Status	EPBC Recovery Plan	Importance to Study Area
<i>Acacia bynoeana</i> *	Bynoe's Wattle	E	V	No adopted or made Recovery Plan for this species	-
<i>Allocasuarina glareicola</i>	-	E	E	No National recovery Plan, but see Cumberland Plain Recovery Plan (DECCW, 2011)	-
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid	E	V	National Recovery Plan (Duncan 2010)	No critical habitat identified. Populations do not occur in the study area (Duncan 2010).
<i>Callistemon linearifolius</i> *	Netted Bottle Brush	V	-	-	-
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	No adopted or made Recovery Plan for this species)	-
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	No adopted or made Recovery Plan for this species	-
<i>Epacris purpurascens</i> var. <i>purpurascens</i> *	-	V	-	-	-

<i>Eucalyptus benthamii</i>	Camden White Gum	V	V	No adopted or made Recovery Plan for this species	-
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	E	E	No adopted or made Recovery Plan for this species	-
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> *	Small-flower Grevillea	V	V	No adopted or made Recovery Plan for this species	-
<i>Gyrostemon thesioides</i> *	-	E	-	-	-
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Wingless Raspwort	V	V	No adopted or made Recovery Plan for this species	-
<i>Leucopogon exolasius</i>	Woronora Beard-heath	V	V	No adopted or made Recovery Plan for this species	-
<i>Melaleuca deanei</i> *	Deane's Paperbark	V	V	National Recovery Plan (DECCW 2010)	Critical habitat has not been declared for this species. A small number of populations occur in the study area (DECCW 2010)
<i>Pelargonium</i> sp. <i>striatellum</i> (G.W.Carr 10345)	Omeo Stork's-bill	E	E	No adopted or made Recovery Plan for this species	-
<i>Persoonia bargoensis</i> *	Bargo Geebung	E	V	No adopted or made Recovery Plan for this species	-

<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	No adopted or made Recovery Plan for this species	-
<i>Persoonia nutans</i>	Nodding Geebung	E	E	No adopted or made Recovery Plan for this species	-
<i>Pimelea spicata</i> *	Spiked Rice-flower	E	E	National recovery Plan for <i>Pimelea spicata</i> (DEC 2005)	No critical habitat has been declared for this species. This species is restricted to areas supporting or have previously supporting Cumberland Plain Woodland (DEC 2005)
<i>Pomaderris brunnea</i> *	Brown Pomaderris	E	V	National Recovery Plan (Sutter 2011)	Critical habitat has not been mapped for this species. Known populations contain about 600 plants, the majority of these in south-west Sydney (Wollondilly and Camden LGAs)
<i>Pterostylis saxicola</i> *	Sydney Plains Greenhood	E	E	No National Recovery Plan, however see Cumberland Plain Recovery Plan (DECCW, 2011)	-
<i>Pultenaea aristata</i>	Prickly Bush-pea	V	V	No adopted or made Recovery Plan for this species	-
<i>Pultenaea pedunculata</i> *	Matted Bush-pea	E	-	-	-
<i>Streblus pendulinus</i>	Siah's Backbone	-	E	Yes (DNP 2010)	In Australia this species is restricted to Norfolk Island, but does occur on other small nearby island continents (DNP 2010).

<i>Syzygium paniculatum</i> *	Magenta Lilly Pilly	E	V	Yes+ (OEH 2012)	No populations outlined in OEH 2012 occur within the study area. All confirmed naturally occurring populations of Magenta Lilly Pilly are considered to be important and, therefore, all habitat in which these populations occur is considered to be critical to the survival of the species (OEH 2012).
<i>Thelymitra kangaloonica</i>	Kangaloon Sun Orchid	CE	CE	No adopted or made Recovery Plan for this species	-
<i>Thesium australe</i>	Austral Toadflax	V	V	No adopted or made Recovery Plan for this species	-

Table 5: Predicted Threatened Fauna

Scientific Name	Common Name	TSC Status	EPBC Status	EPBC Recovery Plan	Importance to Study Area
AMPHIBIANS					
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	No adopted or made Recovery Plan for this species	-
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	No adopted or made Recovery Plan for this species	-
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	No adopted or made Recovery Plan for this species)	-

Scientific Name	Common Name	TSC Status	EPBC Status	EPBC Recovery Plan	Importance to Study Area
<i>Litoria raniformis</i>	Southern Bell Frog	E	V	Yes (Clemann and Gillespie 2012)	No critical habitat has been declared for this species. The recorded distribution of this species does not occur on the study area (Clemmann and Gillespie 2012). There are no records in Wollondilly LGA or Campbeltown LGA (OEH 2017).
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Yes (Hunter and Gillespie 2011)	No critical habitat has been declared for this species. Habitat considered critical to the survival of the Stuttering Frog may comprise not just the stream habitat and adjacent riparian zones, but also the entire catchment adjacent to, and upstream of populations. This habitat has not been mapped (Hunter and Gillespie 2011)
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V	-	-	-

BIRDS

<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E	Yes (OEH 2016)	No critical habitat has been declared for this species. Habitat critical to the survival of the regent honeyeater includes any breeding or foraging areas where the species is likely to occur. The current known distribution is extremely patchy: the four known key breeding areas where this species is regularly recorded are outside the study area (OEH 2016).
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	No adopted or made Recovery Plan for this species	-
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	-	-

Scientific Name	Common Name	TSC Status	EPBC Status	EPBC Recovery Plan	Importance to Study Area
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	-	-
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V	-	-	-
<i>Circus assimilis</i>	Spotted Harrier	V	-	-	-
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	-	-
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	-	-
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	Yes (OEH 2012)	No critical habitat has been identified for this species. All habitat currently occupied by the Eastern Bristlebird is considered critical to its survival (OEH 2012). There is one record of Eastern Bristlebird within the Campbelltown LGA but outside (to the east) of the study area. There are no records in the Wollondilly LGA (OEH 2017).
<i>Ephippiorhynchus asiaticus*</i>	Black-necked Stork	E	-	-	-
<i>Falco subniger</i>	Black Falcon	V	-	-	-
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	-	-
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	-	-
<i>Lathamus discolor</i>	Swift Parrot	E	E	Yes (Saunders and Tzaros 2011)	No critical habitat has been identified for this species. Priority habitat should be identified within the Hawkesbury – Nepean CMA according to vegetation communities. Within the study area, this includes River-Flat Eucalypt Forest on Coastal Floodplains, Shale Sandstone Transition Forests, and Cumberland Plain Woodland.
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	-	-
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern)	V	-	-	-
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	-	-
<i>Ninox connivens</i>	Barking Owl	V	-	-	-

Scientific Name	Common Name	TSC Status	EPBC Status	EPBC Recovery Plan	Importance to Study Area
<i>Ninox strenua</i>	Powerful Owl	V	-	-	-
<i>Petroica boodang</i>	Scarlet Robin	V	-	-	-
<i>Petroica phoenicea</i>	Flame Robin	V	-	-	-
<i>Rostratula australis</i>	Australian Painted Snipe	E	E	No adopted or made Recovery Plan for this species	-
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	-	-
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	-	-

BIRDS – MIGRATORY

<i>Apus pacificus</i>	Fork-tailed Swift	-	M	-	-
<i>Ardea alba</i>	Great Egret	-	M	-	-
<i>Ardea ibis</i>	Cattle Egret	-	M	-	-
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	-	M	-	-
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	-	-
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	-	M	-	-
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M	-	-
<i>Merops ornatus</i>	Rainbow Bee-eater	-	M	-	-
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	-	-
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M	-	-
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	-	-

MAMMALS

<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Yes (DERM 2011)	<p>Maternity roosts are considered habitat critical to the survival of the species. The number of known breeding sites is limited, and none are recorded in the study area (DERM 2011). Largest know populations occur in large sandstone escarpments. Sandstone cliffs and fertile wooded valley habitat within close proximity of each other should be considered habitat critical to the survival of the large-eared pied bat</p>
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Scientific Name	Common Name	TSC Status	EPBC Status	EPBC Recovery Plan	Importance to Study Area
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Yes (DELWP 2016)	The threshold densities of the critical habitat components required to support quoll populations are unknown. It is currently not possible to define (or map) habitat critical to the survival of the Spotted-tailed Quoll (DELWP 2016).
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	-	-
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (Eastern)	E	E	No adopted or made Recovery Plan for this species	-
<i>Miniopterus australis</i> *	Little Bentwing-bat	V	-	-	-
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-	-	-
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-	-	-
<i>Myotis macropus</i>	Southern Myotis	V	-	-	-
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	-	-
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Yes (DEC 2008)	No critical habitat has been identified for this species. No known populations currently occur within the study area (DEC 2008; OEH 2017).
<i>Phascolarctos cinereus</i>	Koala	V	V	Recovery Plan for Koala (DECC 2008).	Draft Comprehensive Koala Plan of management for Campbelltown LGA identifies core and secondary koala habitat in the study area.
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	No adopted or made Recovery Plan for this species	-

Scientific Name	Common Name	TSC Status	EPBC Status	EPBC Recovery Plan	Importance to Study Area
<i>Pteropus poliocephalus</i> *	Grey-headed Flying-fox	V	V	Yes (OEH 2017)	No critical habitat has been declared for this species. Clearing of foraging habitat is the primary threat; the study area contains vegetation communities which contain key foraging trees (OEH 2017). No camps are currently roosting in the study area, although a camp of less than 10,000 individuals currently occurs nearby, in Picton (DotE 2017).
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	-	-
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	-	-

INVERTEBRATES

<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	-	Cumberland Plain Recovery Plan (DECCW, 2011)	-
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REPTILES

<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	No adopted or made Recovery Plan for this species	-
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CE – critically endangered; E – endangered; V – vulnerable; M – migratory; X – extinct

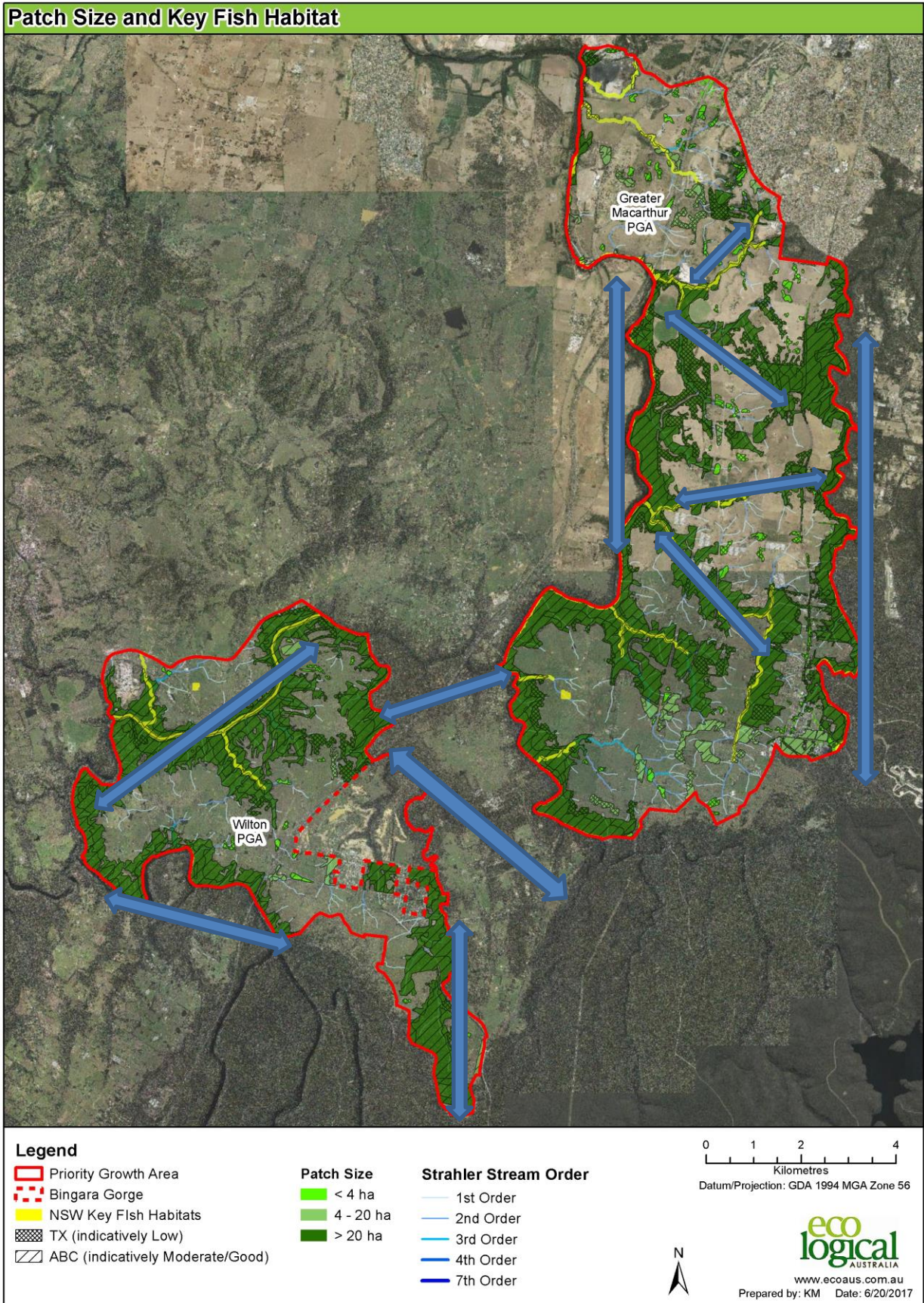


Figure 4 Patch size, connectivity and key fish habitat

3 Framework for Biodiversity Management

3.1 Introduction

The Wilton and Greater Macarthur PGAs have been identified for future urban growth. To achieve workable urban form and efficient infrastructure, vegetation and habitat loss is likely to occur in some instances. The proposed framework acknowledges that a balance between urban form and biodiversity values will be required and that the balance should ensure that biodiversity values are adequately protected. The framework is designed to be consistent with the objectives of the Biodiversity Conservation Act 2016, *A Plan for Growing Sydney*, the *South West District Plan* and the *Cumberland Plain Recovery Plan* as described in the introduction of this strategy.

The principles of avoid, minimise and mitigate have been applied. The use of offsets forms part of the framework and is consistent with the above. The recommended strategies are cognisant of the limitations of data available for use at a landscape scale and the need for subsequent stages in the planning process to provide further analysis and detail on outcomes.

3.2 Strategies

The following strategies are recommended:

- Avoid development within the lands mapped as ‘Conservation’ in **Figure 5**
 - Planning strategies, policies and instruments applying to these lands (eg: Land Use and Infrastructure Plans, Precinct Plans, Local Environmental Plans and Development Control Plans) should provide a consistent direction that residential, rural-residential, employment and commercial development is not supported in the proposed conservation lands.
 - Existing lawful development in the conservation area, such as existing rural residential dwellings will continue to be permissible, however further subdivision for residential or rural residential development should not be supported unless a clear environmental benefit will result.
 - Bushfire asset protection zones for new urban development should be located outside of the proposed conservation lands.
 - Linear infrastructure should be located outside of the proposed conservation lands. Where major infrastructure cannot avoid the conservation lands, mitigation measures such as offsets should be required, however this option should be considered a last resort and all efforts made to avoid impacts.
 - Over the longer term, these lands may form the basis of a recreational resource by bringing them into public ownership. Changes of ownership should be voluntary.
- Development within the ‘potential urban lands’ in **Figure 5** should consider the following
 - Protection of significant patches of vegetation or threatened species habitat, generally being those greater than 4ha (see Figure 4) and/or providing viable populations of threatened species or habitat linkages through the study area. Protection could be via public ownership and conservation or recreational zoning depending on the values of the patch.

- Protection and rehabilitation of riparian corridors, particularly on 2nd and 3rd order streams. First order streams may provide aquatic habitat however they are generally of significantly lower aquatic habitat value than higher order streams.
- Design of urban areas should consider latest best practice in maximising ‘urban green cover’ as a means of maintaining biodiversity, providing pleasant amenity and reducing heat island effects within urban areas.
- Where impacts are unavoidable, offsets will be required in accordance with legislative requirements. If possible, offsets should be provided close to the site of impact. Ideally the ‘conservation areas’ should be the recipient of any offset funding.

3.3 Delivery mechanisms

3.3.1 Biodiversity Certification

Biodiversity Certification is a planning process under the Threatened Species Conservation Act 1995 (to be replaced by the Biodiversity Conservation Act in 2017). The Biodiversity Certification process involves a detailed assessment of biodiversity values and preparation of a report that describes the impacts to biodiversity and the actions that will be undertaken to protect and manage biodiversity values. Subsequent development on the certified land is taken to be development that is not likely to have a significant impact on threatened species and endangered ecological communities and therefore no further assessment or approvals would be required at the development stage. The intended result is certainty of conservation and development outcomes. It is critical that a Biodiversity certification process be undertaken in conjunction with a Strategic Assessment under the EPBC Act 1999 (discussed below) to ensure the biodiversity outcomes are adequate and the planning process at the development application stage is streamlined.

Biodiversity Certification can be undertaken on various scales. With regard to Wilton and Greater Macarthur PGAs, it could be undertaken at:

- Both PGAs in one assessment – or part of a broader assessment of PGAs in Western Sydney
- for each PGA individually
- precinct scale
- sub-precinct scale

The benefits of biodiversity certification at the larger scale is that decision making can be more strategic and potential cost and time savings by gathering field survey data over a large area. The difficulties with planning at the larger scale are more stakeholders involved, lack of certainty regarding landuse and infrastructure decisions and that resolving a problem in one area may delay certification for the whole area.

The appropriate scale to be used for Wilton and Greater Macarthur will need to consider the above as well as time required to put funding and project arrangements in place. The Biodiversity Conservation Act 2016 allows for Biodiversity Certification (proposed by a developer) and Strategic Biodiversity Certification (proposed by a Planning Authority). Certification at the PGA scale or greater will need to be driven by a Planning Authority, where-as precinct scale or less is more likely to be driven by a developer.

There are parts of the PGAs which have no biodiversity value or constraint to development. The decision to include or exclude these areas from a biodiversity certification process should take into consideration timing of the biodiversity certification process and whether all areas should contribute to the funding of biodiversity outcomes for the PGAs.

3.3.1 Strategic Assessment under the EPBC Act 1999

The Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 protects 'Matters of National Environmental Significance' (MNES). The study area contains at least two vegetation communities that are listed as MNES as well as the potential for individual threatened flora and fauna such as koala.

Land development and infrastructure that proposes to have a significant impact on a MNES requires assessment from the Commonwealth to determine whether the development can proceed. As the two PGAs contain MNES, there is the potential for many projects to require Commonwealth approval. To avoid numerous site-by-site assessments and achieve better strategic outcomes, the EPBC Act allows for a Strategic Assessment under Part 9 of the Act. The effect is similar to that of the Biodiversity Certification under the NSW legislation. Development is streamlined in agreed areas and conservation actions are agreed for other areas.

As with the Biodiversity Certification, a Strategic Assessment can be undertaken on various scales including precinct, individual PGA or multiple PGAs. A Strategic Assessment can be undertaken on a plan, policy or program. If a Strategic Assessment is pursued, agreement with the Commonwealth will be required to determine what plan, policy or program is proposed for assessment.

If Biodiversity Certification and Strategic Assessment are to be undertaken, an agreed assessment method should be used for both processes to avoid inconsistent outcomes and repetition of effort.

3.3.2 Planning Instruments

The Wilton and Menangle Land Use and Infrastructure Strategies will provide a basis for future precinct plans, Local Environmental Plans and Development Control Plans. Each plan should re-inforce and deliver on the objectives of each other. For example, precinct plans should be consistent with the strategic directions in this document and the LEP should apply appropriate controls and ensure there are no conflicts of objectives applying to the conservation lands.

3.3.3 Funding

Biodiversity Certification will require funding of two stages:

1. The assessment and planning phase (i.e., field survey, assessment of impacts, development of an offset strategy),
2. The delivery and in-perpetuity management of the conservation areas

The stage 1 costs are predictable and short term. The funding for stage 2 is less predictable because offset costs will be driven by the price of biodiversity credits which are a market commodity. If land release occurs over a 30 year period it is conceivable that the purchase and retirement of credits could occur over that same period. Predicting credit costs any more than 1-2 years ahead at this stage would have a high level of uncertainty.

In order for precinct planning and delivery to be provided at no additional cost to government, the funding options could include:

- Both stages funded and managed by developer - potentially in partnership with other landholders
- Both stages funded and managed by the government – with re-imburement via a Special Infrastructure Contribution

If a Special Infrastructure Levy is used it would need to have a regular review period to adjust for biodiversity credit prices. Minimising impacts to biodiversity will reduce this risk.

3.3.4 Land ownership

Where biodiversity values coincide with recreational opportunities, consideration should be given to whether the land can be brought into an ownership arrangement that allows public access. This could include transfer of ownership to a public land manager such as the National Parks and Wildlife Service, local government or establishment of a Trust. If land is not bought into public ownership, the biodiversity values can still be maintained or improved, but the recreational value of the land may not be realised. Consideration should therefore be given to how conservation areas can be bought into public ownership through a voluntary process over the medium to long term.

Where recreational opportunities are identified within the conservation footprint, they will need to be consistent with the protection of conservation values. Walking trails should be designed to have low impact, whilst ‘active’ recreation such as sporting fields will not be consistent with the conservation outcomes.

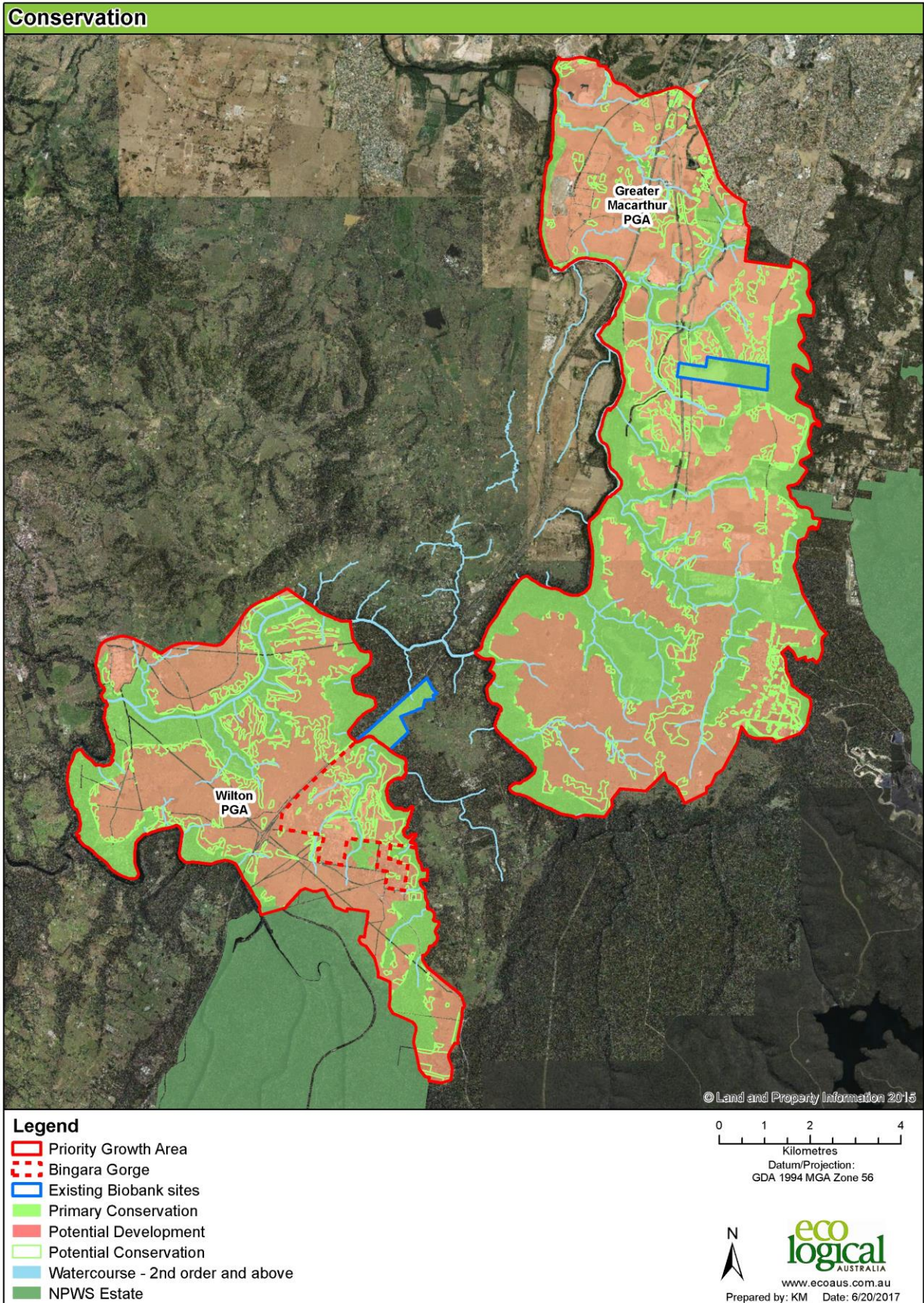


Figure 5 Proposed conservation outcomes

4 Outcomes of the biodiversity framework

This section provides a broad assessment of the conservation outcomes that would be achieved by the proposed Biodiversity Framework.

The limitations identified in previous sections are acknowledged, principally:

- That the vegetation mapping has not been ground truthed and that field survey will be required to confirm vegetation communities and threatened species.
- That the assessment is based on ecosystems and not species. Whilst many of the fauna species habitat aligns with particular ecosystem types, this is not the case for all species, particularly amphibians who are dependent on waterbodies. Similarly, threatened flora do not necessarily align with particular ecosystem types.

Figure 6 below shows the consistency of the proposed framework with the Cumberland Plain Recovery Plan 'Priority Conservation Lands', the OEH BioMap as well as demonstrating the connectivity links that are maintained or improved.

The proposed conservation network includes all lands identified in the 'Priority Conservation Lands' except for an area in the southern extent of the Wilton PGA where there is no vegetation.

The proposed conservation network maintains existing connectivity with all east-west corridors having a minimum width of 200m to facilitate fauna movement. Smaller local corridors are also recommended when retaining riparian zones on second order watercourses. Connectivity is therefore maintained, although it is acknowledged that fauna movement outside of the corridors is less likely to occur in an urbanised environment compared to the existing rural environment.

Table 6 below summarises the hectares of impact and conservation for each vegetation community based on the proposed conservation network. **Table 6** does not include the 'retained' land in Biobank sites which is already conserved and cannot be developed. Nor do the figures include impacts to derived native grasslands which have not been mapped.

Acknowledging the above, the conservation areas would protect and conserve approximately 3,080 ha (70%) of the total 4,360ha of the native vegetation in the PGAs. This is likely an underestimate, as a percentage of the 'potential conservation' vegetation within the urban footprint is also likely to be conserved. It is not possible to accurately assess what this percentage is until a Precinct Planning process and Biodiversity Certification process has been undertaken. The following statistics are therefore a conservative estimate of the conservation outcomes.

For PCTs 835, 1292, 1395, 1181, a greater amount of each PCT is within the conservation area compared to the development footprint. If the proposed development/conservation areas were confirmed via a precinct planning and Biodiversity Certification process, these communities would most likely result in a positive credit balance under the Biodiversity Certification Assessment Method. Although it is not necessary, it is likely that all ecosystem credits could be sourced from within the PGAs or adjoining lands.

For PCTs 830, 849, 850, 1081 and 1253, there is more vegetation in the development footprint than the conservation footprint (although for PCT it is 1081 it is reasonably evenly split). This is due to these

vegetation communities occupying the flatter lands that are more suitable for development. Assessing the outcomes in the Biodiversity Certification Assessment Method will be necessary to determine whether individually – or as vegetation classes – these PCTs would have a positive or negative credit balance. A positive balance may occur if the areas being impacted are generally in poor condition and the areas being protected are in good condition. Precinct Planning will determine if additional areas of these communities can be protected and would be confirmed in the Biodiversity Certification Strategy for the site.

If implemented, the Biodiversity Framework would result in the streamlining of development on agreed ‘certified lands’ and guaranteeing the conservation of the high biodiversity value areas. The ‘development’ sites would provide a potential funding source for the in-perpetuity protection and management of the conservation areas. The choice to put these lands under a conservation (or Stewardship) agreement remains with the land owner - such agreements are voluntary. If the landowners choose not to put their land under a conservation agreement to generate biodiversity credits, the credits required to offset the impacts would need to be sourced elsewhere on the Cumberland Plain. In either scenario, the credits would need to be purchased and retired prior to impact on ecological values.

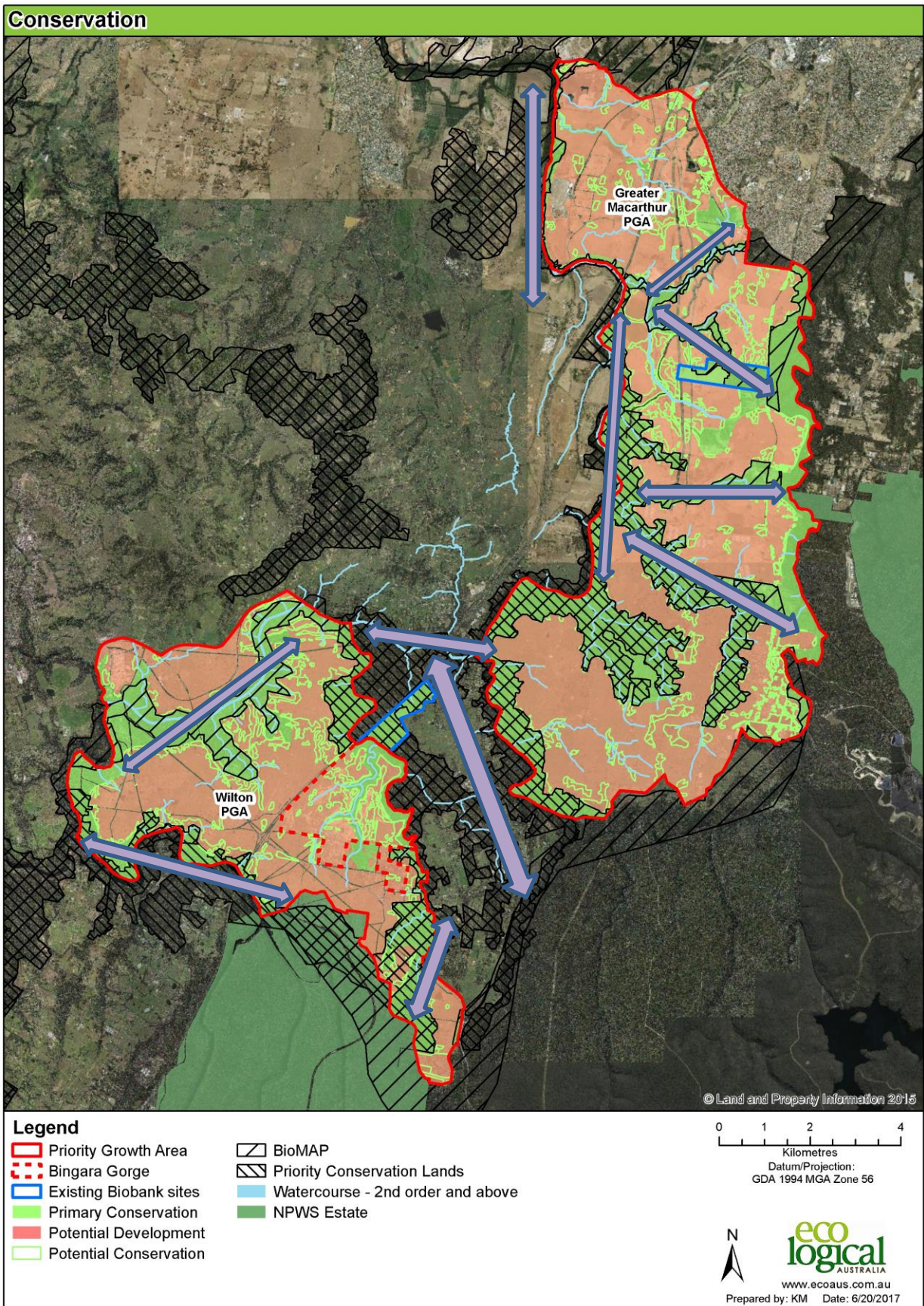


Figure 6 Connectivity and PCL analysis

Table 6 Vegetation conservation and potential impact summary

PCT	Name	EEC or CEEC	Total hectares of vegetation in the two PGAs combined	Wilton		Greater Macarthur		Combined (ha)		Combined (%)	
				Conserve (ha)	Potential impact or conservation (ha)	Conserve (ha)	Potential impact or conservation (ha)	Conserve (ha)	Potential impact or conservation (ha)	% potential impact or conservation	% conserved
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	163.25	0.29	0.00	121.89	27.80	122.18	27.80	17.03	74.84
1292	Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion		62.36	45.79	0.00	15.72	0.45	61.50	0.45	0.72	98.63

Wilton and Greater Macarthur Priority Growth Areas –Biodiversity Study

830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Moist Shale Woodland in the Sydney Basin Bioregion	11.17	0.00	0.00	0.37	10.48	0.37	10.48	93.80	3.33
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	186.23	0.00	7.33	40.62	102.13	40.62	109.47	58.78	21.81
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	151.71	0.00	0.00	23.19	111.98	23.19	111.98	73.81	15.28
1395	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Shale/Sandstone Transition Forest	2797.40	715.07	373.33	1267.58	356.52	1982.66	729.84	26.09	70.87

Wilton and Greater Macarthur Priority Growth Areas –Biodiversity Study

1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion		175.56	2.92	32.19	94.63	43.90	97.55	76.09	43.34	55.56
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion		803.93	381.76	17.74	370.72	25.57	752.48	43.31	5.39	93.60
1253	Sydney Peppermint - White Stringybark - Smooth-barked Apple forest on shale outcrops, Sydney Basin Bioregion		8.42	0.03	8.39	0.00	0.00	0.03	8.39	99.64	0.36
		Total	4360.03	1145.86	438.98	1934.72	678.83	3080.58	1117.82	25.64	70.66

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