



## Reeves Creek Rezoning – Remembrance Drive, Picton

### Biodiversity and Riparian Land

Prepared for  
**Dartanyon Pty Ltd**

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Project Manager	Robyn Johnson Senior Environmental Consultant Suite 204, 62 Moore Street, Austinmer NSW 2515
Prepared by	Robyn Johnson, Michelle Dawson, Katherine Lang, Ashlee Clarke, Kate Kline
Reviewed by	Bruce Mullins and David Bonjer
Approved by	Bruce Mullins
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# Abbreviations

Abbreviation	Description
APZ	Asset Protection Zone
AW	Alluvial Woodland
BBAM	Biobanking Assessment Methodology
BCAM	Biodiversity Certification Assessment Methodology
CEEC	Critically Endangered Ecological Community
CPW	Cumberland Plain Woodland
DCP	Development Control Plan
DoE	Commonwealth Department of the Environment (formerly the Department of Sustainability, Environment, Water, Population, and Communities, SEWPaC)
DNG	Derived Native Grassland
DNS	Derived Native Shrubland
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	<i>NSW Fisheries Management Act 1994</i>
GDEs	Groundwater Dependent Ecosystems
GIS	Geographic Information Systems
GPS	Global Positioning System
ILP	Indicative Layout Plan
LEP	Local Environmental Plan
NOW	NSW Office of Water
OEH	NSW Office of Environment & Heritage
P&I	NSW Planning and Infrastructure (now Department of Planning and Environment)
PBP	<i>Planning for Bushfire Protection</i>
RC	Riparian corridor
RF Act	<i>NSW Rural Fires Act 1997</i>
RFEF	River-flat Eucalypt Forest
SHW	Shale Hills Woodland
SPW	Shale Plains Woodland

Abbreviation	Description
SSTF	Shale Sandstone Transition Forest
SSR	<i>Specialist Studies Requirements – Picton East Planning Proposal</i> (Wollondilly Shire Council).
TSC Act	<i>NSW Threatened Species Conservation Act 1995</i>
VMP	Vegetation Management Plan
VRZ	Vegetated riparian zone
WM Act	<i>NSW Water Management Act 2000</i>

# Executive summary

Eco Logical Australia was engaged by Michael Brown Planning Strategies Pty Ltd on behalf of Dartanyon Pty Ltd to assess the biodiversity and riparian values of lands within the Reeves Creek rezoning study area, and to consider those against the Indicative Layout Plan (ILP) and rezoning that has been prepared, to determine the suitability of the proposal in light of the environmental values identified.

The Reeves Creek watercourse runs predominately south to north west through the study area. There are a number of reaches upstream of Reeves Creek that are in a highly modified and degraded state. The natural geomorphic conditions have been extensively altered through the creation of dams, clearing of native vegetation, unrestricted access for cattle grazing and the proliferation of weeds. Despite this, the larger reaches of Reeves Creek have a high recovery potential given the presence of AW and other remnant riparian vegetation.

Habitat features were generally lacking and unlikely to support the threatened species identified as having the potential to occur within the study area. Four hollow bearing trees were identified, three within the study area and one on the study area boundary.

The study area is 39.1 ha, of which the majority is made up of cleared land or land dominated by exotic species. The remaining area is made up of Shale Hills Woodland (SHW) and Alluvial Woodland (AW) in varying levels of condition and recovery potential. SHW is a sub-community of Cumberland Plain Woodland, which is a critically endangered ecological community under both the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and NSW *Threatened Species and Conservation Act 1995* (TSC Act), although none of the SHW was in a state of condition to satisfy the EPBC Act listing criteria within the study area. Also present within the study area is the AW sub-community of River-flat Eucalypt Forest, which is an endangered ecological community under the TSC Act.

Areas of high, medium and low ecological constraint were identified across the study area. The ecological constraint ranking was determined on the basis of conservation status, condition, recovery potential, and habitat value. Endangered ecological communities in low to good condition (with moderate to high recovery potential) and hollow bearing trees were ranked as having a high ecological constraint, while areas cleared of native vegetation to pasture were considered low constraint.

The proposed ILP seeks to rezone the study area from its current RU2 Rural Landscape and R2 Low Density Residential zoning under *Wollondilly Local Environmental Plan 2011* (WLEP), to a combination of E2 Environmental Conservation, E3 Environmental Management, RE1 Public Recreation, R2 Low Density Residential and R3 Medium Density Residential zones.

The proposed ILP would rezone approximately 0.58 ha (23%) of the 2.49 ha of high ecological constraint AW within the study area to residential zones R2 or R3. The remaining 1.91 ha (77%) retained within an environmental conservation E2 zone. Approximately 2.59 ha (77%) of the SHW will be zoned residential (R2 or R3), however, more than 50% of this is either Derived Native Grassland or Derived Native Shrubland that is in low condition with only moderate to very low recovery potential. In general, these vegetation types are located in relatively small isolated patches within the cleared parts of the study area. The remaining 0.76 ha (23%) of SHW would be retained within an E3 environmental management zone.



Five reaches Reeves Creek with high riparian recovery potential and one with low recovery potential would be rezoned within as E2 Environmental Conservation. One reach would be removed and offset within the averaged riparian corridor and another reach was determined not to be waterfront land.

ELA has calculated that a riparian corridor of 6.0 ha is required within the study area to meet the NSW Office of Water (NoW) guidelines. This riparian corridor area can be achieved by the current ILP by application of the averaging rule (NoW 2012) within the riparian areas of the study area and immediately adjacent within residual lands proposed for rezoning at a later stage. The current ILP has been developed in consultation with the NoW, who have provided their in-principle support for the proposed layout.

Given the environmental features of the study area and the land uses proposed in the ILP, the rezoning of the land is not likely to result in unacceptable environmental impacts and is considered to provide a suitable balance between the maintenance and protection of the biodiversity values of the study area, and orderly urban development.

# 1 Introduction

## 1.1 Project background

Eco Logical Australia (ELA) was engaged by Michael Brown Planning Strategies on behalf of Dartanyon Pty Ltd in 2013 to investigate ecological and riparian features of the 'study area' and to identify any potential constraints these would pose to rezoning of the study area for future urban development.

The Reeves Creek study area is located immediately east of Picton Town Centre within the Wollondilly Shire Council Local Government Area (LGA), in the south west of the Greater Sydney Region (**Figure 1**).

Wollondilly Shire Council (Council) has resolved to investigate the potential for rezoning the study area in accordance with a 'Gateway Determination' made by the former NSW Planning and Infrastructure (now Department of Planning and Environment (DPE)) and specifically the *Specialist Studies Requirements – Picton East Planning Proposal* (July 2013).

A portion of land to the immediate east, north and south of the study area is identified as 'residual lands' in **Figure 1** and is intended for future rezoning and urban development. In 2013, when ELA was engaged for this rezoning assessment, the residual lands formed part of the study area and field works were undertaken over both the study area and residual lands. This report details the outcomes of ecological and riparian investigations in the context of the proposed changes in land use for the study area. Detailed information is not provided for the residual lands, except to the limited extent required to address specialist study requirements in **Section 5.4**.

## 1.2 Field work approach

When the field works were conducted in September 2013 it was intended that the residual lands be rezoned at the same time as the study area. The field survey method was agreed and carried out in accordance with the Biodiversity Certification Assessment Methodology (BCAM) (OEH 2011) considering both the study and the residual lands as one site. Following field works, ELA were informed that the gateway approval only allowed the rezoning of the study area (and not the residual lands) and that the study area on its own was no longer proposed for Biodiversity Certification.

In this regard, while survey requirements have been undertaken in accordance with the BCAM, potential environmental impacts and the broader suitability of this proposal have been assessed using a conventional approach based on an assessment of the proposal and the ecological and riparian values of the study area. Should formal Biodiversity Certification be sought in the future, impacts for the study area and / or residual lands would need to be assessed and calculated in accordance with the BCAM.

## 1.3 The Reeves Creek study area

The Reeves Creek study area (39.1 ha) and residual lands comprise 121.5 ha and they are located at 108 – 114 Menangle Street, Picton. The study area and residual lands comprise three parcels, being:

- Lot 2 Deposited Plan (DP) 229679
- Lot 6 DP 1111043
- Lot 9 DP 233840.

The study area and residual lands are largely bounded by private land and front onto Remembrance Driveway to the north, Menangle Street to the west, and can be accessed directly from Margaret Street and Baxter's Lane.

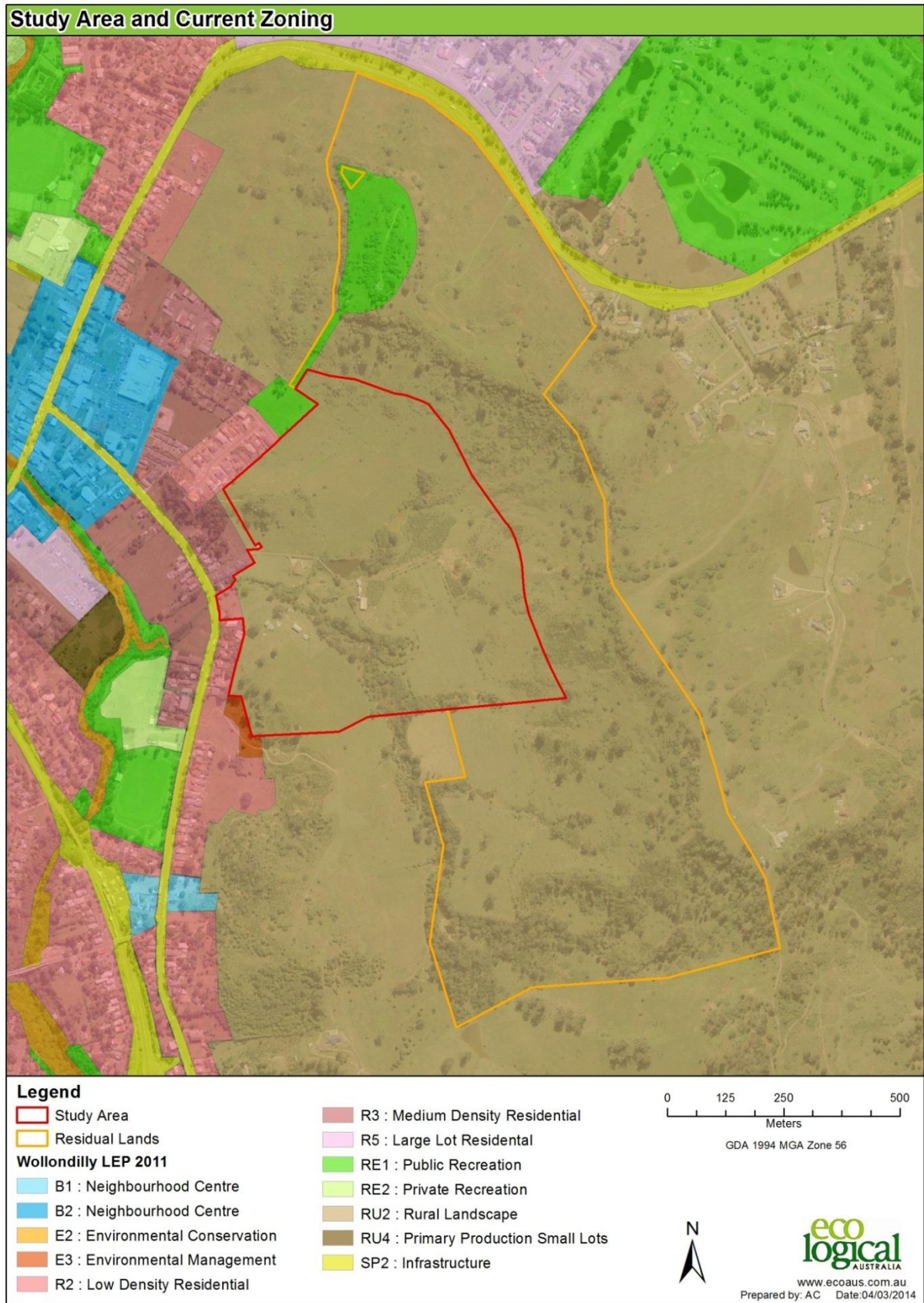
The study area and residual lands are predominately rural land with patches of native and exotic vegetation primarily along creeks, ridge tops and steeper slopes. The area is gently sloping on the boundary with Menangle Street and steeper on the upper slopes to the east. Most of the area falls to the west with smaller stream reaches running into Reeves Creek. Three native vegetation communities have been previously mapped including Shale Hills Woodland, Shale Sandstone Transition Forest (Low Sandstone Influence) and Alluvial Woodland (NPWS 2002). The remainder has been extensively cleared and modified for agricultural purposes, primarily dairy and beef production and has a number of mature scattered paddock trees. The study area and residual lands are currently being used for low intensity cattle grazing.

The study area is currently zoned RU2 Rural Landscape and R2 Low Density Residential under *Wollondilly Local Environmental Plan 2011* (WLEP), as shown in **Figure 2**. It is proposed to amend the WLEP and rezone the study area into the following zones: E2 Environmental Conservation, E3 Environmental Management, R2 Low Density Residential, R3 Medium Density Residential, RE1 Public Recreation and RU2 Rural Landscape, as shown in **Figure 3**.



Figure 1: Location of study area and residual lands





**Figure 2: Reeves Creek study area and current zoning**



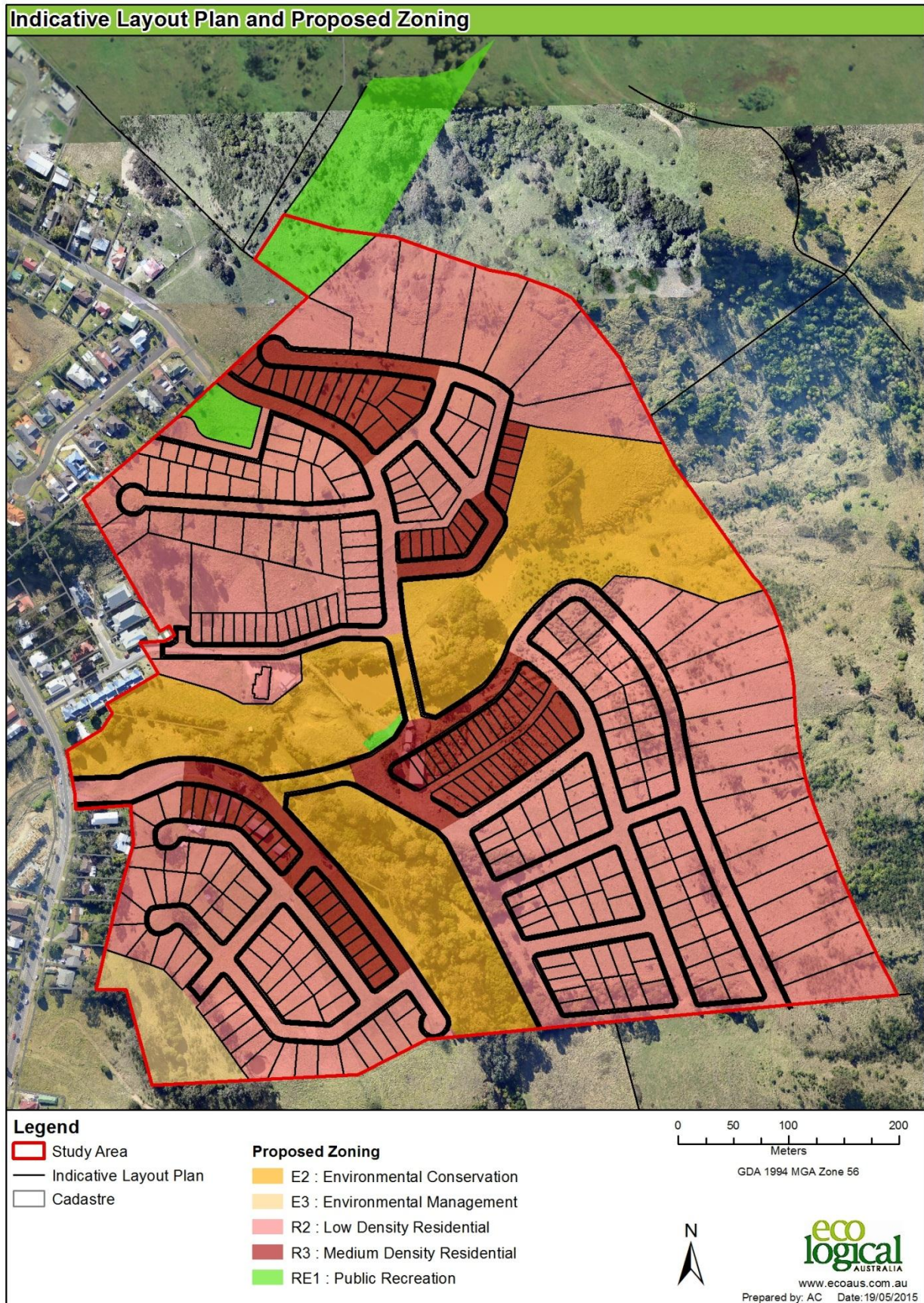


Figure 3: Proposed zoning and indicative layout plan

## 2 Legislative requirements

The following section provides a brief description of the relevant legislation and outlines how it pertains to the study area and proposed rezoning.

### 2.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a national scheme for protecting the environment and conserving biodiversity values. The EPBC Act stipulates that approval from the Commonwealth Environment Minister is required if a development is likely to have a significant impact on matters considered to be of National Environmental Significance (MNES).

The potential impact of development in the study area on any threatened species, populations or communities is assessed at the development application stage, and not at the rezoning stage. If the activity is likely to have a significant impact on MNES, the proponent may make a 'Referral' to the Commonwealth Department of the Environment (DoE). DoE will then determine if the action is a controlled or a non-controlled action. Controlled actions require a full assessment under Part 8 of the *EPBC Act* and approval under Part 9. Non controlled actions may proceed without further assessment or approval by the Commonwealth. Assessments under the EPBC Act can run concurrently with assessments under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and NSW *Threatened Species Conservation Act 1995* (TSC Act).

Note that a planning proposal (i.e rezoning) is not considered an 'action' under the EPBC Act and, therefore, does not require referral to the Commonwealth.

### 2.2 Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for the state, providing a framework for the overall environmental planning, and development assessment process. Various legislative instruments, such as the TSC Act, NSW *Water Management Act 2000* (WM Act) and NSW *Rural Fires Act 2007* (RF Act) are integrated with EP&A Act and have been reviewed below.

Part3, Division 4 of the EP&A Act describes the steps that must be taken to prepare or amend an LEP in accordance with the 'gateway' process. Under this framework, a planning proposal is prepared by the local planning authority. The proposal includes a summary of intended outcomes together with a justification on why the proposal should proceed. The proposal is then determined by the Minister (or their delegate) under the 'gateway' approval process. The Minister may either reject the proposal or include specific requirements under which it can proceed, such as the preparation of additional studies to determine environmental impacts, including impacts to threatened species, populations or ecological communities. The gateway approval may also delegate plan making powers to the local planning authority, which is then responsible for ensuring the application proceeds in accordance with Ministers approval and the broader requirements of the Act.

A gateway determination for the proposed rezoning was issued by NSW Planning and Infrastructure (now DPE) on 28 March 2013 (Ref: PP\_2013\_WOLLY\_002\_00). This report addresses the specialist study requirements relevant to biodiversity, bushfire and the residual lands.



### 2.3 Threatened Species Conservation Act 1995

The NSW *Threatened Species Conservation Act 1995* (TSC Act) aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The TSC Act is integrated with the EP&A Act and requires consideration of whether a development (Part 4 of the EP&A Act) or an activity (Part 5 of the EP&A Act) is likely to significantly affect threatened species, populations and ecological communities or their habitat. Obligations placed on Councils under Part 3 of the EP&A Act when rezoning land include consideration of threatened species, populations, ecological communities and recovery plans.

The schedules of the TSC Act list species, populations and communities as endangered or vulnerable. All developments, land use changes or activities need to be assessed to determine if they will have an unacceptable impact on species, populations or communities listed on these schedules.

The potential impact of development within the study area on any threatened species, populations or communities is assessed using the Assessment of Significance (or 7 part test) under Section 5A of the EP&A Act at the development application stage, and not at the rezoning stage. If the impacts on the area are found to be 'significant', a Species Impact Statement would be required as would concurrence from the Director General of the NSW Office of Environment & Heritage (OEH).

### 2.4 Water Management Act 2000

The NSW *Water Management Act 2000* (WM Act) together with the *Water Act 1912* control the extraction of water, the use of water, the construction of works such as dams and weirs and the carrying out of activities in or near water sources in NSW. '*Water sources*' are defined very broadly and include any river, lake, estuary, or place where water occurs naturally on or below the surface and coastal waters.

If a '*controlled activity*' is proposed on '*waterfront land*', an approval is required under the WM Act. The WM Act is administered by the NSW Office of Water (NOW), who assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. '*Controlled activities*' include:

- *The construction of buildings or carrying out of works;*
- *The removal of material or vegetation from land by excavation or any other means;*
- *The deposition of material on land by landfill or otherwise; or*
- *Any activity that affects the quantity or flow of water in a water source.*

Rezoning proposals are not considered 'activities' and therefore do not trigger approval requirements under the WM Act, however subsequent development of the study area may require approval and therefore planning proposals should address issues of riparian protection that are consistent with the NoW *Guidelines for Riparian Corridors on Waterfront Land* (NoW 2012).

Stream classification in NSW is now completed according to the Strahler Stream Ordering process and riparian corridors widths are assigned based on the relevant stream order.

### 2.5 Fisheries Management Act (1994)

The NSW *Fisheries Management Act 1994* (FM Act) replicates the protections of the TSC Act for aquatic (freshwater and marine) species, including fish, insects, molluscs, crustaceans, echinoderms and polychaetes but does not include whales, mammals, reptiles, birds, amphibians or species specifically excluded. Field and desktop survey work have not identified any species within the study area or surrounding area that are protected under the FM Act, however, any activity proposed that



would block or interfere with fish passage will require a permit under this Act, at the development application stage.

## 2.6 Rural Fires Act (1997)

Bushfire issues are regulated by the NSW *Rural Fires Act 1997* (RF Act). Both the EP&A Act and the RF Act were modified by the *Rural Fires and Environmental Assessment Legislation Amendment Act* in 2002 to enhance bushfire protection through the development assessment process (NSW RFS 2006b). Key requirements of the RF Act include:

- The need for a bushfire safety authority to be issued by the RFS under section 100B of the RF Act for any development applications for subdivision (therefore, considered integrated development); and
- All landowners to exercise a duty of care to prevent bushfire from spreading on or from their land under section 63 of the RF Act. This relates to the appropriate provision and maintenance of Asset Protection Zones (APZs), landscaping and any retained vegetation when developing land (NSW RFS 2006b).

The rezoning of land also requires consultation with the NSW RFS as the lead agency for managing bushfire issues. As such, rezoning aims to satisfy the requirements of *Planning for Bushfire Protection* (NSW RFS, 2006) guideline. Bushfire considerations and / or requirements in relation to the proposal are being considered under a separate *Bushfire Assessment* report, also prepared by ELA in 2015.

## 2.7 Local Environmental Plans

### 2.7.1 Wollondilly Local Environmental Plan (LEP) 2011

The Wollondilly Local Environmental Plan (WLEP) 2011 is the principal planning instrument for the Wollondilly Shire Local Government Area (LGA). The WLEP sets out the planning framework and establishes the requirements for the use and development of land in the LGA. The LEP provides broad direction with regard to what types of development are permitted within specific land use zones.

Under WLEP the study area is currently zoned RU2 Rural Landscape Zone and R2 Low Density Residential.

### 2.7.2 Wollondilly Development Control Plan (DCP) 2011

Wollondilly Development Control Plan (DCP) 2011 aims to make detailed local provisions for all land within the LGA. Specifically, the DCP provides detailed construction, building and environmental controls for the types of permitted land use described in WLEP. Environmental controls address issues such as biodiversity, water, bushfire prone land, land slip and subsidence, trees and vegetation, and salinity.

### 2.7.3 Wollondilly Growth Management Strategy (GMS) (2011)

The Wollondilly GMS sets the future direction for the LGA describing how it will accommodate future urban growth over the next 25 years. The GMS contains key policy directions that form an overall growth strategy for the LGA and all planning proposals (including the Reeves Creek proposed rezoning) must be considered against its requirements. One of its primary requirements is for the provision of housing near existing towns and villages in order to reduce the need for new infrastructure and community support services. In supporting the Reeves Creek Planning Proposal for Gateway determination, Council has determined that it generally meets the requirements of the GMS.

## 3 Methods

### 3.1 Literature and database review

The following information was reviewed prior to field survey to assist in locating threatened ecological communities, populations and species known or potentially occurring within the study area and surrounding lands:

- BioNet Atlas of NSW Wildlife (TSC Act scheduled flora and fauna, 10 km radius)
- EPBC Protected Matters Search Tool (EPBC Act scheduled flora, fauna and ecological communities, 10 km radius)
- NSW Department of Primary Industries Fisheries Records Viewer (FM Act threatened and protected species, 10 km radius)
- NSW National Parks and Wildlife Service (2002) Native Vegetation of the Cumberland Plain
- Threatened Species Profile Database, Biobanking Assessment Tool (OEH 2013a).

The likelihood of these threatened ecological communities, populations and species occurring within the study area is assessed in **Appendix A**, and was determined by reviewing records in the area, considering the habitat available within the study area during field assessment and using expert knowledge of the species ecology. These searches were initially undertaken prior to field survey in September 2013 and then updated in 2015.

### 3.2 Field survey

The field survey was carried out regarding the study area and residual lands as one site, as discussed in **Section 1.2**.

Terrestrial field work was undertaken on the 11, 12, 18 and 19 of September 2013 by four ELA ecologists: Bruce Mullins, Lucas McKinnon, Rebecca Dwyer and Dr Rodney Armistead for a period of 64 person hours. Lucas McKinnon is an Accredited BioBank Assessor (Accreditation No. 0076).

Riparian field work was undertaken on 17 and 18 September 2013 by ELA aquatic ecologist, Ian Dixon and environmental scientist, Jack Talbert. Field conditions during the assessment were generally cool and calm (**Table 1**).

Field survey was designed to validate vegetation community type, extent and condition; species identified for survey under the BCAM; and species 'known', 'likely' or with the 'potential' to occur within the combined study area and residual lands. Targeted survey was not undertaken given the limited habitat features for threatened species known, likely or potentially occurring within the study area or residual lands. Other threatened species are predicted to occur as ecosystem credits under the BCAM (e.g. microchiropteran bats) and have, therefore, been assumed to be present within the study area and residual lands.

**Table 1: Weather conditions during field survey (recorded at Station No. 068192 Camden, ~18 km north-east of the study area)**

Date	Temps		Rain	9:00 am					3:00 pm				
	Min	Max		Temp	Rh	Cld	Dir	Spd	Temp	Rh	Cld	Dir	Spd
	°c	°c		°c	%	8th		Km/h	°c	%	8th		Km/h
11	7.9	24.3	0	15.9	47	-	NW	13	23.3	19	-	W	22
12	3.6	23.8	0	14.5	57	-	E	4	22.4	24	-	WSW	24
17	8	22.6	0	16	64	-	SSW	11	19.3	55	-	ESE	17
18	10	24.6	0	19.6	49	-	WNW	20	23.5	29	-	W	20
19	12.9	23.2	0	17.4	29	-	WSW	24	21.5	20	-	WSW	31

### 3.2.1 Vegetation mapping

#### *Endangered ecological communities*

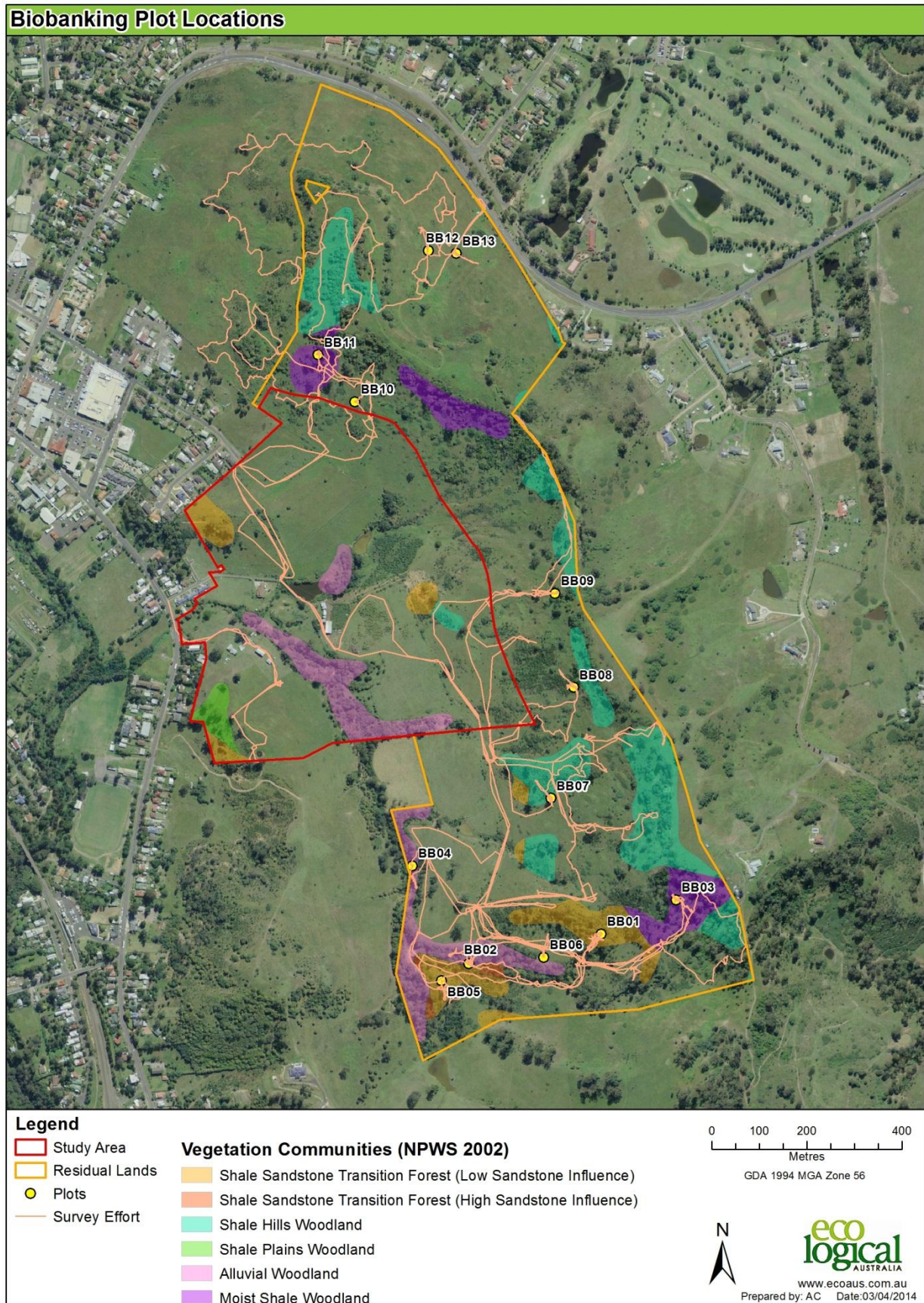
Vegetation mapping was undertaken using aerial photography and ground-truthing of the Cumberland Plain mapping (NPWS 2002, and updated in 2009). The field survey targeted locations that were considered representative of the mapped vegetation communities in their various condition states across the 121.5 ha of the combined study area and residual lands. A discrete vegetation type in a particular condition is referred to as a vegetation unit.

Vegetation surveys followed the NSW Biobanking Assessment Methodology (BBAM) (DECC 2008) (a 20 m x 20 m plot nested in a 20 m x 50 m plot). Within the 20 m x 20 m (0.04 hectare (ha)) all visible vascular flora species observed were recorded, along with cover and abundance for each species using a modified Braun-Blanquet scale (i.e. measures of cover and abundance to determine species dominating each stratum). Habitat features were determined over a 0.1 ha survey (50 m x 20 m quadrat); measures including number of hollow bearing trees and length of fallen dead timber greater than 10 centimetre (cm) diameter. Within the 0.1 ha quadrats, projected foliage cover of each strata level and exotic flora was assessed along a 50 m transect. Thirteen BBAM plots representative of the vegetation within the study area and residual lands were conducted and a list of all species were recorded (**Appendix B**). The location of the assessment plots and survey effort is provided in **Figure 4**.

Transect habitat assessments were undertaken following the BBAM (DECC 2008). Visual assessments were also undertaken for vegetation patches scattered throughout the study area and residual lands.

Vegetation boundaries were marked on aerial photography and mapped using Geographic Information Systems (GIS). Where delineation of boundaries in the field was not obvious from the aerial photography, boundaries were marked using a Global Positioning System (GPS). Traverses were undertaken in areas of grassland to compile a list of species, to estimate the cover abundance of each species in order to determine whether Derived Native Grasslands (DNG) of the 'Cumberland Plain Woodland in the Sydney Basin Bioregion' (CPW) under the TSC Act were present. DNG are areas of the CPW that have been historically cleared of over storey vegetation but are still considered a component of the broader CPW ecological community under the TSC Act. Similar areas that have been cleared of canopy species but retain mid storey and ground layer species have been identified as Derived Native Shrubland (DNS) of the CPW community. A list of flora identified during the field work is provided in **Appendix B**.





**Figure 4: Biobanking plot locations and survey effort**



### 3.2.2 Threatened flora

Random meanders for threatened flora species were undertaken in areas of potential habitat, in accordance with DECCW guidelines (DEC 2004). The location of random meanders was determined in the field based on site conditions and the experience of the ecologists to identify any threatened flora species potentially occurring.

### 3.2.3 Threatened fauna

#### Avifauna

##### *Diurnal Birds*

Opportunistic records of diurnal birds were taken during the four day survey period.

##### *Nocturnal Birds*

Nocturnal bird survey focused on identifying evidence of owls (owl wash and faecal pellets) and potential roosting and / or nesting trees during the survey period. No stag watching or spotlighting was conducted during the survey period, as the nocturnal bird species listed in **Appendix A** were assumed to be present within the study area and residual lands under the BCAM.

#### Mammals

##### *Ground dwelling and arboreal mammals*

Habitat assessments were conducted for ground dwelling and arboreal mammals. Random meanders of the study area and residual lands noted the presence of different habitat types (riparian, woodland, grassland, low shrubs, waterbodies, hollow bearing trees, man-made structures, etc). Opportunistic observations and evidence of these fauna were noted throughout the survey period.

##### *Microchiropteran bat species*

A daytime search was undertaken for preferred habitat features for microbats, such as escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels within the study area and residual lands. The bat species listed with the potential to occur in **Appendix A** were assumed to be present within the study area and residual lands under the BCAM. More intensive survey for microbats, in the form of anabat detection may be required to assess potential impacts to resident species at the development application stage.

#### Reptiles and amphibians

Opportunistic observations and habitat assessment for reptiles and amphibians were undertaken throughout the field survey. Locations focused on water bodies and fallen logs; however, no targeted survey was undertaken given the lack of suitable habitat for target species such as the *Litoria aurea* (Green and Golden Bell Frog).

#### Invertebrates

Field survey and habitat assessments for *Meridolum corneovirens* (Cumberland Plain Land Snail) were undertaken in SHW, where litter had accumulated around the base of eucalypts during the survey period.

## Fish

Threatened fish surveys were not conducted during the field survey, as a review of the database listed threatened fish species dependant on in-stream habitat revealed that none are likely to occur within the aquatic habitats present in the study area or residual lands. No threatened or protected fish species were considered to have the potential, be likely or were known in the study area or residual lands.

### **3.3 Ecological assessment**

#### **3.3.1 Vegetation condition**

Vegetation condition categories (Good, Moderate and Low) were assigned to the vegetation communities validated in the field in accordance with the EPBC and TSC Act criteria for CPW, where relevant. Using a combination of the vegetation mapping (NPWS 2002), aerial photograph interpretation and site validation, each patch of vegetation with a canopy cover was assigned a condition category based on its condition, density of canopy and area (ha). These classification rules for this process are explained in **Appendix C – Table 10** and **Table 11**.

#### **3.3.2 Vegetation recovery potential**

A recovery potential rating of High, Moderate, Low and Very Low was assigned to each vegetation unit using the 'recovery potential' matrix in **Appendix C – Table 12**. The matrix considers a range of factors including landuse history, soil condition and vegetation composition.

#### **3.3.3 Ecological constraints**

Following the literature review, field survey and assessment of vegetation condition and recovery potential, ecological constraints were assigned to vegetation patches and habitat features within the study area. Depending on the site characteristics, ecological constraints were ranked as high, moderate and low. The criteria for each of these levels was determined during the project and identified in **Section 4.8**.

### **3.4 Riparian assessment**

#### **3.4.1 Top of bank mapping**

A Top of Bank (ToB) survey was conducted for all mapped watercourses (shown on the current 1:25,000 topographic map series) within the study area and residual lands. The survey was done using a differential GPS (accuracy 50 cm - 70 cm) and the resulting mapping used as the basis for determining the initial riparian buffer delineation and riparian corridor boundaries.

#### **3.4.2 Stream classification**

Each stream reach within the study area was classified using the Strahler stream ordering system. The system classifies streams based on the number of confluences a watercourse has with other streams. For example, a watercourse at the top of the catchment that does not join with another is classified as a 1<sup>st</sup> order stream. Where two 1<sup>st</sup> order streams join the resulting watercourse is classified as a 2<sup>nd</sup> order stream. Where two 2<sup>nd</sup> order streams meet the resulting water course is then classified as a 3<sup>rd</sup> order stream and so on.

Each stream order has a corresponding recommended riparian corridor (RC) width requirement as specified by the NoW (2012) guidelines (**Table 2**). The vegetated riparian zone (VRZ) contains areas formerly referred to as the core riparian zone (CRZ) and the vegetated buffer (VB) and is measure from the mapped 'top of bank'.

**Table 2: NOW (2012) stream ordering and riparian corridor specifications**

Watercourse type	VRZ width (each side of watercourse)	Total RC width
1 <sup>st</sup> Order	10 m	20 m + channel width
2 <sup>nd</sup> Order	20 m	40 m + channel width
3 <sup>rd</sup> Order	30 m	60 m + channel width
4 <sup>th</sup> Order	40 m	80 m + channel width

### 3.4.3 Stream condition and recovery potential

The riparian assessment assigned a condition class to the various stream reaches that were confirmed within the study area and residual lands. Reaches that were not classified are deemed to be of limited riparian value or do not meet the definition of a river and are, therefore, suitable for engineered drainage solutions.

Each watercourse was given an individual identifying code to enable clear descriptions of the relevant sections (reach) of each watercourse. The condition of each reach was assessed, along with its recovery potential, based on its hydrological, physical, water quality and aquatic habitat and streamside vegetation characteristics. The condition of each reach was classified into one of the following categories:

- Near intact condition
- Good condition
- Moderate condition
- Degraded condition.

### 3.4.4 Groundwater dependant ecosystems

Groundwater Dependant Ecosystems (GDEs) are defined as ecosystems whose current species composition, structure and function are reliant on a supply of groundwater (Eamus 2009) as opposed to surface water supplies from overland flow paths. The frequency of groundwater influence may range from daily to inter-annually, however, it becomes clearly apparent when either the supply of groundwater or its quality (or both) is altered for a sufficient length of time to cause changes in plant function. Groundwater use by an ecological community or species does not necessarily imply groundwater dependence (Dressel et al 2010).

In Australia, the majority of ecosystems have little to no dependence on groundwater, although the full understanding of the role of groundwater in maintaining ecosystems is generally poor. The exception to this is wetland communities, for which it is thought that most have some level of dependence on groundwater resources (Hatton and Evans 1998).

GDEs are generally classified into six categories (SCCG 2006, SKM 2001):

- **Terrestrial vegetation** – forests and woodland which develop a permanent or seasonal dependence on groundwater, often by extending roots into the water table
- **Base flow in streams** – aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow
- **Aquifer and cave systems** – aquatic ecosystems that occupy caves or aquifers

- **Wetlands** – aquatic communities and fringing vegetation that depend on groundwater fed lakes and wetlands
- **Estuarine and near shore marine ecosystems** – various ecosystems including mangroves, salt marsh and seagrass, whose ecological function has some dependence on groundwater discharge
- **Terrestrial fauna** – fauna species assemblages reliant on groundwater for drinking water
- A final category is also recognised – **not apparently dependant**. This category acknowledges that some ecosystems, particularly wetland and riparian vegetation, might superficially appear to be groundwater dependent while in fact they are dependant entirely on surface flows and or rainfall.

## 4 Results

The following section outlines the results for the study area only, and not the residual lands (which are no longer the subject of this rezoning proposal).

### 4.1 Literature and database review

A search of the online EPBC Act Protected Matters Search Tool (DoE 2013) was performed on 23 October 2013 and updated on 23 February 2015 (DoE 2015). The BioNet Atlas of NSW Wildlife (OEH 2013a) was performed on 24 October 2013 and updated on 23 February 2015 (OEH 2015). These searches utilised a 10 km grid centered on the study area.

The location of threatened species recorded within these Commonwealth and NSW databases in proximity to the study area and residual lands are shown in **Figure 5**. The desktop review identified four threatened ecological communities, nine threatened flora and 34 threatened fauna previously recorded within 10 km of the study area and residual lands. The likelihood of these occurring within the study area and residual lands is assessed in **Appendix A**.



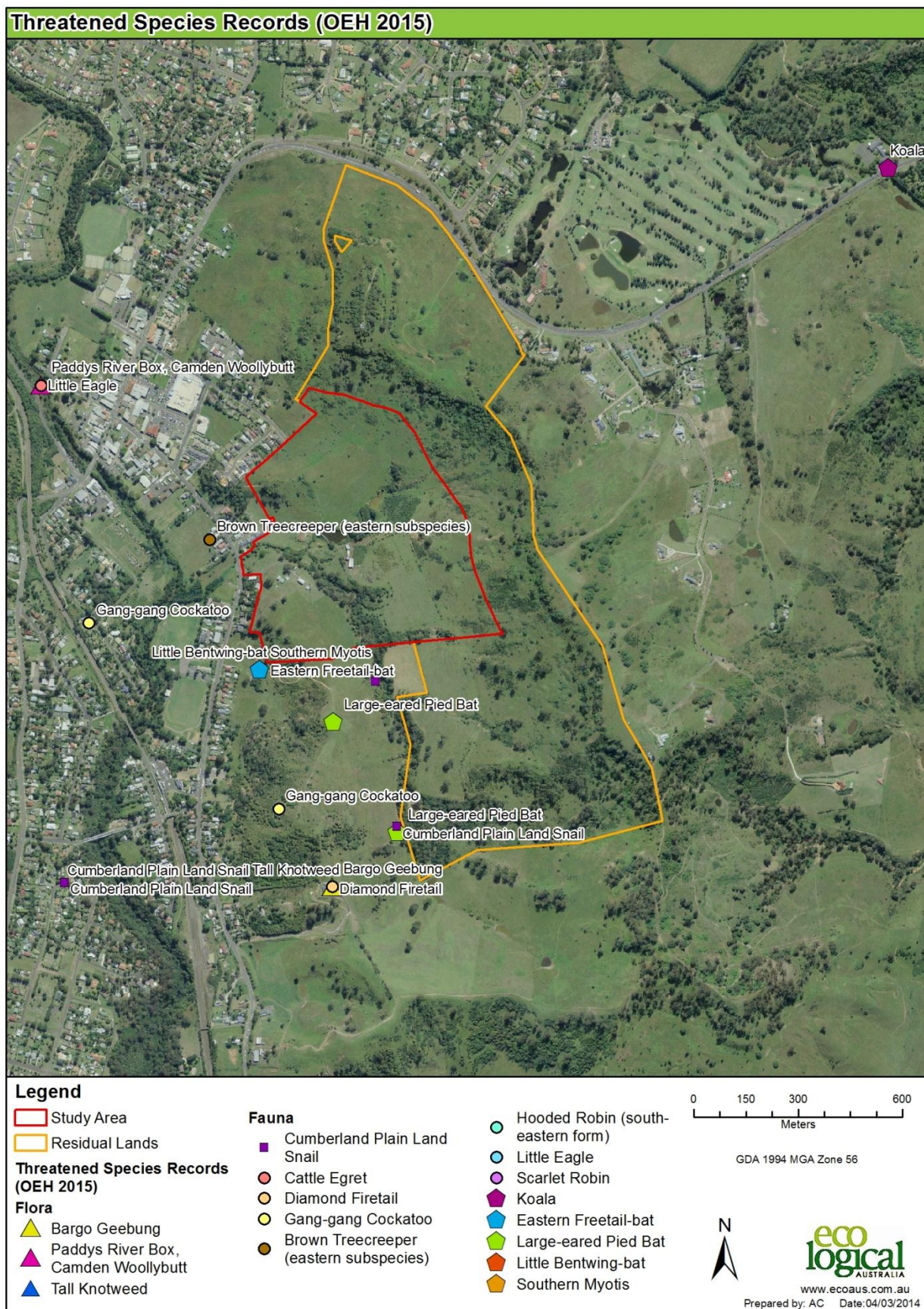


Figure 5: Threatened species records from the Bionet Atlas of NSW Wildlife search



## 4.2 Vegetation mapping

The field survey validated the type, extent and condition of vegetation communities previously classified by NPWS (2002, and updated in 2009), as shown in **Figure 4**. Within the study area, the following vegetation communities were identified and their extent shown in **Figure 6**:

- Shale Hills Woodland (SHW) - (Open Woodland)
- SHW – Derived Native Shrubland (DNS)
- SHW – Derived Native Grassland (DNG)
- Alluvial Woodland (AW)
- Exotic vegetation
- Exotic pasture.

Some areas that were previously mapped as Shale Sandstone Transition Forest (SSTF) were field validated as SHW (Open Woodland), SHW (DNS) and SHW (DNG), while Shale Plains Woodland (SPW) does not occur within the study area.

The relationship between the field validated vegetation mapping units classified by NPWS, Plant Community Types (OEH 2011), and threatened ecological communities listed under the TSC Act are included in **Table 3**. The remainder of the study area was made up of exotic vegetation and exotic pastures.

**Table 3: Relationship between vegetation and threatened ecological communities in the study area**

Native Veg Of Cumberland Plain (NPWS 2002)	Plant Community Types (PCTs) (OEH 2011)	Threatened Ecological Community (TSC Act)	Amount Of Threatened Ecological Community Validated in the Study Area (ha)
Shale Hills Woodland (MU 9)	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	3.35 ha
Alluvial Woodland (MU 11)	Forest Red Gum – Rough Barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Region	River Flat Eucalypt Forests of the NSW North Coast, Sydney basin and South- East corner Bioregions <sup>1</sup>	2.49 ha

Validated vegetation communities within the residual lands are discussed briefly in **Section 5.4** in order to address the specialist study requirements.



Figure 6: Validated vegetation communities for study area and residual lands



#### 4.2.1 Shale Hills Woodland

Shale Hills Woodland (SHW) is listed under both the EPBC and TSC Acts, however none of the SHW within the study area meets the condition criteria to be classified as Cumberland Plain Shale Woodland & Shale Gravel Transition Forest (CPSW & SGTF) and is listed as a Critically Endangered Ecological Community (CEEC) under the EPBC Act.

Approximately 3.35 ha of SHW has been validated within the study area. This SHW is a sub-community of Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) and is listed as a CEEC under the TSC Act. Of this, 1.80 ha was SHW (Open Woodland), 0.98 ha was SHW (DNS) and 0.57 ha was SHW (DNG) (**Figure 6**). A brief description of the various forms of SHW identified during the field work is provided below.

##### *SHW Open Woodland*

The open woodland canopy was made up of *E. tereticornis* (Forest Red Gum), with a shrub layer dominated by *Bursaria spinosa* (Native Blackthorn). *Brachychiton populneus* (Kurrajong) was also present as a canopy species. Exotic shrub species were present including *Lycium ferocissimum* (African Boxthorn) and *Olea europaea* subsp. *cuspidata* (African Olive).

The groundcover vegetation included the native species *Poa labillardieri* (Common Tussock Grass), *Glycine tabacina*, *Glycine clandestina*, *Cynodon dactylon* (Common Couch) and *Dichondra repens* (Kidney weed). Exotic groundcovers commonly recorded include *Paspalum dilatatum* (Paspalum), *Pennisetum clandestinum* (Kikuyu), *Medicago* spp. (Medic), *Sida rhombifolia* (Paddy's Lucerne), *Senecio madagascariensis* (Fireweed) and *Trifolium* spp. (Clover).

##### *SHW Derived Native Shrubland (DNS)*

Canopy vegetation had been completely removed, with a mid-storey dominated *Bursaria spinosa*. Groundcover vegetation included native species *Eragrostis leptostachya* (Paddock Lovegrass), *Aristida ramosa* (Purple Wire-grass), *Poa* spp., *Dichondra repens* and *Themeda australis* (Kangaroo grass). Exotic groundcovers commonly recorded include *Medicago* spp., *Lolium perenne*, *Trifolium* spp., *Lantana camara* (Lantana), *Olea europaea* subsp. *cuspidata* and *Verbena bonariensis* (Purpletop).

##### *SHW Derived Native Grassland (DNG)*

Typical of DNG, the woody mid and overstorey vegetation had been completely removed. Groundcover vegetation included native species *Glycine tabacina*, *Glycine clandestina*, *Eragrostis leptostachya* (Paddock Lovegrass), *Cynodon dactylon* and *Hypericum gramineum* (Small St. John's Wort). Exotic groundcovers commonly recorded include *Paspalum dilatatum*, *Pennisetum clandestinum*, *Medicago* spp., *Lolium perenne* (Perennial Ryegrass) and *Trifolium* spp.

#### 4.2.2 Alluvial Woodland

Alluvial Woodland (AW) vegetation is a sub-community of the River-flat Eucalypt Forest (RFEF) and is listed as an Endangered Ecological Community (EEC) under the TSC Act. Approximately 2.49 ha of the AW community occurs along Reeves Creek and its tributaries within the study area (**Figure 6**).

The most common AW canopy species found within the study area were *Eucalyptus amplifolia* (Cabbage Gum) and *E. tereticornis* (Forest Red Gum). The shrub layer was dominated by the exotic species *Ligustrum lucidum* (Large-leaved Privet) and *Ligustrum sinense* (Small-leaved Privet), with the only native species present being *Bursaria spinosa*. Groundcover vegetation included *Microlaena*

*stipoides* (Weeping Grass), *Dichondra repens* and *Glycine clandestina*. Exotic groundcovers included *Ehrharta erecta* (Panic Veldtgrass) and *Asparagus asparagoides* (Bridal creeper).

### 4.3 Flora

The literature and database review indicated that there were no threatened flora species likely to occur within the study area or residual lands. No threatened flora species were recorded during the field works nor were they considered to have the potential to occur within the study area or residual lands.

A total of 160 flora species were observed during the field works in the study area and residual lands. Of these 98 were native, while the remaining 62 were exotic species.

Five weeds listed as noxious in the Wollondilly LGA (NSW DPI 2014) under the *Noxious Weeds Act 1993* were recorded within the study area and residual lands (**Table 4**). Under this Act, Class 4 noxious weeds must be managed in a manner that reduces their spread and incidence and continuously inhibits their reproduction. Three of these, plus an additional three species are Weeds of National Significance (WoNS).

**Table 4: Noxious Weeds and Weeds of National Significance identified**

Scientific name	Common name	NW Act class	WoNS
<i>Asparagus asparagoides</i>	Bridal Creeper	4	Yes
<i>Lantana camara</i>	Lantana	4	Yes
<i>Lycium ferocissimum</i>	African Boxthorn	4	Yes
<i>Opuntia stricta</i>	Prickly Pear	4	No
<i>Rubus fruticosus</i> sp. agg.	Blackberry	4	No
<i>Asparagus asparagoides</i>	Bridal Creeper	-	Yes
<i>Senecio madagascariensis</i>	Fireweed	-	Yes
<i>Lantana camara</i>	Lantana	-	Yes

### 4.4 Fauna

A total of 21 fauna species were observed within the study area and residual lands, of which 19 were native species and two exotic species. The majority of species observed were birds (14), with four mammals (two native species, two exotic species) and one amphibian. None of the species observed were listed as threatened under either the TSC or EPBC Acts.

The study area predominantly comprises an open grassland, with riparian woodland, scattered trees and shrubs, farm dams and hollow bearing trees as fauna habitat. Habitat diversity is low, and is best described as a rural landscape. Many of the birds recorded in the study area are typical of this landscape and these habitats.

Habitat assessments for threatened species with the potential to occur within the study area were also undertaken, and while relevant features were limited, hollow bearing trees in the south western corner

of the study area provide some value. Four hollow bearing trees were identified, three within the study area and one on the study area boundary.

## **4.5 Ecological assessment**

### **4.5.1 Vegetation condition**

The SHW (Open Woodland) vegetation within the study area is considered to be in low condition using the criteria in **Appendix C – Table 10** and this is shown in **Figure 7**.

The vegetation condition criteria in **Appendix C** only apply to vegetation with over-storey canopy cover. The SHW (DNG) and (DNS) community were generally made up of isolated remnants with a mid and understorey that were often missing or dominated by exotic species. In order to discuss the relative vegetation condition of these patches of the SHW community, ELA took into consideration past and current validated vegetation mapping, field observations, connectivity to other vegetation and patch size to assign a condition category and these patches were considered to be of low condition.

The 2.49 ha of AW within study area was assessed as being in good, moderate or low condition (**Figure 7**). The good condition AW comprised two separate patches along reach E of Reeves Creek.

### **4.5.2 Recovery potential**

Two separate patches of SHW (Open Woodland) on the western boundary of the study area were considered to have high recovery potential, despite having low vegetation condition (**Figure 8**). These areas remain largely uncultivated, evidenced by the presence of mature trees, and therefore, have groundcover vegetation dominated by native species with the potential to support recovery within the ground and mid storey strata.

All patches of AW within the study area were considered to have moderate recovery potential (**Figure 8**), with exception of a small patch in the east of the study area, which had very low recovery potential. Exotics within the riparian corridor currently contribute to bank stability along the creek and with future weed control and vegetation rehabilitation under a Vegetation Management Plan (VMP) there is potential to increase biodiversity values of these areas.

The remainder of the study area is predominately cleared, modified or exotic, these areas were considered to be of very low recovery potential, including small isolated patches of SHW and AW.





Figure 7: Vegetation condition for validated vegetation communities



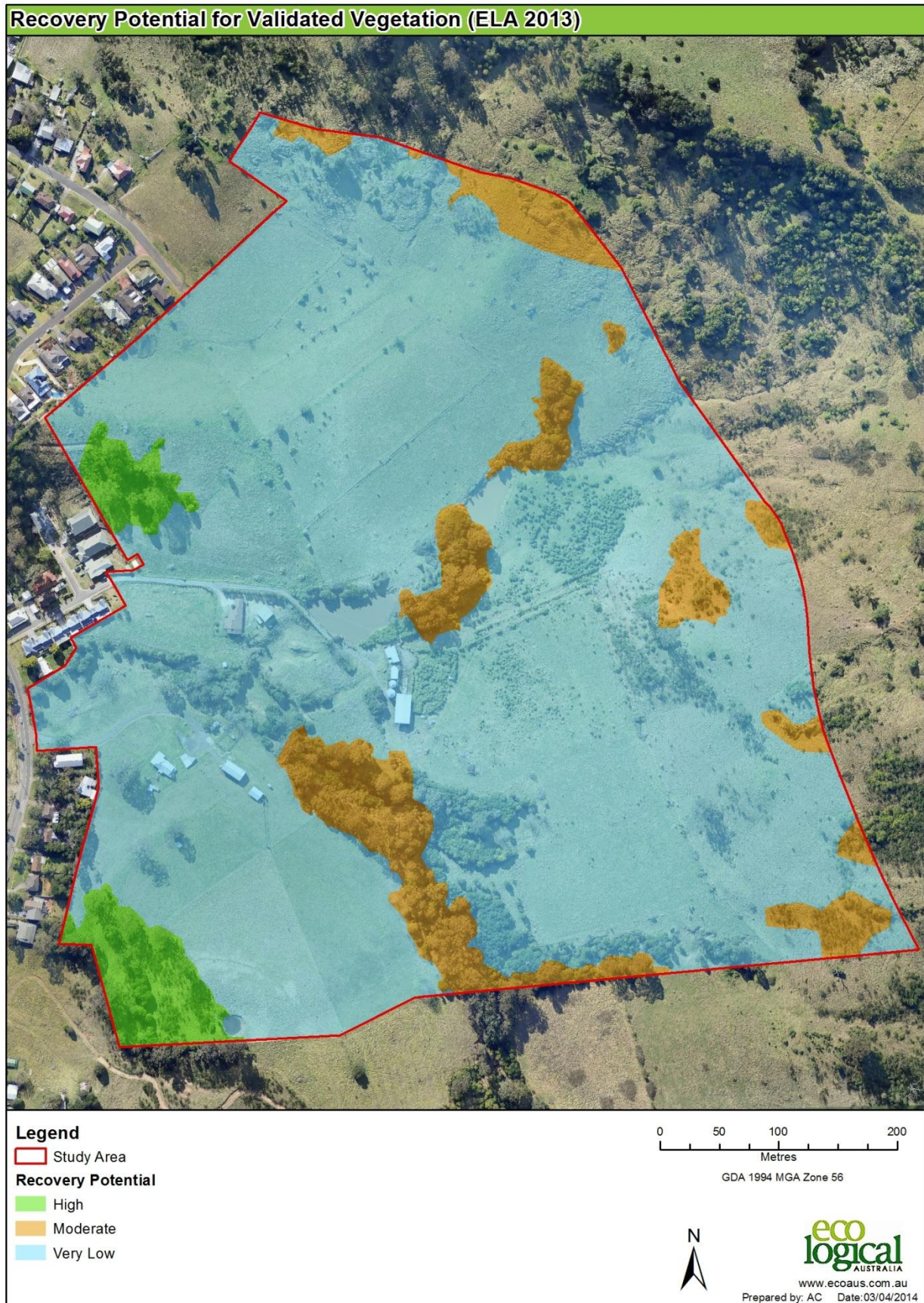


Figure 8: Recovery potential of field validated vegetation communities

### 4.5.3 Ecological constraints

Vegetation condition and recovery potential values have been used to rank the study areas in terms of high, moderate and low ecological constraint (**Table 5** and **Figure 9**).

The ILP should seek to avoid impact to areas of high ecological constraint and maximise retention of moderate constraint, where possible. Areas of low ecological constraint have the least value.

**Table 5: Classification of ecological constraint**

Ecological constraint	Vegetation and habitat components
High	EEC in moderate to good condition and moderate to high recovery potential Hollow bearing trees Vegetation with excellent connectivity
Moderate	EEC in low condition and high recovery potential Vegetation with broken connectivity
Low	EEC in low condition and moderate to very low recovery potential Mature isolated paddock trees without hollows



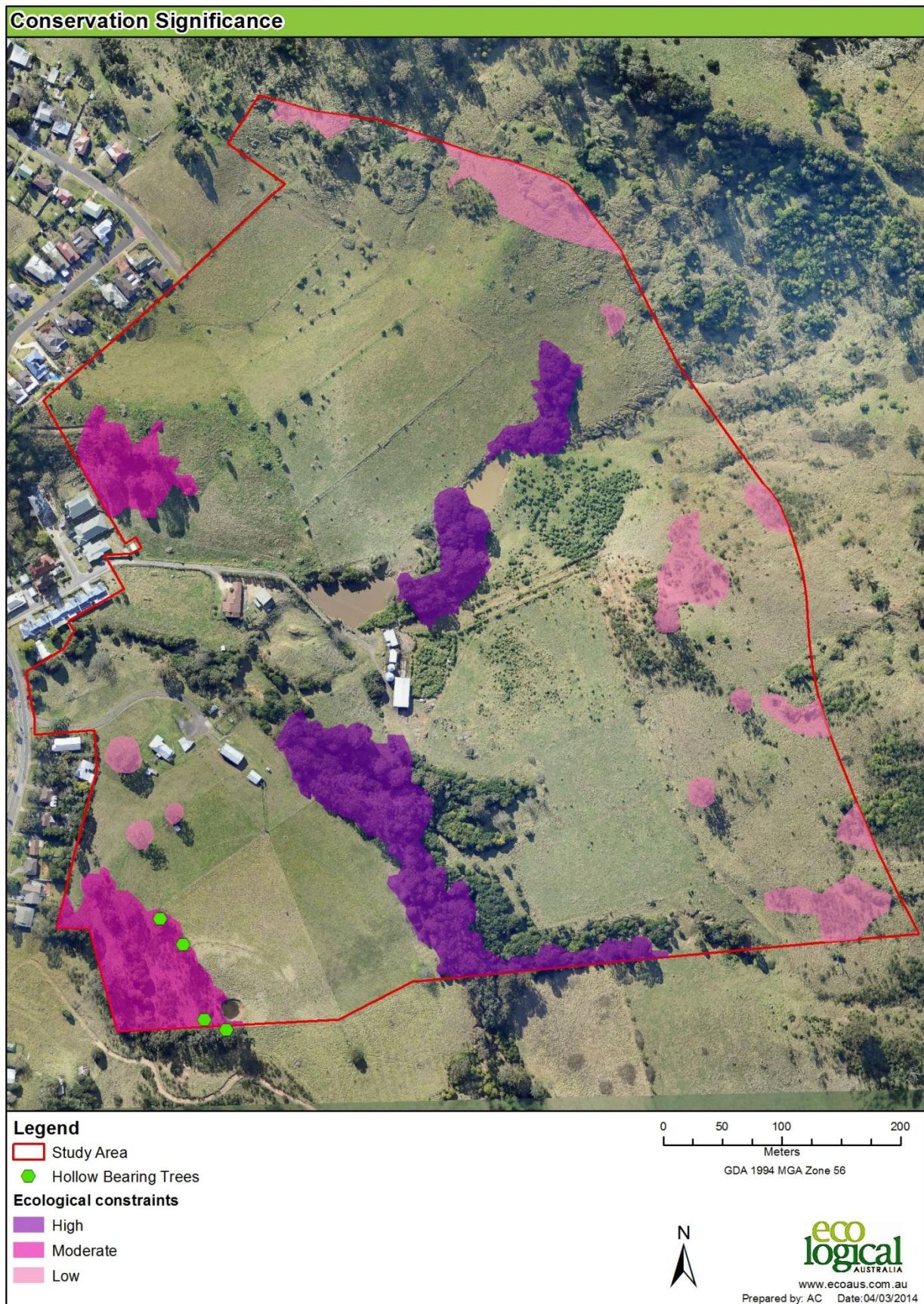


Figure 9: Ecological constraint of vegetation communities and habitat features

## 4.6 Riparian assessment

### 4.6.1 Identified stream reaches

Reeves Creek is the main watercourse within the study area and flows in a north westerly direction along reaches G and F (**Figure 10**). Based on the original (NoW) hydroline mapping there are two tributaries (reach E and reach H) of the creek that originate on the steeper slopes of the eastern portion of the study area. Upstream of reach E are three smaller reaches B, C and D.

Hydrolines were classified according to their Strahler stream order prior to field validation. One 3<sup>rd</sup> order, three 2<sup>nd</sup> order and three 1<sup>st</sup> order watercourses were validated in the field and are shown in **Figure 11**. The required vegetated riparian zone (VRZ) consistent with the NoW guidelines, are also shown.

Reach A was mapped on the original (NoW) hydroline mapping as a 1<sup>st</sup> order watercourse, and was found not to exist during the field validation, based on the absence of a defined channel, bed and bank.

Reach H, the 1<sup>st</sup> order watercourse on the southern boundary of the study area was identified as having little environmental value and a merit-based assessment case was put to the NoW in December 2013 to allow for the removal of this watercourse (**Appendix D**). Following its assessment, the NoW advised that it was supportive of reach H being subject to engineered drainage solutions, as it is a 1<sup>st</sup> order stream with limited riparian function. The filling of reach H was supported so long as any loss in riparian habitat would be suitably offset by vegetation management works within the averaged riparian corridor of Reeves Creek.







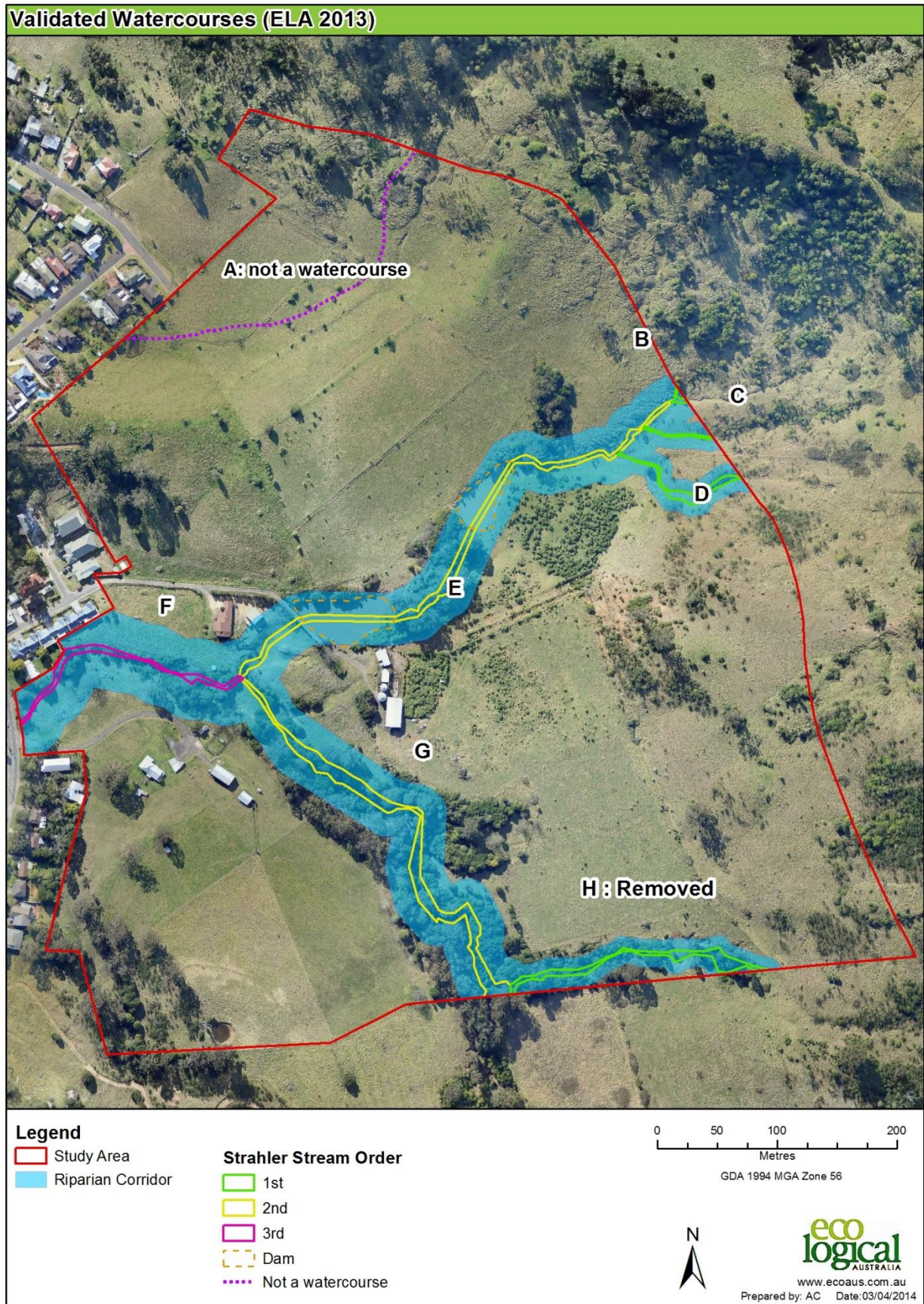


Figure 11: Validated watercourses, stream order and corresponding riparian corridors

#### 4.6.2 Stream and riparian condition

The results of the physical health assessment of each reach is presented in **Table 6**. Overall it is considered that the reaches within the study area exist in a highly modified and degraded state. The natural geomorphic conditions have been extensively altered through the creation of dams, clearing of native vegetation, unrestricted access for cattle grazing and the proliferation of weeds.

Much of the native vegetation from the banks has been removed, particularly on the upper slopes and there are very limited areas of aquatic in stream habitat remaining. Where adjacent vegetation does occur, it is generally dominated by weed species with small isolated patches of native vegetation. Habitat components such as large woody debris or in stream snags, pools or riffles are also rare. In this regard, for most reaches, pools comprise less than 10% of their length and riffles <5%, and in many instances are completely absent.

Habitat connectivity is generally more pronounced along reaches B, C, E and F where stream-side vegetation is more common and integrated with ridge top vegetation within the residual lands.

Patterns of natural water flow across the study area have been highly modified with the clearing of native vegetation and the construction of farm dams, which are online and exist within the area that will be established as a VRZ.

**Table 6: Riparian assessment of stream reaches**

Reach no.	Hydrology	Streamside vegetation	Physical form	Water quality and aquatic habitat	Stream Condition rating
A	Not a watercourse				
B, C & D	<p>1<sup>st</sup> Order Stream</p> <p>Unmodified channel with no flow barriers.</p> <p>Inflows modified due to partially cleared catchment.</p>	<p>Substantially modified</p> <p>Native vegetation patchy in well separated patches.</p> <p>Most strata dominated by exotic species, 'high threat' species abundant.</p> <p>More than one stratum completely altered from reference (lost or &lt;10% remaining compared to reference)</p> <p>Reduced cover (&lt;50%) of dominant strata, and only one age class present.</p> <p>Very small quantities of debris present.</p>	<p>Clay bank with slope &gt; 70°</p> <p>Gully erosion 25-50%, minor sheet and undercut erosion (&lt;5%)</p> <p>Dominant substrate clay. Subdominant substrate gravel</p>	<p>Limited aquatic habitat</p> <p>Dry channel with average wetted width 0-1 m. Some pooling of turbid water with average depth &lt;10cm</p> <p>In stream woody debris rare. Rare native aquatic vegetation with <i>Juncus</i> spp. Present in some sections</p> <p>Habitats: Fish: Unlikely Bird: Moderate Frog: Poor</p>	Moderate
E	<p>2<sup>nd</sup> Order Stream</p> <p>Partially modified channel with numerous low flow barriers (including 2 x dams).</p> <p>No fish passage</p>	<p>Severely modified</p> <p>Native vegetation an EEC and remains in well separated patches.</p> <p>One or more strata dominated by exotic species, 'high threat' species present</p> <p>More than one stratum completely altered from reference (lost or &lt;10% remaining compared to reference)</p> <p>Reduced cover (&lt;50%) of dominant strata, and only one age class present.</p> <p>Very small quantities of debris present.</p>	<p>Clay bank with slope 30-70°</p> <p>Gully's are mildly eroded (&lt;5%) with reminder of banks well stabilised by native and exotic vegetation</p> <p>Dominant substrate clay Subdominant substrate gravel</p>	<p>Limited aquatic habitat</p> <p>Dry channel with average wetted width 1-3. No pooling or riffles with entire reach comprised of run only</p> <p>In stream woody debris rare.</p> <p>Habitats: Fish: Unlikely Bird: Moderate Frog: Poor</p>	Degraded



Reach no.	Hydrology	Streamside vegetation	Physical form	Water quality and aquatic habitat	Stream Condition rating
F	<p>3<sup>rd</sup> Order Stream</p> <p>Unmodified channel with minor flow barriers.</p> <p>Inflows modified due to mostly cleared catchment.</p>	<p>Substantially modified</p> <p>Native vegetation in small well separated patches.</p> <p>Most strata dominated by exotic species, 'high threat' species present</p> <p>More than one stratum completely altered from reference (lost or &lt;10% remaining compared to reference)</p> <p>Reduced cover (&lt;50%) of dominant strata, and only one age class present.</p> <p>Quantities and/or cover of debris 50% higher or lower than reference</p>	<p>Clay bank with slope 30-70°</p> <p>Minor slump erosion (&lt;5%) with remainder of banks well stabilised by native and exotic vegetation</p>	<p>Limited aquatic habitat</p> <p>Dry channel with average wetted width 1-3 m. Some pooling of stagnant, turbid water at average depths of &lt;10 cm.</p> <p>Occasional in stream woody debris with weed (<i>Rumex</i> spp.) and macrophyte habitat species (<i>Juncus</i> spp.) present.</p> <p>Habitats: Fish: Unlikely Bird: Moderate Frog: Poor</p>	Degraded
G	<p>2<sup>nd</sup> Order Stream</p> <p>Unmodified channel with no low flow barriers</p> <p>Inflows modified due to mostly cleared catchment.</p>	<p>Largely modified</p> <p>Width reduced by up to 1/3 and/or some breaks in continuity.</p> <p>Native vegetation an EEC</p> <p>One or more strata dominated by exotic species, 'high threat' species present</p> <p>One stratum missing or extra, cover within remaining strata 50% lower or higher than reference.</p> <p>Reduced cover (&lt;50%) of dominant strata, and only one age class present.</p> <p>Quantities and/or cover of debris %0% higher or lower than reference</p>	<p>Clay/bedrock bank with slope &gt;70°</p> <p>Dominant substrate is bedrock</p> <p>Mildly eroded with slump erosion (5-25%) and gully and undercut erosion (1-5%)</p>	<p>Limited aquatic habitat</p> <p>Dry channel with average wetted width 1-3 m. Some pooling of stagnant, very turbid water at average depths. of &lt;10 cm.</p> <p>Common in stream woody debris with no native aquatic habitat or weed species present.</p> <p>Habitats: Fish: Unlikely Bird: Good Frog: Poor</p>	Degraded

Reach no.	Hydrology	Streamside vegetation	Physical form	Water quality and aquatic habitat	Stream Condition rating
H	<p>1<sup>st</sup> Order Stream</p> <p>Unmodified channel with no low flow barriers</p> <p>Inflows modified due to mostly cleared catchment.</p>	<p>Substantially modified</p> <p>Native vegetation an EEC, forming a narrow band along stream surrounded and integrated by weeds.</p> <p>One or more strata dominated by exotic species, 'high threat' species present</p> <p>One stratum missing with cover in remaining strata 50% lower of higher than reference.</p> <p>Reduced cover (&lt;50%) of dominant strata, and only one age class present.</p> <p>Quantities and/or cover of debris 50% higher or lower than reference</p>	<p>Clay bank with slope &gt;70°</p> <p>Dominant substrate is bedrock</p> <p>Mildly eroded with gully (1-5%) and undercut erosion (5-25%)</p>	<p>Limited aquatic habitat</p> <p>Dry channel with average wetted width 0-1 m. Some pooling of stagnant, very turbid water at average depths. of &lt;10 cm.</p> <p>Common in stream woody debris with no native aquatic habitat or weed species present.</p> <p>Habitats: Fish: Unlikely Bird: Good Frog: Poor</p>	Degraded

#### 4.6.3 Aquatic habitat condition assessment

All stream reaches within the study area are considered highly modified from their original natural state due to the removal and modification of riparian vegetation, provision of uncontrolled stock access and increases in sediment and nutrients loads. Vegetation removal in particular has resulted in a marked increase in water velocities within the study area, especially on its eastern parts. This increase in flow rate has contributed to bank and bed erosion through nearly all watercourses within the study area.

Aquatic habitat is generally considered poor throughout the area with some portions of frog habitat present in the form of emergent macrophytes and sedge grasses in and around the dams on reach E. Habitat connectivity for terrestrial species is considered to be more favourable along Reeves Creek (reaches E, F and G) and its eastern tributaries (reaches B, C and D), largely due to the presence of riparian vegetation that extends along these reaches and joins with the ridge top vegetation within the residual lands.

No native or introduced aquatic species were identified in any of the reaches in the study area or the residual lands. This also included relatively tolerant species such as eels and pest species such as carp and mosquito fish.

#### 4.6.4 Riparian recovery potential

While the majority of the reaches have been assessed as being in a degraded condition, their recovery potential in the context of improvements to the riparian corridor, is generally high given their connectivity with surrounding remnant vegetation, position within the broader catchment, or potential for enhanced in stream habitat. In contrast, the natural recovery potential is limited due to continued disturbance and water quality impacts from livestock, and the largely cleared, steep nature of the study area and residual lands, which gives rise to frequent high intensity flow events.

A summary of recovery potential is provided in **Table 7** and depicted in **Figure 12**. The recovery potential is highest for reaches E, F and G, which form the main reaches of Reeves Creek within the study area, while also having areas of high value riparian AW vegetation within the existing riparian corridor. Reach E has two existing online farm dams which are further discussed in **Section 5.1**.

#### 4.6.5 Groundwater dependent ecosystems

GDEs mapped in the study area are confined to the Alluvial Woodland (AW) EEC riparian vegetation listed under the TSC Act (**Figure 6**). This vegetation may utilise groundwater fed **base flows** of the creek and its tributaries. AW is associated with Reeves Creek (reach G) and its northern tributary (reach E), both of which are proposed to be retained (although modified) and vegetated as riparian corridor per a VMP, at the development application stage.

The dependence on groundwater varies greatly with each community and its position in the landscape. Moreover, there is little available information on the level of groundwater dependency of the patch of this AW community within the study area. Regardless, 1.91 ha (77%) of AW within the study area would be rezoned E2 Environmental Conservation, and in time augmented with the implementation of a VMP that will guide its maintenance and or enhancement. The specific requirements of any VMP will be further developed as part of the development application process.

**Table 7: Riparian corridor recovery potential**

Reach	Recovery potential
A	Not a watercourse
B	High
C	High
D	Low
E	High
F	High
G	High
H	Low (approved for removal)

Reaches B and C on the upstream eastern part of the study area also have high recovery potential driven by their existing condition class (moderate) and the presence of riparian vegetation that extends to the ridge top vegetation within the residual lands. In contrast, reach D is considered to have low recovery potential given that it is relatively isolated from reaches B and C and located within a part of the study area that lacks any form of woody riparian vegetation and is instead dominated by exotic pasture grasses.

Reach H, is also considered to have low recovery potential given that its function within the study area (and residual lands) is largely a drainage function. Moreover, the upper part of the reach H has less riparian vegetation connectivity with its ridge top counterpart on the eastern boundary. The area of AW vegetation in the lower portion of reach H is extremely narrow and linear and as a 1<sup>st</sup> order stream would only require a 20 m (plus channel width) VRZ. In the context of potential urban development the watercourse would, therefore, be prone to greater edge effects than Reeves Creek (reaches F and G) and its northern tributary (reach E) which as 3<sup>rd</sup> and 2<sup>nd</sup> order streams would require VRZs of 60 m (plus channel width) and 40 m (plus channel width) respectively. The recovery potential of the respective watercourses are presented in **Figure 12**.



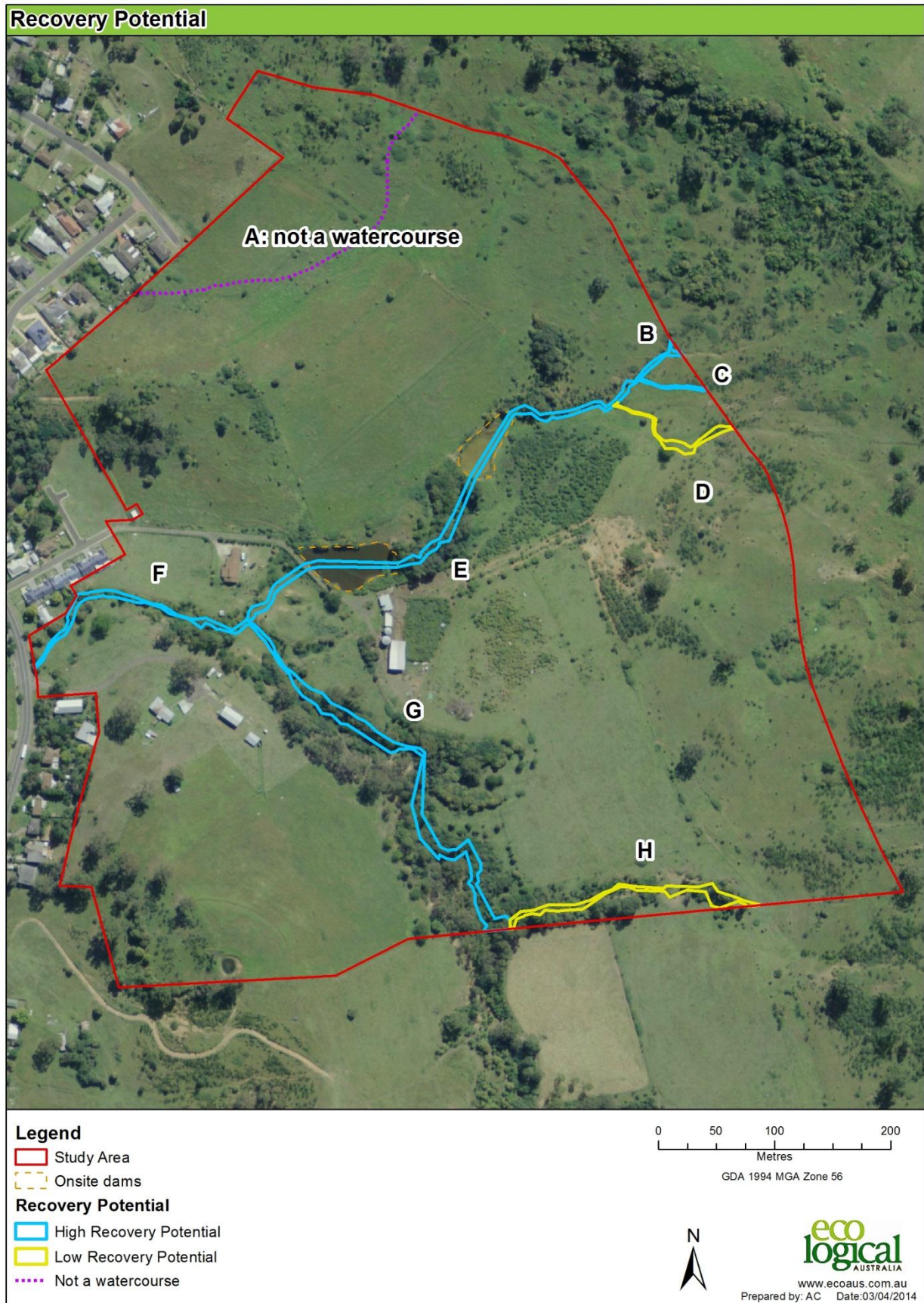


Figure 12: Watercourse recovery potential

## 5 Assessment of proposed land uses

This section discusses the proposed zoning (**Figure 2**) and proposed ILP (**Figure 3**) in light of the ecological and riparian values identified within the study area, in particular those identified by high constraint.

### 5.1 Riparian assessment

#### 5.1.1 NoW requirements for riparian corridors

Whilst a controlled activity approval from the NoW is not required to rezone the study area, it may be required for future development applications and hence the feasibility of achieving the total required area (ha) of RC is addressed within this report. The proposed RC has been developed in consultation with Jeremy Morice (NoW Water Regulation Officer) and the following principles (NoW 2012) where possible:

- Maintaining or rehabilitating the RC with fully structured native vegetation
- Minimising any disturbance and harm to the recommended RC
- Minimising the number of creek crossings and provision of a perimeter road separating development from the RC (which will also assist with bushfire management)
- Locating all services and infrastructure outside of the RC. Within the RC combine multiple service installations into one easement and / or utilise road crossings for service installations where possible
- Ensuring all stormwater is treated before discharging into the RC.

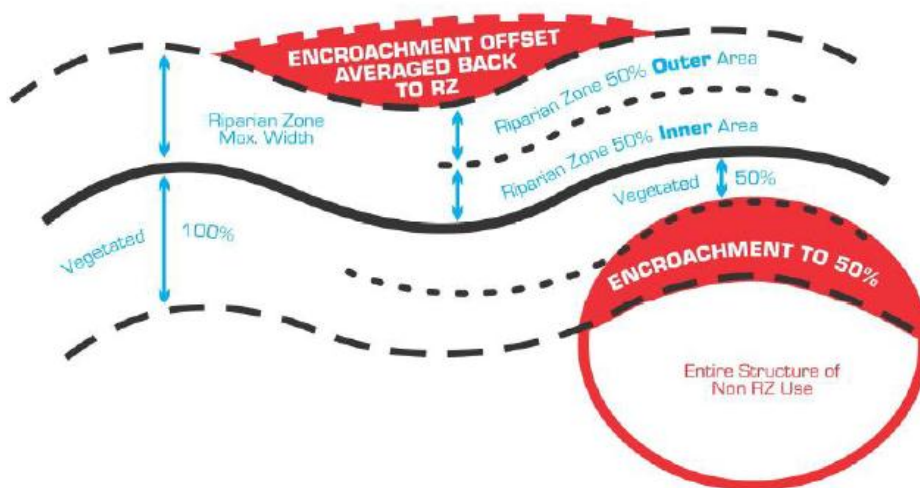
The riparian corridor matrix outlined in **Figure 13** is used as a guide by NoW when assessing works proposed within RC areas that require controlled activity approval. Departures from this matrix require justification to NoW and merit based assessment / approval.

Stream order	Vegetated Riparian Zone (VRZ)	RC off-setting for non RC uses	Cycleways and paths	Detention basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1 <sup>st</sup>	10 m	•	•	•	•	•	•	•		
2 <sup>nd</sup>	20 m	•	•	•	•	•		•		
3 <sup>rd</sup>	30 m	•	•	•		•			•	•
4 <sup>th</sup>	40 m	•	•	•		•			•	•

**Figure 13: Riparian corridor matrix (Source: NoW 2012)**

The NoW guidelines (2012) allow for non-riparian works and activities within the outer 50% of the RC so long as the average width of the RC is achieved over the length of all watercourses within the study area. The averaging rule is illustrated in **Figure 14**.

### Diagram 1 - Averaging Rule<sup>2</sup>



**Figure 14: Averaging rule (Source: NoW 2012)**

A total riparian corridor (RC) of 5.98 ha (rounded to 6.0 ha) would be required within the study area, as calculated from the required VRZ and channel widths of the validated streams. The required RC could not be achieved within the bounds of the study area, however NoW have given in-principle support for the headwaters of streams B, C and D outside of the study area to be used for offsetting of the required RC, given it will improve upstream areas and is proposed for rezoning at a later stage (pers comm. Jeremy Morice NoW, during site visit on 21 November 2014).

#### 5.1.2 Assessment of proposed rezoning and ILP

The proposed zoning and ILP was assessed to determine conformance with NoW principles and requirements. A summary of the proposed rezoning on riparian values is provided in **Table 8** and shown in **Figure 15** and **Figure 16**.

**Table 8: Riparian values within the proposed rezoning**

Reach no.	Description of riparian values and the proposed rezoning
B, C and D 1 <sup>st</sup> and 2 <sup>nd</sup> Order Streams 20 m and 40 m plus channel width RC	There are no proposed works within the inner or outer 50% of the required RC for any of these reaches. These reaches would be rezoned as E2 Environmental Conservation.
E 2nd Order Stream 40 m plus channel width RC	Proposed works within the inner 50% of required RC include a road crossing, an APZ to existing lot (Baxter property), two proposed online detention basins (and proposed stream realignment) and an outlet structure from an offline basin. There are two existing farm dams along this reach that will be reshaped into two online dry vegetated basins. The online basins would have a defined channel, remain



Reach no.	Description of riparian values and the proposed rezoning
	<p>dry (except during flood events), have fully structured vegetation, and to help maintain suitable flow velocities within the watercourses to prevent erosion and the deposition of sediment within the downstream catchment.</p> <p>Proposed works within the outer 50% of required RC include APZs and one area of public recreation. Southern batters of a third basin (offline) would be vegetated within the proposed RC.</p> <p>Note: NoW has advised that <i>any existing farm dams to be retained as online structures should be modified so as to provide limited permanent water storage and provision of low flows to retained watercourses. Online basins should comply with the requirements as specified in the NSW Office of Water Guidelines for Riparian Corridors. Any design variations from the guidelines will require further merit assessment (Appendix D).</i></p> <p>Note: NoW has also advised that <i>any required bushfire asset protection zones (APZs) are to be located outside required riparian corridor widths. APZs are allowed within the outer 50% of the VRZ, so long as offsets are provided in accordance with the averaging rule. NoW have agreed in principle that an APZ within the outer 50% of the RC adjacent the existing Baxter lot would be acceptable provided it is offset within the averaged RC.</i></p>
<p>F</p> <p>3rd Order Stream</p> <p>60 m plus channel width RC</p>	<p>Proposed works within the inner 50% of required RC include the entrance road, online detention basin and APZs. A portion of the inner 50% RC also extends outside the study area to the north.</p> <p>Proposed works within the outer 50% of required RC include the entrance road and APZs.</p> <p>See above note in reach E for APZs.</p>
<p>G</p> <p>2nd Order Stream</p> <p>40 m plus channel width RC</p>	<p>Proposed works within the inner 50% of required RC include a road crossing and online detention basin.</p> <p>Proposed works within the outer 50% of required RC include roads and APZs.</p> <p>See above note in reach E for APZs.</p>
<p>H</p> <p>1st Order Stream</p> <p>20 m plus channel width RC</p>	<p>Proposed removal of entire reach H, approved by NoW (<b>Appendix D</b>).</p> <p>NoW will allow for the filling of this reach so long as suitable offsets are provided within the averaged RC for the study area.</p>



Figure 15: Averaged riparian corridor and associated APZs



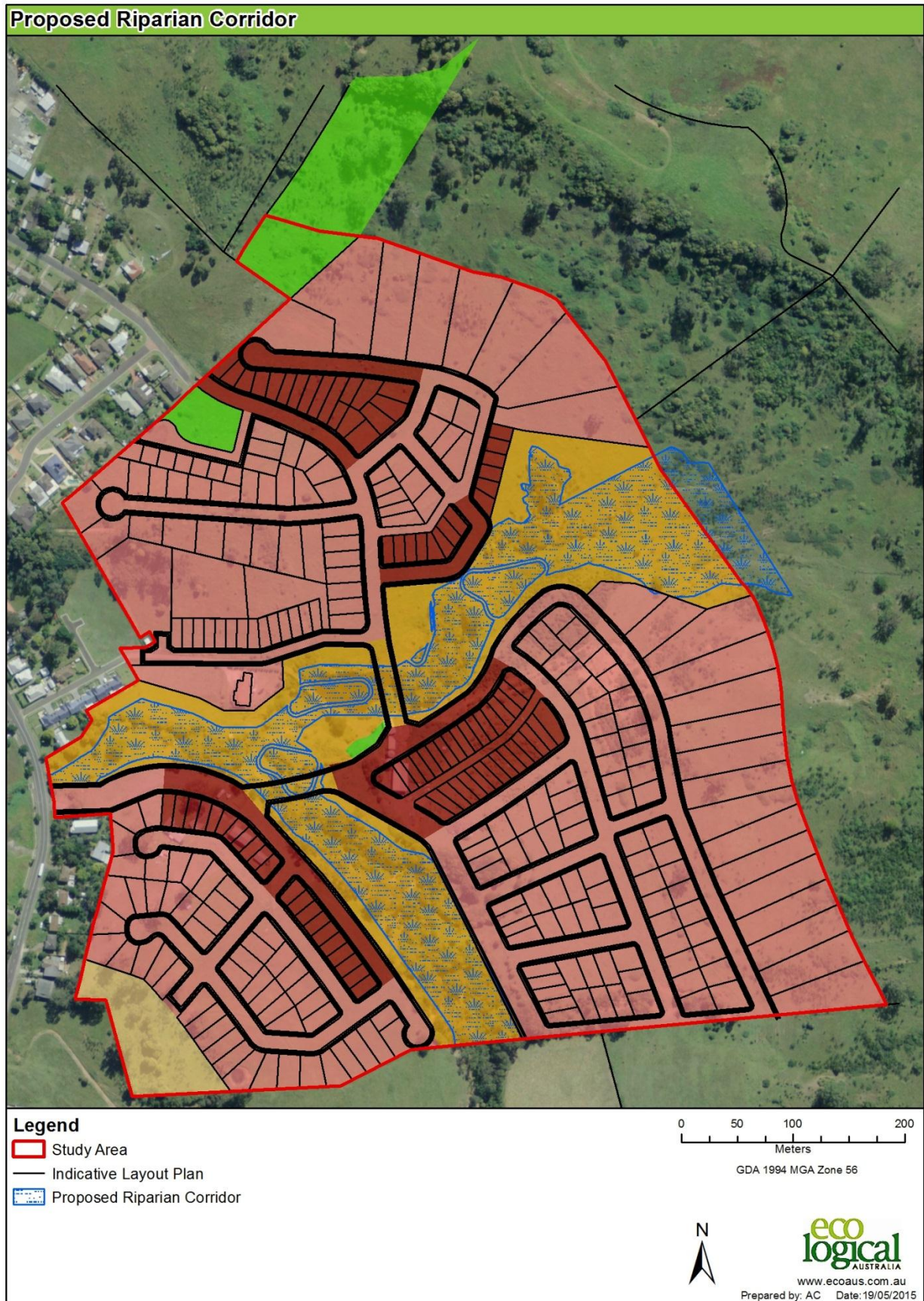


Figure 16: Proposed riparian corridor with proposed zoning



The proposed rezoning was compared to the riparian corridor matrix in **Figure 13**. Throughout the project and in consultation with NoW many changes were made to the proposed ILP to ensure protection of an adequate RC. Due to constraints of existing farm dams, site topography, existing lots both within and outside the study area and a narrow entry to the study area the following departures from the matrix are still proposed and would require merit based assessment at the development application stage:

- Reach E – proposed stream realignment associated with reshaping of existing farms dams and proposed online basins and an APZ within the inner 50% RC
- Reach F – proposed entrance road, online detention basin and APZs within the inner 50% RC
- Reach G – proposed online detention basin within inner 50% RC
- Reach H – proposed filling of reach.

The NoW has provided in-principle support for these proposed departures from the riparian matrix through verbal consultation on and offsite and in writing in **Appendix D**. The detailed design of the proposed online basins at the DA stage will need to comply with the requirements as specified in the NoW (2012). NoW require these basins to have a defined channel, remain dry (except during flood events), have fully structured vegetation, and to help maintain suitable flow velocities within the watercourses to prevent erosion and the deposition of sediment within the downstream catchment.

In terms of feasibility of the proposed rezoning to achieve NoW RC requirements, a total RC of 6.0 ha has been achieved for the study area (including adjacent headwaters of reaches B, C and D). The averaging rule has been applied to ensure the offset of the following (as occurring within the inner and outer 50% RC):

- APZs
- Retaining wall structures to proposed online basins
- Public recreation area to south of reach E
- Roads (including entrance road)
- Required RC width of entire reach H to be removed.

The retained reaches will be afforded adequate protection from the surrounding residential land use and, in time, will be maintained and improved in accordance with a VMP that will be prepared as part of a controlled activity approval under the WM Act at the development application stage. The inclusion of the RC within the riparian protection layer of the WLEP (**Section 6.2**) is recommended as the RC contains features of high biodiversity, riparian and water quality significance which will contribute to the maintenance of both biodiversity and water quality outcomes within the broader locality. Indeed vegetation within this corridor will assist in filtering nutrients and sediment and other contaminants from future urban development, while appropriately designed vegetated dry basins will assist in the attenuation storm flows, both of which will help protect and maintain water quality within the study area and the locality more generally.

The bushfire hazard of future vegetation has been considered in applying the averaging rule, whereby the extent of the RC has been kept to a minimum to ensure a reduced fire run for future development. APZs are mapped adjacent the averaged RC and shown in **Figure 15**. Vegetation species and their densities would be determined during preparation of a VMP at the development application stage. The averaged RC extent is proposed to be rezoned as E2 Environmental Conservation as shown in **Figure 16**.

## 5.2 Endangered ecological communities

### 5.2.1 Vegetation communities

Vegetation proposed to be included in residential areas (R2 and R3) have been calculated based on the proposed ILP and zoning. Areas of cleared and retained endangered ecological communities are shown in **Table 9** and **Figure 17**.

**Table 9: Vegetation communities and proposed zoning**

Vegetation community	Zoned E2 and E3 (ha) (retained)	Zoned R2 and R3 (ha) (cleared)	Total (ha)
Shale Hills Woodland (Open Woodland)	0.76 (42%)	1.04 (58%)	1.80
Shale Hills Woodland (DNS)	0	0.98 (100%)	0.98
Shale Hills Woodland (DNG)	0	0.57 (100%)	0.57
<b>Sub-Total (SHW)</b>	<b>0.76 (23%)</b>	<b>2.59 (77%)</b>	<b>3.35</b>
<b>Alluvial Woodland</b>	<b>1.91 (77%)</b>	<b>0.58 (23%)</b>	<b>2.49</b>
<b>TOTAL EEC</b>	<b>2.67 (46%)</b>	<b>3.17 (54%)</b>	<b>5.84</b>

#### Shale Hills Woodland

The proposed rezoning and ILP would include approximately 1.04 ha (58%) of the SHW (Open Woodland) and all of the SHW (DNS) (0.98 ha) and SHW (DNG) (0.57 ha) within the study area as residential (**Table 9**). It is assumed that areas zoned residential will be proposed for removal at the DA stage.

Two areas of SHW (Open Woodland) with high recovery potential and moderate ecological constraint were identified within the study area. One of these patches is proposed to be rezoned E3 Environmental Management (in the south western corner) and the other is proposed for residential zoning (on the western boundary). The south west patch proposed for rezoning to E3 is approximately 0.76 ha (42% of all the SHW within the study area) and is associated with retention of one hollow bearing tree within the study area and one on the property boundary.

The SHW (Open Woodland) patch on the western boundary proposed for residential zoning is approximately 0.49 ha. This patch has mature canopy trees and is considered to have moderate ecological constraint. This patch of vegetation is located on the boundary of the study area adjacent to existing residential development, and if retained would be subject to considerable edge effects that would detract from its integrity in the medium to long term.

The remaining SHW (Open Woodland) remnants containing individual paddock trees scattered throughout the study area, SHW (DNS) and SHW (DNG) are all considered to be in low condition and of low ecological constraint, and these areas are proposed for residential zoning.





Figure 17: Validated vegetation and proposed ILP



### 5.2.2 Alluvial woodland

All the AW in the study area was considered to have high ecological constraint with moderate recovery potential. The proposed rezoning would include approximately 1.91 (77%) of the AW as E2 Environmental Conservation within the study area. In this regard, ecological constraints have been factored into the proposed rezoning to retain the majority of this vegetation community. Approximately 0.58 ha (23%) of the AW within the study area would be zoned residential (**Table 9**).

### 5.2.3 Threatened flora and fauna

#### Flora

No threatened flora species were recorded during the field works or were considered to have the potential to occur within the study area or residual lands.

#### Fauna

Habitat assessments for fauna identified a number of hollow bearing trees within the south western corner of the study area in a patch of SHW (Open Woodland). Of these trees, the two to the north are within an area to be rezoned for residential development. The two southern most trees are proposed for E3 Environmental Management, one of these trees are within the study area and the other is on the property boundary.

Three patches of vegetation categorised as 'high' and one patch of 'moderate' ecological constraint would be rezoned for environmental conservation or management within the study area. Riparian corridor and habitat linkages with remnant vegetation beyond the study area would also be enhanced to ensure connectivity is maintained with the broader locality, by revegetation / regeneration of 6.0 ha of RC through a VMP. Moreover, key habitat features including ephemeral water bodies would continue to provide important habitat for birds and microbats that may frequent the study area.

The initial approach of assessing the study area via the BCAM has assumed the presence of a number of threatened species, listed in **Appendix A**. Depending on the approval pathway, target survey for the following threatened species (based on literature review and habitat assessment) may be required in the future, at the development application stage:

• <i>Anthochaera phrygia</i>	Regent Honeyeater (also EPBC Act listed)
• <i>Ardea ibis</i>	Cattle Egret
• <i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo
• <i>Chthonicola sagittata</i>	Speckled Warbler
• <i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)
• <i>Daphoenositta chrysoptera</i>	Varied Sittella
• <i>Glossopsitta pusilla</i>	Little Lorikeet
• <i>Hieraaetus morphnoides</i>	Little Eagle
• <i>Lathamus discolor</i>	Swift Parrot (also EPBC Act listed)
• <i>Lophoictinia isura</i>	Square-tailed Kite
• <i>Melanodryas cucullata cucullata</i>	Hooded Robin
• <i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)
• <i>Merops ornatus</i>	Rainbow Bee-eater
• <i>Neophema pulchella</i>	Turquoise Parrot
• <i>Ninox connivens</i>	Barking Owl
• <i>Ninox strenua</i>	Powerful Owl
• <i>Petroica boodang</i>	Scarlet Robin
• <i>Stagonopleura guttata</i>	Diamond Firetail

• <i>Chalinolobus dwyeri</i>	Large-eared Pied Bat (also EPBC Act listed)
• <i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle
• <i>Miniopterus australis</i>	Little Bentwing-bat
• <i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat
• <i>Mormopterus norfolkensis</i>	Eastern Freetail Bat
• <i>Myotis macropus</i>	Southern Myotis
• <i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (also EPBC Act listed)
• <i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat
• <i>Meridolum corneovirens</i>	Cumberland Plain Land Snail.

### 5.3 Suitability of proposed zones and compliance with s117 directions

The objective of Ministerial Direction 2.1 Environmental Protection Zones (EP&A Act) is to protect and conserve environmentally sensitive areas. This direction applies to land within an environmental protection zone or land otherwise identified for environmental protection purposes in a LEP, such that an LEP must not reduce the environmental protection standards that apply to the land. The study area does not currently contain any land zoned for environmental protection.

The proposed zoning is shown in **Figure 3** and **Figure 16**. Two new environmental protection zones (E2 Environmental Conservation and E3 Environmental Management) are proposed to protect riparian habitat and some parts of the EECs within the study area.

The riparian areas under the proposed rezoning would be managed under public ownership and management, within two zone types (E2 and RE1). The proposed ILP does not include an increase of lot frontage directly to the watercourses within the study area (as lots are separated from riparian areas by roads), thus enabling the riparian corridors to be rehabilitated with fully structured riparian vegetation.

Within the study area, five land use zones are proposed and these are discussed in detail below:

- E2 – Environmental Conservation
- E3 – Environmental Management
- R2 – Low Density Residential
- R3 – Medium Density Residential
- RE1 – Public Recreation.

#### 5.3.1 Zone E2 Environmental Conservation

The objectives of the E2 zone are:

- To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values
- To prevent development that could destroy, damage or otherwise have an adverse effect on those values.

E2 Environmental Conservation zoning has been applied to the riparian corridor of Reeves Creek (reaches B, C, D, E, F, G). AW of high ecological constraint would be retained in the vicinity of these reaches and would be enhanced with subsequent revegetation / regeneration works through a VMP to better facilitate habitat links with the relatively large stands of remnant vegetation to the south (riparian) and eastern (ridge top) vegetation. The revegetation / regeneration of the headwaters of reaches B, C and D outside of the study area would further improve habitat linkages with the ridge top areas in the residual lands.

In order to better manage post development stream flows it is proposed that online dry vegetated basins be incorporated within the RC. In-principle support from the NoW for the proposed rezoning has been sought through this project, and a merit based assessment for a controlled activity approval from the NoW under the WM Act would be required at the development application stage.

Local planning directions made under s. 117(2) of the EP&A Act for Environment Protection Zones also apply to the proposed E2 zone. The direction applies to all relevant planning authorities when preparing a planning proposal and require the authority to *include provisions that facilitate the protection and conservation of the environmentally sensitive land*, and in applying the zone must not *reduce the environmental protection standards that apply to the land*. The proposed zoning is consistent with these requirements given that specific controls under the WLEP would apply to the land proposed to be rezoned as E2, which would facilitate its protection and conservation. These areas would be afforded considerably enhanced environmental protection, when compared to the current RU2 Rural Landscape zone under WLEP.

### **5.3.2 Zone E3 Environmental Management**

The objectives of this zone are:

- To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values
- To provide for a limited range of development that does not have an adverse effect on those values
- To maintain existing significant stands of native vegetation and wildlife corridors
- To ensure land degradation and soil disturbance are minimised.

The SHW (Open Woodland) in the south western corner of the study area will assist in protecting 0.76 ha of the EEC, including one hollow bearing tree within the study area and one on the study area boundary. The area contains open woodland with important habitat features, and is located on the edge of the remnant vegetation that adjoins the study area. While the condition of the vegetation beyond the site is unknown, given that the vegetation within the study area is at its edge, the proposed E3 zoning is considered appropriate. In this regard, the proposed zone would provide for suitable low impact recreation opportunities for adjoining residential properties while also contributing to the maintenance of the study areas broader environmental values.

This area has been recommended for inclusion in the Biodiversity map layer of WLEP. Any future development within the E3 lot would require development consent under clause 7.2 Biodiversity protection of the WLEP, to determine there are no adverse environmental impacts to the EEC.

### **5.3.3 Zone RE1 Public Recreation**

The objectives of this zone are:

- To enable land to be used for public open space or recreational purposes
- To provide a range of recreational settings and activities and compatible land uses
- To protect and enhance the natural environment for recreational purposes.

Two areas of RE1 zone are proposed within the study area, both within areas currently comprising 'exotic pasture'. These areas are proposed as managed land with grassed areas and scattered trees. The proposed public recreation areas are consistent with the objectives of the RE1 zoning.



### **5.3.4 Zone R2 Low Density Residential**

The objectives of this zone are:

- To provide for the housing needs of the community within a low density residential environment
- To enable other land uses that provide facilities or services to meet the day to day needs of residents.

This zone has been applied to those parts of the study area that are largely cleared and made up of exotic pastures and vegetation and as such potential future biodiversity impacts within these areas are considered to be relatively minor. Nevertheless, some areas of high ecological constraint are likely to be zoned residential including SHW (Open Woodland) on the western boundary of the study area and the edge of the SHW (Open Woodland) patch in the south west corner of the study area. The zone also encompasses the steeper slopes of the study area where more intense forms of urban development such as medium density residential development would be less suited.

### **5.3.5 Zone R3 Medium Density Residential**

The objectives of this zone are:

- To provide for the housing needs of the community within a medium density residential environment
- To provide a variety of housing types within a medium density residential environment
- To enable other land uses that provide facilities or services to meet the day to day needs of residents
- To encourage the provision of affordable housing.

This zone has been applied to land within the study area that contains the AW EEC and also exotic vegetation and exotic pastures.

The zone will also provide for more intense forms of residential development and in this regard is located in reasonable proximity to the RE1 zones which it is envisaged will cater for passive recreational activities, and in doing so alleviate edge effects within the E2 zones. Moreover, the location of the zone is such that less intense forms of development within the adjacent R2 Low Density Residential zone are likely to enjoy suitable visual amenity of the environmental features of the study area and general locality.

## 5.4 Residual land

A portion of land to the immediate east, north and south of the study area is identified as ‘residual lands’ in **Figure 1** and is intended for future rezoning. The residual lands are not the subject of this rezoning, but are addressed here to the limited extent required to address the *Specialist Studies Requirements – Picton East Planning Proposal* (July 2013).

The total area of the residual land is 82.5 ha. The residual lands are currently zoned RU2: Rural landscape and RE1: Public recreation (**Figure 2**). It is understood that the residual lands will form part of a future planning proposal that will include a combination of land uses similar to those proposed in this rezoning. In general, the urban development types will extend to the south of the study area, while the remaining ridge top lands are proposed for a combination of environmental conservation and / or managed riparian corridor areas.

Within the residual lands, the following vegetation communities were identified:

- Cleared (Exotic pasture) and (Exotic vegetation)
- Shale Hills Woodland (SHW) (Open Woodland), (Woodland), (Derived Native Grassland) and (Derived Native Shrubland)
- Alluvial Woodland (AW)
- Moist Hills Woodland.

These vegetation communities are listed as CEECs and EECs under the EPBC and TSC Acts, and areas of ecological values are concentrated within the riparian areas in the south and along the ridge top vegetation. The current proposal excludes the rezoning of the residual lands and, therefore, any environmentally sensitive areas would be conserved and continue to be managed for agricultural purposes.

The current proposal does not preclude the use of the residual lands for agricultural purposes. Indeed, low intensity cattle grazing that is used in a strategic and / or rotational manner would assist in the management of both weeds and fuel loads within the residual lands. This management approach is considered the most appropriate agricultural production method for the residual lands given that its steep slopes are likely to prevent the use of tillage equipment and pasture improvement and / or fodder production.

Given the recommended use of low intensity and targeted cattle grazing, the potential for urban – rural land use conflicts is considered limited. Low intensity grazing will also ensure that impacts on any unfenced watercourses within the residual lands are minimised. Well managed grazing activity, together with a combination of appropriate herbicide use and slashing (to control excessive pasture growth and weed proliferation) will also help maintain the environmental values and biodiversity of the residual lands, while also facilitating ongoing rural land uses.

In terms of riparian features, reach G continues upstream of the development (to the south) as a 2<sup>nd</sup> order stream, with an additional two 1<sup>st</sup> order streams located off this reach. Reach H also continues upstream into the residual lands, although this reach has been approved for removal by NoW. Portions of reaches B, C and D have been included within the proposed RC for the study area rezoning, therefore future rezoning / development of the residual lands will need to observe this RC area.

Constraints for future rezoning of the residual lands will need to consider slope, vegetation communities and required buffers to protect riparian vegetation and water quality. Bushfire protection is being considered under a separate *Bushfire Assessment* report.

## 6 Recommendations

The following recommendations are provided to guide the rezoning and future development of the land to assist in maintaining the biodiversity and riparian integrity of the study area.

### 6.1 Vegetation communities, flora and fauna

- Avoid impact to areas of high ecological constraint.
- Retain, protect and manage important vegetation identified for inclusion within the Biodiversity map layer of the WLEP (**Figure 18**)
- Manage retained AW within the RC in accordance with a Vegetation Management Plan (VMP), to be prepared for Controlled Activity Approval at the development application stage
- Manage retained SHW (Open Woodland) within the study area, including retained hollow bearing trees (HBT) to provide habitat for hollow dependant species.

### 6.2 Riparian recommendations

- Avoid impact to areas of high ecological constraint.
- Retain, protect and manage important riparian areas identified for inclusion in the Riparian map layer of the WLEP (**Figure 19**)
- Design watercourses in the study area to mimic the natural hydrology and geomorphology of the local creeks. Development must not increase the frequency and intensity of flows to the watercourses
- Basins are to be constructed in accordance with NoW guidelines to provide a suitably functioning watercourse and habitat corridor
- Any road crossing of Reeves Creek must be in accordance with NoW guidelines
- Prepare a Vegetation Management Plan (VMP) which details the management and revegetation of the riparian corridor, at the development application stage
- The subdivision layout should not increase lot frontage to the watercourses within the study area and the creation of new basic landholder rights (BLRs).

With respect to the **residual lands**, consideration and integration of the study area and its environmental values should be undertaken for any future planning proposal prepared for the residual lands.





Figure 18: Land for inclusion within the biodiversity map layer of WLEP



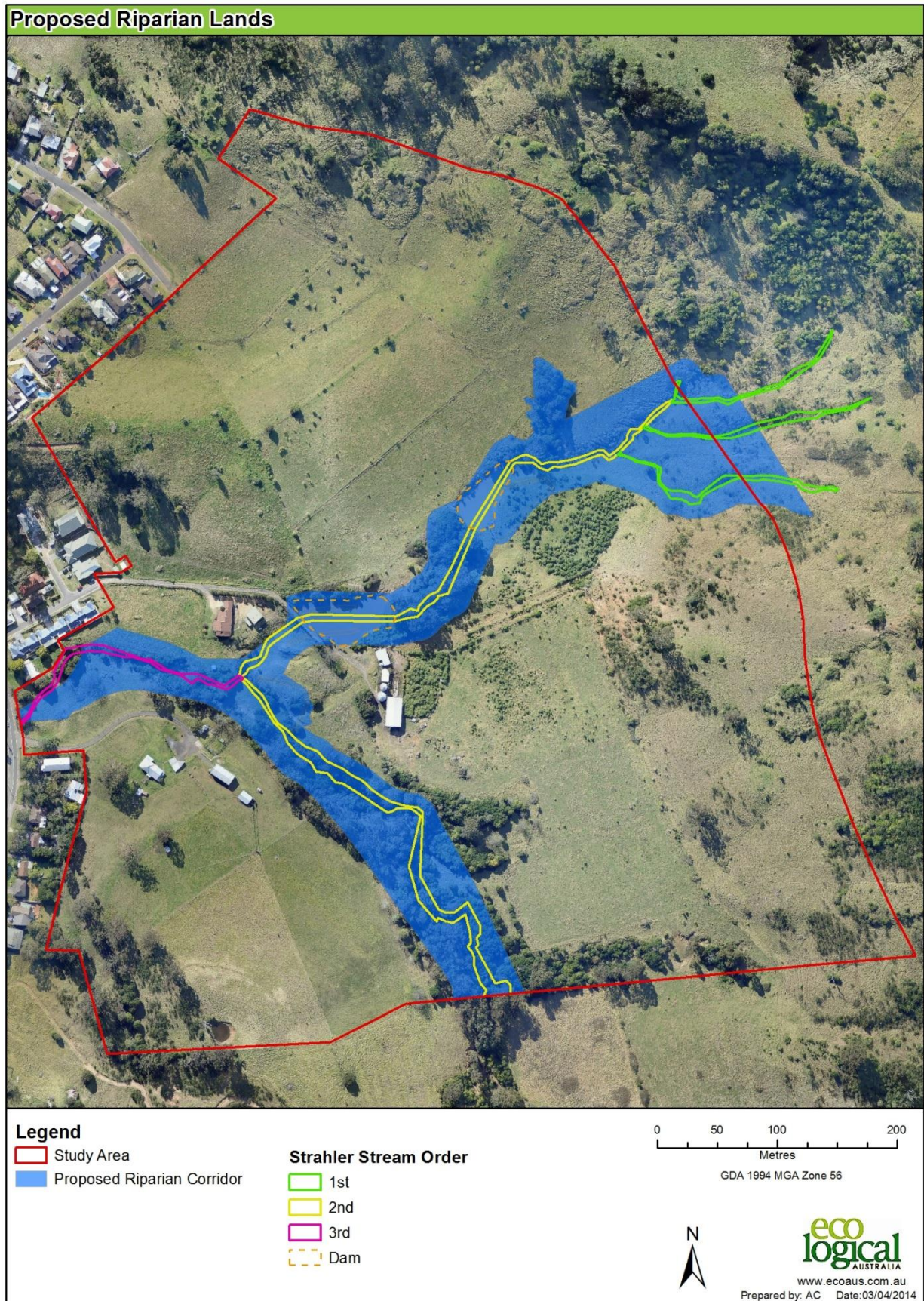


Figure 19: Land for inclusion in the riparian map layer of the WLEP

## 7 Conclusion

This report highlights the ecological values and constraints of the study area, comments on the proposed future land use of the ILP and makes recommendations to avoid or alleviate areas of ecological and riparian value.

The Reeves Creek study area contains a number of important biodiversity and riparian features including Shale Hills Woodland (SHW), a sub community of Cumberland Plain Woodland (CPW) which is listed as a critically endangered ecological community under TSC Act. The CPW community is also listed under the EPBC Act, but the condition and size of the vegetation patches within the study area did not meet the EPBC Act criteria. The site also contains Alluvial Woodland, a component of River Flat Eucalypt Forests of the NSW North Coast, Sydney Basin and South-East corner Bioregions, which is listed as and EEC under the TSC Act.

Approximately 0.76 ha (42%) of moderate ecological constraint SHW and two hollow bearing trees of high ecological constraint (one on boundary of study area) are proposed for rezoning to E3 Environmental Management. Approximately 1.91 ha (77%) of high ecological constraint AW within the study area would also be rezoned as E2 Environmental Conservation.

The proposed rezoning would rezone 1.04 (58%) of the SHW considered to have moderate to low ecological constraint, and two hollow bearing trees to residential. An area of 0.58 ha (23%) of the high ecological constraint AW within the study area would be rezoned residential. The remainder of impacted areas are made up of cleared land or land dominated by exotic species with very low biodiversity value.

The watercourses within study area are in moderate to degraded condition. Nevertheless, remnant riparian vegetation along some of the reaches have high potential to serve as important habitat corridors that would integrate the study area with relatively large stands of the remnant vegetation on the ridge tops to the east of the study area, and the broader catchment up and downstream of the study area.

While the ILP does not avoid all areas of high ecological constraint, it does retain many of these features. This includes the key riparian corridors of Reeves Creek and its eastern tributary within the central portion of the study area and the majority of SHW and AW vegetation considered to have high to moderate ecological constraint. The impact of the planning proposal must be assessed at the development application stage by Wollondilly Shire Council on behalf of the landowner.



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## Appendix A: Likelihood tables

Three terms for likelihood of occurrence were considered for each threatened ecological community and species identified in the data audit. These were:

- “known” = the species was or has been observed on the study area.
- “likely” = a medium to high probability that a species uses the study area.
- “potential” = suitable habitat for a species occurs in the study area, but there is insufficient information to categorise the species as likely, or unlikely to occur.
- “unlikely” = a low probability that the species uses the study area
- “no” = the species would not use the study area.

Each species’ likely occurrence within the study area was determined by reviewing records in the area, considering the habitat available on site during field assessment and using expert knowledge of the species ecology. Note, no threatened species under the Fisheries Management Act were considered to have the potential, be likely or were known in the study area.

Scientific name	Common name	Conservation status		Likelihood of occurrence
		TSC Act	EPBC Act	
Ecological communities				
Cumberland Plain Woodland		CE	CE	Known
River-flat Eucalypt Forest on Coastal Floodplains		E	-	Known
Shale Sandstone Transition Forest		E	E	Potential
Moist Shale Woodland in the Sydney Basin Bioregion		CE	E	Unlikely
Flora				
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E, P		Unlikely
<i>Darwinia peduncularis</i>		V, P		No
<i>Eucalyptus macarthurii</i>	Paddys River Box, Camden Wollybutt	E, P		No
<i>Genoplesium baueri</i>	Yellow Gnat-orchid		E	No
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V, P		No
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Wingless Raspwort, Square Raspwort		V	No
<i>Persicaria elatior</i>	Tall Knotweed	V, P		No
<i>Persoonia bargoensis</i>	Bargo Geebung	E, P		Unlikely
<i>Thesium australe</i>	Austral Toadflax, Toadflax		V	Unlikely
Aves				
<i>Anthochaera phrygia</i>	Regent Honeyeater	E	E	Potential
<i>Ardea ibis</i>	Cattle Egret	P		Likely
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	E		Potential
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V		Unlikely

Scientific name	Common name	Conservation status		Likelihood of occurrence
		TSC Act	EPBC Act	
<i>Chthonicola sagittata</i>	Speckled Warbler	V		Potential
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V		Potential
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		Potential
<i>Erythrorhynchus radiatus</i>	Red Goshawk		V	No
<i>Glossopsitta pusilla</i>	Little Lorikeet	V		Potential
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Potential
<i>Hirundapus caudacutus</i>	White-throated Needletail	P		Unlikely
<i>Lathamus discolor</i>	Swift Parrot	E	E	Potential
<i>Lophoictinia isura</i>	Square-tailed Kite	V		Potential
<i>Melanodryas cucullata cucullata</i>	Hooded Robin	V		Potential
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V		Potential
<i>Merops ornatus</i>	Rainbow Bee-eater	P		Potential
<i>Neophema pulchella</i>	Turquoise Parrot	V		Potential
<i>Ninox connivens</i>	Barking Owl	V		Potential
<i>Ninox strenua</i>	Powerful Owl	V		Potential
<i>Petroica boodang</i>	Scarlet Robin	V		Potential
<i>Stagonopleura guttata</i>	Diamond Firetail	V		Potential
Mammalia				
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Potential
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		Potential
<i>Miniopterus australis</i>	Little Bentwing-bat	V, P		Potential
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat	V	-	Potential
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat	V	-	Potential
<i>Myotis macropus</i>	Southern Myotis	V	-	Potential
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Potential
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Potential

Invertebrates				
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	-	Known
Fish				
<i>Macquaria australasica</i>	Macquarie Perch		E	No
Amphibians				
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	No
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	No
<i>Litoria littlejohni</i>	Heath Frog	V	V	No



## Appendix B: Flora and fauna recorded on site

### Flora

Scientific Name	Common Name
<i>Acacia decurrens</i>	Green Wattle
<i>Acacia implexa</i>	Hickory Wattle
<i>Acacia mearnsii</i>	Black Wattle
<i>Acacia parramattensis</i>	-
<i>Acacia</i> sp.	Wattle
<i>Acacia terminalis</i>	Sunshine Wattle
<i>Acacia ulicifolia</i>	Prickly Moses
<i>Adiantum aethiopicum</i>	Common Maidenhair
<i>Anagallis arvensis</i>	Scarlet/Blue Pimpernel
<i>Angophora bakeri</i>	Small-leaved Apple
<i>Araujia sericifera</i>	Moth Vine
<i>Aristida ramosa</i>	-
<i>Aristida</i> sp.	Large
<i>Aristida vagans</i>	Three-awned Speargrass
<i>Asparagus asparagoides</i>	Bridal Creeper
<i>Asperula conferta</i>	Common Woodruff
<i>Asplenium flabellifolium</i>	Necklace Fern
<i>Austrostipa rudis</i>	Veined Spear-grass
<i>Bidens pilosa</i> *	Cobbler's Pegs
<i>Bothriochloa macra</i>	Red Grass
<i>Bothriochloa</i> sp.	-
<i>Brachychiton populneus</i>	Kurrajong
<i>Brachyscome</i> sp.	-
<i>Bromus catharticus</i>	Prairie Grass
<i>Bursaria spinosa</i>	Native Blackthorn
<i>Callitris rhomboidea</i>	-
<i>Carduus tenuiflorus</i>	-
<i>Carex appressa</i>	Tall Sedge
<i>Carex inversa</i>	Knob Sedge
<i>Carex</i> sp.	-
<i>Cenchrus caliculatus</i>	Hillside Burrgrass
<i>Centaurea</i> sp.	-
<i>Cheilanthes sieberi</i>	Mulga Fern
<i>Chloris truncata</i>	Windmill Grass
<i>Chloris ventricosa</i>	Tall Chloris
<i>Cirsium vulgare</i>	-
<i>Clematis aristata</i>	Old Man's Beard
<i>Convolvulus erubescens</i>	Blushing Bindweed
<i>Conyza bonariensis</i>	Flaxleaf Fleabane

Scientific Name	Common Name
<i>Conyza</i> sp.	Fleabane
<i>Cotoneaster</i> sp.	-
<i>Cryptandra spinescens</i>	-
<i>Cymbopogon refractus</i>	Barbed Wire Grass
<i>Cynodon dactylon</i>	Couch
<i>Cyperus</i> sp.	-
<i>Desmodium brachypodum</i>	Large Tick-trefoil
<i>Desmodium varians</i>	Slender Tick-trefoil
<i>Dichelachne micrantha</i>	Shorthair Plumegrass
<i>Dichondra repens</i>	Kidney weed
<i>Echinopogon</i> sp.	-
<i>Ehrharta erecta</i>	Panic Veldgrass
<i>Einadia hastata</i>	Berry Saltbush
<i>Einadia nutans</i>	Climbing Saltbush
<i>Einadia nutans</i>	--
<i>Einadia</i> sp.	-
<i>Elymus scaber</i>	-
<i>Elymus</i> sp.	-
<i>Entolasia marginata</i>	Bordered Panic
<i>Entolasia stricta</i>	Wiry Panic
<i>Eragrostis leptostachya</i>	Paddock Lovegrass
<i>Eragrostis</i> sp.	-
<i>Eucalyptus agglomerata</i>	Blue Leaved Stringybark
<i>Eucalyptus baueriana</i>	-
<i>Eucalyptus moluccana</i>	Grey Box
<i>Eucalyptus punctata</i>	Grey Gum
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Euphorbia peplus</i>	Petty Spurge
<i>Exocarpos cupressiformis</i>	Cherry Ballart
<i>Facelis retusa</i>	Annual Trampweed
<i>Fumaria</i> sp.	Fumitory
<i>Geitonoplesium cymosum</i>	Scrambling Lily
<i>Geranium homeanum</i>	Native Geranium
<i>Geranium solanderi</i>	Native Geranium
<i>Glycine clandestina</i>	-
<i>Glycine</i> sp.	Small leaf
<i>Glycine</i> sp.	Huge
<i>Glycine tabacina</i>	Glycine
<i>Goodenia hederacea</i>	Ivy Goodenia
<i>Hardenbergia violacea</i>	Purple Coral Pea
<i>Holcus lanatus</i>	
<i>Hypericum gramineum</i>	Small St. Johns Wort
<i>Hypochaeris radicata</i>	Cat's Ear

Scientific Name	Common Name
<i>Imperata cylindrica</i>	Blady Grass
<i>Kunzea ambigua</i>	Tick Bush
<i>Lachnagrostis filiformis</i>	-
<i>Lantana camara</i>	Lantana
<i>Laxmannia gracilis</i>	Slender Wire Lily
<i>Lepidium</i> sp.	-
<i>Lepidosperma gunnii</i>	Little Sword sedge
<i>Lepidosperma laterale</i>	-
<i>Leucopogon juniperinus</i>	Prickly Beard-heath
<i>Ligustrum lucidum</i>	-
<i>Ligustrum sinense</i>	*Small-leaved Privet
<i>Lolium perenne</i>	-
<i>Lomandra filiformis</i>	Wattle Mat-rush
<i>Lomandra obliqua</i>	Fish Bones
<i>Lycium ferocissimum</i>	African Boxthorn
<i>Medicago</i> sp.	-
<i>Mentha</i> sp.	-
<i>Microlaena stipoides</i>	-
<i>Myoporum montanum</i>	Western Boobialla
<i>Olea europaea</i>	Olive
<i>Opercularia diphylla</i>	-
<i>Oplismenus aemulus</i>	-
<i>Opuntia stricta</i>	Prickly Pear
<i>Oxalis perennans</i>	-
<i>Oxalis pes-caprae</i>	-
<i>Pandorea pandorana</i>	Wonga Wonga Vine
<i>Paspalum dilatatum</i>	Paspalum
<i>Pellaea falcata</i>	Sickle Fern
<i>Pennisetum clandestinum</i>	Kikuyu Grass
<i>Persoonia linearis</i>	Narrow-leaved Geebung
<i>Petrorhagia nanteuillii</i>	-
<i>Phyllanthus hirtellus</i>	-
<i>Pimelea</i> sp.	-
<i>Pittosporum multiflorum</i>	Orange Thorn
<i>Plantago lanceolata</i>	Plantain
<i>Plantago</i> sp.	Plantain
<i>Plectranthus parviflorus</i>	-
<i>Poa affinis</i>	-
<i>Poa labillardierei</i>	-
<i>Poa</i> sp.	-
<i>Pomax umbellata</i>	-
<i>Poranthera microphylla</i>	-
<i>Raphanus raphanistrum</i>	Wild Radish



Scientific Name	Common Name
<i>Rhaphiolepis indica</i>	-
<i>Romulea</i> sp.	-
<i>Rubus fruticosus</i> sp. agg.	Blackberry
<i>Rubus parvifolius</i>	Native Raspberry
<i>Rumex brownii</i>	Swamp Dock
<i>Rytidosperma</i> sp.	-
<i>Senecio hispidulus</i>	Hill Fireweed
<i>Senecio madagascariensis</i>	Fireweed
<i>Senecio prenanthoides</i>	-
<i>Senecio</i> sp.	-
<i>Setaria parviflora</i>	Whorled Pigeon Grass
<i>Sida corrugata</i>	-
<i>Sida rhombifolia</i>	Paddy's Lucerne
<i>Sigesbeckia orientalis</i>	-
<i>Sigesbeckia</i> sp.	-
<i>Solanum nigrum</i>	Black-berry Nightshade
<i>Solanum prinophyllum</i>	Forest Nightshade
<i>Solanum pseudocapsicum</i>	Madeira Winter Cherry
<i>Sonchus oleraceus</i>	Common Sowthistle
<i>Sporobolus africanus</i>	Parramatta Grass
<i>Sporobolus creber</i>	Western Rat's Tailed Grass
<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass
<i>Sporobolus parramattensis</i>	-
<i>Stellaria media</i>	Common Chickweed
<i>Taraxacum officinale</i>	Dandelion
<i>Themeda australis</i>	Kangaroo Grass
<i>Trifolium arvense</i>	-
<i>Trifolium campestre</i>	Hop Clover
<i>Trifolium</i> sp.	-
<i>Verbena bonariensis</i>	-
<i>Verbena</i> sp.	-
<i>Veronica plebeia</i>	-
<i>Wahlenbergia</i> sp.	-

**Fauna**

Scientific Name	Common Name
<b>Birds</b>	
<i>Alisterus scapularis</i>	Australian King Parrot
<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul
<i>Anthus richardi</i>	Richard's Pipit
<i>Cormobates leucophaeus</i>	White-throated Treecreeper
<i>Corvus coronoides</i>	Australian Raven
<i>Cracticus tibicen</i>	Australian Magpie
<i>Cracticus torquatus</i>	Grey Butcherbird
<i>Dacelo novaeguineae</i>	Laughing Kookaburra
<i>Malurus cyaneus</i>	Superb Fairy Wren
<i>Myiagra inquieta</i>	Restless Flycatcher
<i>Neochmia temporalis</i>	Red-browed finch
<i>Pardalotus punctatus</i>	Spotted Pardalote
<i>Psophodes olivaceus</i>	Eastern Whipbird
<i>Rhipidura albiscapa</i>	Grey Fantail
<b>Mammals</b>	
<i>Bos</i> sp.	Cattle
<i>Macropus giganteus</i>	Eastern Grey Kangaroo
<i>Vulpes vulpes</i>	Red Fox
<i>Wallabia bicolor</i>	Swamp Wallaby
<b>Frogs</b>	
<i>Crinia signifera</i>	Common Froglet

# Appendix C: Vegetation conservation significance

## Vegetation condition

### NSW condition criteria

Using a combination of the vegetation mapping (NPWS 2002), aerial photograph interpretation and site validation, each patch of SHW and AW vegetation with canopy cover was assigned a condition category based on its condition, density of canopy and area (ha). These classification rules for this process are explained in **Table 10**. This table is a modification of the Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney (Table 4 in NPWS 2002).

**Table 10: NPWS Vegetation of the Cumberland Plain condition classes (NPWS 2002)**

ELA condition category	Code	Area (ha)	Crown cover projection density	Description
Good	A	> 0.5	>10%	Relatively intact native tree canopy. Dominant canopy and understorey species identified.
Moderate	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 characteristic not assessed.
Low	TX	> 0.5	<10%	Areas of native trees with very discontinuous canopy cover. Tree cover only with agriculture but no major urban or suburban development.
	TXr	> 0.5	<10%	Areas of Tx (as above) located in areas where there rural residential development.
	TXu	> 0.5	<10%	Areas of Tx (as above) located where the dominant land use is urban (residential/industrial etc).

**Source:** Table 4 in the Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain Western Sydney (NPWS 2002).

Some patches of vegetation within the study area did not contain canopy level vegetation, namely SHW (DNG) and SHW (DNS). In order to discuss the relative vegetation condition of these patches of the SHW community, ELA took into consideration past and current validated vegetation mapping, field observations, connectivity to other vegetation and patch size to assign a condition category of good, moderate or low.



### Commonwealth condition criteria

Vegetation within the study area did not meet the criteria in **Table 11**, and as such no vegetation within the study area is subject to the EPBC Act. The listing advice and condition thresholds for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest under the EPBC Act differ from that for CPW under the TSC Act. Condition is assigned based on patch size and perennial understorey cover.

**Table 11: Condition thresholds for patches that meet the listing advice for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest critically endangered ecological community**

Category and rationale	Thresholds
<b>A.</b> Core thresholds that apply under most circumstances: patches with an understorey dominated by natives and a minimum size that is functional and consistent with the minimum mapping unit size applied in NSW.	Minimum patch <sup>3</sup> size is ≥0.5ha;
	<b>AND</b> ≥50% of the perennial understorey vegetation cover <sup>4</sup> is made up of native species.
<b>OR</b>	
<b>B.</b> Larger patches which are inherently valuable due to their rarity.	The patch size is ≥5ha;
	<b>AND</b> ≥30% of the perennial understorey vegetation cover is made up of native species.
<b>OR</b>	
<b>C.</b> Patches with connectivity to other large native vegetation remnants in the landscape.	The patch size is ≥0.5 ha;
	<b>AND</b> ≥30% of the perennial understorey vegetation cover is made up of native species; <b>AND</b> The patch is contiguous <sup>5</sup> with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is ≥5ha in area.
<b>OR</b>	
<b>D.</b> Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain.	The patch size is ≥0.5 ha in size; <b>AND</b> ≥30% of the perennial understorey vegetation cover is made up of native species; <b>AND</b> The patch has at least one tree with hollows per hectare or at least one large tree (≥80 cm dbh) per hectare from the upper tree layer species outlined in the Description and Appendix A.

<sup>3</sup> A *patch* is defined as a discrete and continuous area that comprises the ecological community, outlined in the Description. Patches should be assessed at a scale of 0.04 ha or equivalent (e.g. 20m x 20m plot). The number of plots (or quadrats or survey transects) per patch must take into consideration the size, shape and condition across the site. Permanent man-made structures, such as roads and buildings, are typically excluded from a patch but a patch may include small-scale disturbances, such as tracks or breaks or other small-scale variations in native vegetation that do not significantly alter the overall functionality of the ecological community, for instance the easy movement of wildlife or dispersal of spores, seeds and other plant propagules.

<sup>4</sup> Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers (as outlined in the Description and Appendix A) with a life-cycle of more than two growing seasons (Australian Biological Resources Study, 2007). Measurements of perennial understorey vegetation cover exclude annuals, cryptogams, leaf litter or exposed soil (although these are included in a patch of the ecological community when they do not alter functionality as per footnote 3 and the Description and Condition Thresholds are met).

<sup>5</sup> Contiguous means the woodland patch is continuous with, or in close proximity (within 100 m), of another patch of vegetation that is dominated by native species in each vegetation layer present.

**Source:** DEWHA (2009) *Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on an Amendment to the List of Threatened Ecological Communities under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

**Vegetation recovery potential**

A recovery potential matrix was used to assign a recovery potential to each vegetation unit. The matrix has been adapted by ELA from a matrix developed by Ian Perkins Consultancy Services (2002) to identify the recovery potential of vegetation of the Cumberland Plain and has been used in a variety of similar assessments. The matrix considers a range of factors including landuse history, soil condition and vegetation composition. Based on the characteristics of the various vegetation units, a recovery potential rating of High, Moderate, Low or Very Low was assigned to each (**Table 12**).

**Table 12: Recovery potential matrix**

Current Condition And Landuse	Past Landuse And Disturbance	Soil Condition	Vegetation	Recovery Potential
Cleared (no woodland canopy)	Recently cleared (<2 years)	Unmodified or largely natural. Uncultivated	Native dominated	High
			Exotic dominated	Moderate
		Modified. Heavily cultivated and/or pasture improved and/or existing grazing. Imported material	Native dominated	Moderate
			Exotic dominated	Low
	Historically cleared (>2 years) and consistently managed as cleared	Unmodified or largely natural. Uncultivated	Native dominated	Moderate
			Exotic dominated	Low
		Modified. Heavily cultivated and/or pasture improved and/or existing grazing. Imported material	Either	Very low
Wooded/native canopy present or regenerating	No recent clearing of understorey	Unmodified or largely natural. Uncultivated	Native understorey relatively intact or in advanced state of regeneration. Native dominant	High
			Native understorey significantly structurally modified absent of largely absent includes areas dominated African Olive.	Moderate
			Exotic dominated	Low
		Moderately modified by long term grazing or slashing	Native dominated	Low

Current Condition And Landuse	Past Landuse And Disturbance	Soil Condition	Vegetation	Recovery Potential
		Modified. Heavily cultivated and/or pasture improved and/or existing grazing. Imported material	Native understorey present. Heavily weed invaded	Very low
			Native understorey significantly structurally modified, absent or largely absent.	
	Understorey patchily intact	Disturbed	Native dominated	Moderate
			Exotic dominated	Low
	Recent clearing of understorey and or native understorey significantly structurally modified due to existing landuse (e.g. slashing/grazing)	Unmodified or largely natural. Uncultivated	Native dominated. If no vegetation present, assume native dominated	High
			Exotic dominated	Moderate
		Modified. Heavily cultivated and/or pasture improved and/or existing grazing. Imported material	Native dominated	Low
			Exotic dominated	Very low



## Appendix D: Correspondence with NoW

**From:** Jeremy Morice [mailto:[jeremy.morice@dpi.nsw.gov.au](mailto:jeremy.morice@dpi.nsw.gov.au)]  
**Sent:** Tuesday, 7 April 2015 2:44 PM  
**To:** Robyn Johnson  
**Subject:** Re: Reeves Creek Rezoning - in principle support

Hi Robyn,

I have reviewed the revised Reeves Creek rezoning proposal as detailed in your email.

I am satisfied that the revised plans and documentation are consistent with discussions held with the NSW Office of Water and are compliant with a merit assessment under the NSW Office of Water Controlled Activity Guidelines for riparian corridors on waterfront land.

The NSW Office of Water provides in principle support for the proposal as presented.

Regards,

Jeremy Morice | Water Regulation Officer  
NSW Department of Primary Industries | NSW Office of Water  
Level 0 | 84 Crown Street | Wollongong NSW 2500  
PO Box 53 | Wollongong NSW 2520  
T: 02 4224 9736 | F: 02 4224 9740 | E: [jeremy.morice@dpi.nsw.gov.au](mailto:jeremy.morice@dpi.nsw.gov.au)  
W: [www.dpi.nsw.gov.au](http://www.dpi.nsw.gov.au) | [www.water.nsw.gov.au](http://www.water.nsw.gov.au)

**From:** Robyn Johnson  
**Sent:** Wednesday, 1 April 2015 10:19 AM  
**To:** [Jeremy.Morice@water.nsw.gov.au](mailto:Jeremy.Morice@water.nsw.gov.au)  
**Subject:** Reeves Creek Rezoning - in principle support

Hi Jeremy,

We've made the changes as discussed at our last meeting for the Reeves Creek rezoning and are now seeking your written in-principal support for the proposed rezoning. Below is a summary of the proposed rezoning on riparian values:

**Table 1:** Riparian values within the proposed rezoning

Reach no.	Potential impacts
B, C and D  1st Order Streams  20 m plus channel width RC	There are no proposed works within the inner or outer 50% of the required RC for any of these reaches.
E  2nd Order Stream  40 m plus channel width RC	<p>Proposed works within the inner 50% of required RC include a road crossing, an APZ to existing lot (Baxter property), two proposed online detention basins (and proposed stream realignment) and an outlet structure from an offline basin. There are two existing farm dams along this reach that will be reshaped into two online dry basins.</p> <p>Proposed works within the outer 50% of required RC include APZs and one area of public recreation.</p> <p>Note: NoW has advised that <i>any existing farm dams to be retained as online structures should be modified so as to provide limited permanent water storage and provision of low flows to retained watercourses. Online basins should comply with the requirements as specified in the NSW Office of Water Guidelines for Riparian Corridors. Any design variations from the guidelines will require further merit assessment.</i></p> <p>Note: NoW has also advised that <i>any required bushfire asset protection zones (APZs) are to be located outside required riparian corridor widths. APZs are allowed within the outer 50% of the VRZ, so long as offsets are provided in accordance with the averaging rule.</i></p>
F  3rd Order Stream	Proposed works within the inner 50% of required RC include the entrance road, online detention basin and APZs. A portion of the inner 50% RC also extends outside the study area to the north.

Reach no.	Potential impacts
60 m plus channel width RC	Proposed works within the outer 50% of required RC include the entrance road and APZs.  See above note in reach E for APZs.
G	Proposed works within the inner 50% of required RC include a road crossing and online detention basin.
2nd Order Stream	Proposed works within the outer 50% of required RC include roads and APZs.
40 m plus channel width RC	See above note in reach E for APZs.
H	Proposed removal of entire reach H, approved by NoW.
1st Order Stream	NoW will allow for the filling of this reach so long as suitable offsets are provided within the site for the loss of otherwise required vegetated riparian zones (i.e. the required RC for reach H would need to be added to the total RC required for the study area).
20 m plus channel width RC	

The proposed ILP would require merit based assessment for:

- Reach E – proposed stream realignment associated reshaping of existing farm dams into proposed online basins and an APZ within the inner 50% RC
- Reach F – proposed entrance road, online detention basin and APZs within the inner 50% RC
- Reach G – proposed online detention basin within inner 50% RC.

Proposed works within the outer 50% of the RC, entire reach H and the above works within the inner 50% have been subjected to the 'averaging rule'. Of the basins the rock walls are being offset, the remaining parts of the basins have not been offset as these will be planted in accordance with a VMP at the DA stage. Based on the TOB mapping and stream orders an RC of 5.98 ha was required for the study area. Using the headwaters of reaches B, C and D, the proposed rezoning can achieve a RC of just over this amount with 6.0 ha.

Please let me know if you need any further information, otherwise we look forward to your written confirmation of in-principle support to include within our rezoning report that we are hoping to send to the client this week.

Robyn Johnson

**HEAD OFFICE**

Suite 4, Level 1  
2-4 Merton Street  
Sutherland NSW 2232  
T 02 8536 8600  
F 02 9542 5622

**CANBERRA**

Level 2  
11 London Circuit  
Canberra ACT 2601  
T 02 6103 0145  
F 02 6103 0148

**COFFS HARBOUR**

35 Orlando Street  
Coffs Harbour Jetty NSW 2450  
T 02 6651 5484  
F 02 6651 6890

**PERTH**

Suite 1 & 2  
49 Ord Street  
West Perth WA 6005  
T 08 9227 1070  
F 08 9322 1358

**DARWIN**

16/56 Marina Boulevard  
Cullen Bay NT 0820  
T 08 8989 5601

**SYDNEY**

Level 6  
299 Sussex Street  
Sydney NSW 2000  
T 02 8536 8650  
F 02 9264 0717

**NEWCASTLE**

Suites 28 & 29, Level 7  
19 Bolton Street  
Newcastle NSW 2300  
T 02 4910 0125  
F 02 4910 0126

**ARMIDALE**

92 Taylor Street  
Armidale NSW 2350  
T 02 8081 2681  
F 02 6772 1279

**WOLLONGONG**

Suite 204, Level 2  
62 Moore Street  
Austinmer NSW 2515  
T 02 4201 2200  
F 02 4268 4361

**BRISBANE**

51 Amelia Street  
Fortitude Valley QLD 4006  
T 07 3503 7193

**ST GEORGES BASIN**

8/128 Island Point Road  
St Georges Basin NSW 2540  
T 02 4443 5555  
F 02 4443 6655

**NAROOMA**

5/20 Cauty Street  
Narooma NSW 2546  
T 02 4476 1151  
F 02 4476 1161

**MUDGEES**

Unit 1, Level 1  
79 Market Street  
Mudgee NSW 2850  
T 02 4302 1230  
F 02 6372 9230

**GOSFORD**

Suite 5, Baker One  
1-5 Baker Street  
Gosford NSW 2250  
T 02 4302 1220  
F 02 4322 2897

1300 646 131  
[www.ecoaus.com.au](http://www.ecoaus.com.au)