Townson Road Precinct, Marsden Park Planning Study

Biodiversity, Riparian and Bushfire Assessment

Prepared for
Mecone

March 2014

DOCUMENT TRACKING

ITEM	DETAIL
Project Name	West Schofields, Townson Road Rezoning Assessment: Biodiversity, Riparian and Bushfire
Project Number	12WOLPLA_0035
File location	W:\Synergy\Projects\12WOLPLA\12WOLPLA-0035 West Schofields, Townson Rd Precinct - Biodiversity & Riparian Corridor Assessment\Report\Draft Reports
Prepared by	Kimberly McCallum and Sally Perry
Approved by	Steven House
Status	Final
Version Number	2
Last saved on	21 March 2014
Cover photos	Cumberland Plain and Alluvial Woodland and an existing watercourse in the Townson Road Precinct. Photos by Kimberly McCallum Oct 2012

This report should be cited as '*Eco Logical Australia 2014. Townson Road Rezoning Study*: *Biodiversity, Riparian and Bushfire Assessment*. Prepared for Mecone.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Mecone.

Contents

List of Figures

List of Tables

Abbreviations

ABBREVIATION	DESCRIPTION
AHCVV	Additional High Conservation Value Vegetation – vegetation meeting the requirements for ENV that was not mapped in the Growth Centres Conservation Plan
APZ	(Bushfire) Asset Protection Zone
AW	Alluvial Woodland
CEEC	Critically Endangered Ecological Community
CPW	Cumberland Plain Woodland
CPLS	Cumberland Plain Land Snail
DECCW	(Former) NSW Department of Environment, Climate Change and Water
DP & I	NSW Department of Planning and Infrastructure
SEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
ENV	Existing Native Vegetation, as defined in the Growth Centres Conservation Plan
EPA Act	NSW Environmental Planning and Assessment Act (1979)
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act (1999)
OEH	NSW Office of Environment and Heritage (formerly DECCW)
MNES	Matters of National Environmental Significance
PBP / PBP 2006	NSW Rural Fire Service Planning for Bushfire Protection Guidelines 2006
RC	Riparian Corridor
RBM	Relevant Biodiversity Measure (from the Growth Centres Biodiversity Certification Order)
RFS	NSW Rural Fire Service
SEPP	State Environmental Planning Policy
TSC Act	NSW Threatened Species Conservation Act (1995)
VRZ	Vegetated Riparian Zone
WSUD	Water Sensitive Urban Design

Executive Summary

The Townson Road study area is part of the West Schofields Precinct in the North West Growth Centre of north-west Sydney. While the broader West Schofields precinct has not yet been released for detailed planning investigations, the Townson Road study area was released by the NSW Government in May 2013. Eco Logical Australia Pty Ltd (ELA) was engaged by Mecone to undertake preliminary investigations of the ecological, riparian and bushfire issues within the Townson Road study area. The aim of the assessment is to identify the ecological and riparian values on the site, consider the interplay between these site values, investigate the current and future constraints posed by ecological, riparian and bushfire management issues and provide recommendations for the future master planning, rezoning and urban development of the site.

The site contains a number of ecological values that are currently listed under State and Commonwealth legislation. Biodiversity Certification of the Growth Centres Conservation Plan contains a regional biodiversity offsets package, effectively enabling the loss of ecological values on 'certified lands' without triggering further assessment under the NSW TSC Act, similarly the Strategic Assessment under the Commonwealth EPBC Act exempts certified land from further assessment under commonwealth legislation. The loss occurring on certified land is offset through the retention and management of areas of higher ecological value across the Growth Centres and through a levy that will be used to protect and manage areas of high ecological value outside of the Growth Centres.

Within the Townson Road study area, a mix of certified and non-certified land is present. Non-certified land occurs along the western portion of the precinct and coincides with Bells Creek. This land is subject to conditions 8, 17 and 19 of the Biodiversity Certification Order and any stands of Existing Native Vegetation (ENV) in the non-certified area must be protected (or offset if clearing is required for the provision of essential infrastructure).

The vast majority of the Townson Road study site is Certified Land, consequently the extensive stands of remnant native vegetation on this land are exempt from further assessment under the TSC or EPBC Acts.

Bells Creek is the only watercourse to occur within the study site and runs approximately south to north essentially along the western site boundary. A first order tributary enters Bells Creek (a second order stream) to the west of the precinct boundary, but the riparian corridor of this stream does not extent into the study area. As the site is located relatively high in the catchment, no streams exceed the Strahler 2nd order classification and the requirements for twenty (20) metre riparian corridors on each side of the watercourse banks. However Bells Creek currently exists as two parallel streams for much of the Townson Road study area, effectively making the total potential riparian corridor width up to 130m in parts.

This report also considers the bushfire hazard currently affecting the Townson Road study area. It identifies limitations to development, integrated bushfire and environmental management actions as well as the location and adequacy of emergency response facilities. The bushfire section is intended to provide technical guidance on the development of the Masterplan for the Townson Road study area and identifies limitations to development and rezoning opportunities, integrated bushfire and environmental management actions as well as the location and adequacy of emergency response facilities.

The bushfire hazard across the site is generally considered to be moderate. While the site is heavily vegetated, the relatively open grassy woodland formation with limited shrub layer generally creates a lower fire intensity and the relatively flat topography across the majority of the site and influence of the riparian corridor combine to reduce the potential wildfire intensity.

The main source of bushfire threat is vegetation within the Townson Road study area as the adjoining lands have predominantly been cleared of native vegetation in the immediate vicinity and replaced with exotic pasture grasses. Large stands of remnant vegetation occur further to the north and south of the site.

Asset Protections Zones (APZ) are a key component of bushfire planning measures and the issue which often has the greatest impact on development yields. Based on the bushfire hazard analysis, residential and Special Fire Protection Purpose (SFPP) APZs have been recommended according to the specifications contained within PBP 2006. The exact width and location of APZs will be dependent on the retention and regrowth of remnant vegetation across the study area and on adjacent lands (particularly the riparian corridor along the west of the site) and the bushfire related planning controls at the time future development applications are lodged.

Future development at the subject site can meet the requirements of NSW Rural Fire Service Guideline *Planning for Bushfire Protection* (2006) given the incorporation of a number of strategies designed to minimise the risk from bushfire.

1 Introduction

1.1 DESCRIPTION OF PROJECT

Eco Logical Australia Pty Ltd (ELA) was engaged by Mecone to undertake an assessment of the ecological, riparian and bushfire issues so as to inform the rezoning process for the Townson Road study area within the North-West Growth Centre. The Townson Road area was released by the NSW Government in May 2013. The aim of this assessment is to identify key ecological, riparian and bushfire features and constraints of the site as well as to provide recommendations with respect to terrestrial and aquatic ecosystem management and management of bushfire issues.

The aim of this integrated assessment is to identify the key constraints and opportunities, assess the impacts and provide input for the likely stages of the Townson Road rezoning process:

- Stage 1 – flora and fauna field surveys, riparian location and habitat survey, assessment of bushfire threats, provision of a consolidated constraints analysis and provision of recommendations for incorporation into the Indicative Layout Plan (ILP);
- Stage 2 – assessment of the ILP, updated reporting, agency consultation and project team liaison,
- Stage 3 – input to finalisation of the ILP and associated reporting for public exhibition.

Specific objectives of this project are to:

- Undertake a strategic biodiversity assessment including a flora and fauna study, analysis of ecological values particularly in regards to identifying areas of high, moderate and low ecological value,
- Ensure the statutory requirements for the protection, restoration and enhancement of threatened species, populations, ecological communities and their habitats will be met, and that precinct rezoning processes are consistent with the terms of the biodiversity certification granted to the Growth Centres SEPP,
- Ensure protection of biodiversity values within areas identified by the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 Growth Centres SEPP,
- Ensure the statutory requirements for bushfire protection are identified and can be adequately met,
- Provide recommendations for achieving innovative management frameworks for ecological, riparian and bushfire issues which enable long term conservation and management while facilitating the safe urban development outcomes for the precinct.

This report demonstrates the objectives are achieved through;

- Methodology that includes a literature review of previous work, detailed terrestrial aquatic and geomorphic field assessment, assessment of current and future bushfire management issues and scenarios,
- Integrated assessment of the current and future ecological, riparian and bushfire issues,
- Consideration of statutory requirements, including; Growth Centres Commission Development Code, Threatened Species Conservation Act (TSC Act), Environment Protection and Biodiversity Conservation Act (EPBC Act), Growth Centres SEPP

Biodiversity Certification Order, Water Management Act (WM Act), Fisheries Management Act (FM Act), NSW Rural Fires Act (RF Act) and NSW Planning for Bushfire protection Guidelines 2006 (PBP 2006).

1.2 STUDY AREA

The Townson Road study area (hereafter referred to as the study area) forms part of the broader West Schofield Precinct (Figure 1). It is located approximately 500m north of the southern border of the North-West Growth Centre. The West Schofields Precinct and the study area both exist entirely within the Blacktown City Council Local Government Area. The study area is bound to the west by Bells Creek and to the North by Townson Road and is approximately 30 ha in size (Figure 2).

The southern part of the study area consists of one large landholding. The northern portion of the study area is made up of five smaller freehold allotments that front Townson Road and the rear portions of 4 similar sized allotments which face Richmond Road and which are used primarily for light manufacturing / materials storage, landscape materials storage, livestock grazing and rural residential land uses. Substantial areas of remnant native vegetation remain within all of the allotments.

The majority of the study area is covered by remnant vegetation, parts of which are relatively intact while other areas are heavily cleared and disturbed. There are two distinct, regular shaped areas within the site that have been previously cleared and are now used as a 'paintball' recreation site while other areas within the site have also been previously cleared and exist in varying levels of disturbance and regrowth.

The Bells Creek watercourse forms the western site boundary. Currently the Bells Creek corridor is in a reasonable to good condition, with high levels of intact native vegetation along the banks in the southern part of the study area and banks which are relatively stable. The vegetation declines in extent and condition towards the north of the study area and in parts the banks are actively eroding. Drainage lines shown on topographic maps do not accurately reflect the on-ground situation as Bells Creek divides in two channels in the southern part of the study area and therefore one branch of the watercourse extends further east into the study area than originally mapped by NSW Office of Water. The watercourse has also been modified by land owners with the construction of culverts and raised banks. Inflows into Bells Creek (outside the study area) have been, and continue to be modified by land clearance activities in the surrounding area.

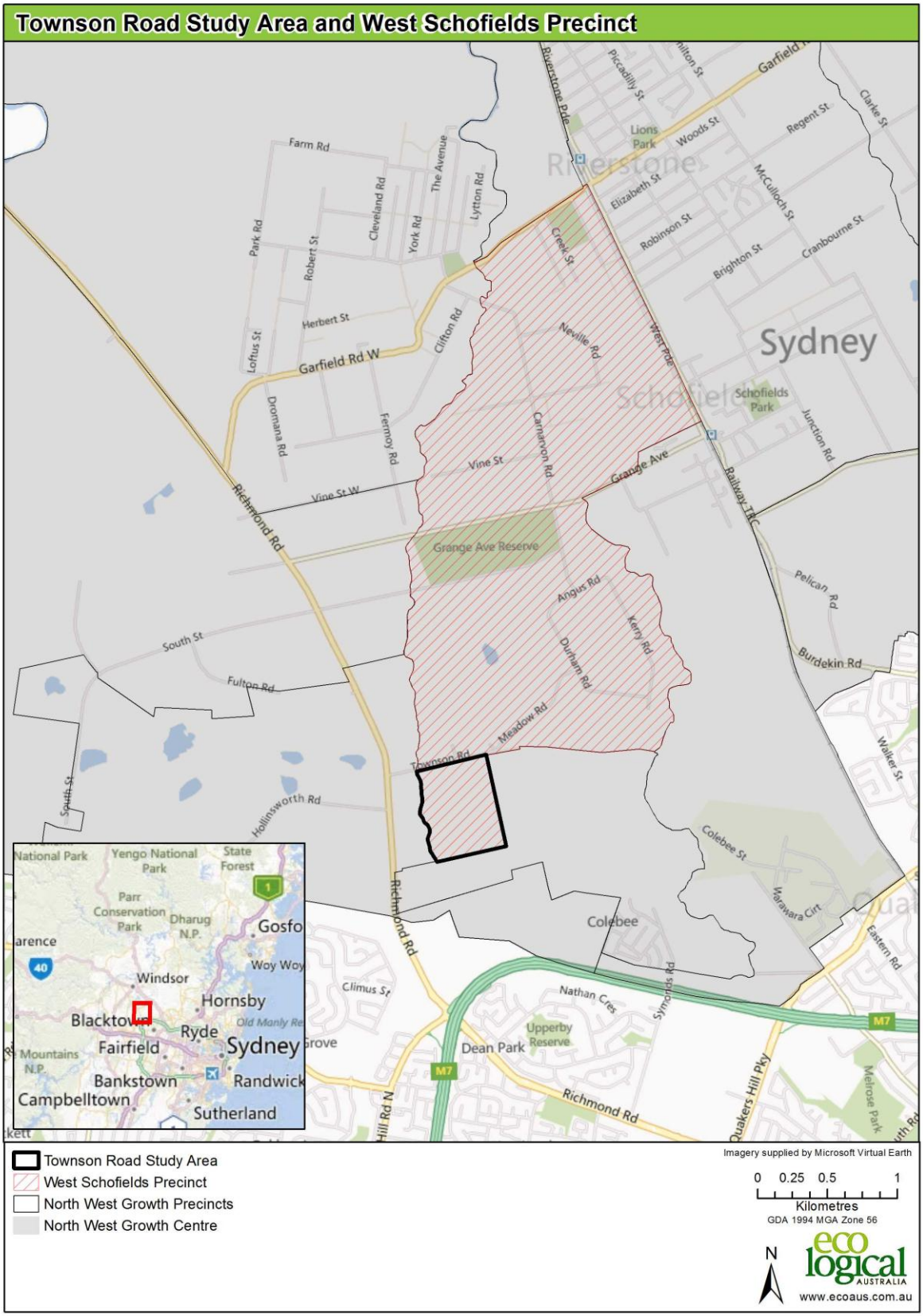

Figure 1: Townson Road Study area, West Schofields Precinct and North West Growth Centre

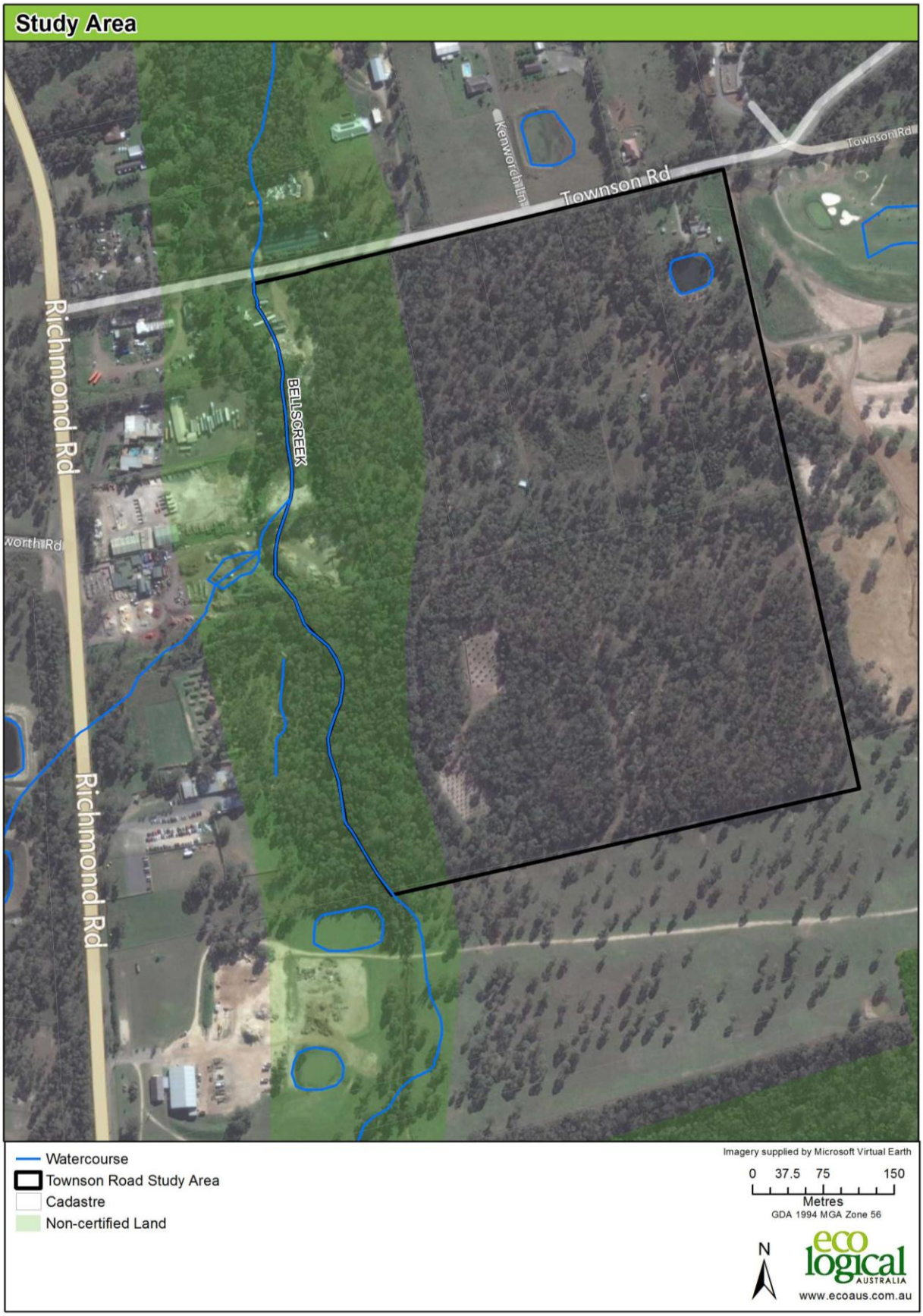

Figure 2 :Townson Road Study Area

1.3 BIODIVERSITY METHODOLOGY OVERVIEW

An overview of the methodology is provided below. For full details see Appendix B:

- Database search for threatened species, populations and ecological communities under the TSC Act and Matters of National Environmental Significance (NES) under the EPBC Act;
- Assessment of State and Federal statutory requirements;
- Field validation of Existing Native Vegetation (ENV), threatened species and aquatic / riverine habitat condition mapping. Assessments include the identification of additional high conservation value vegetation (AHCVV);
- Assessment of biodiversity values and mapping including analysis and identification of ecological constraints;
- Impact assessment discussion for the Indicative Layout Plan; and
- Recommendations for the development of the Indicative Layout Plan.

2 Statutory Framework

A substantial array of legislation, policies and guidelines apply to the assessment, planning and management of biodiversity values within the Townson Road study area. This information was reviewed and will be used to identify priority constraints and opportunities within the study area (Refer to Appendix A). Legislation and policies reviewed include:

2.1 INTERNATIONAL

- Japan – Australia Migratory Bird Agreement (JAMBA)
- China – Australia Migratory Bird Agreement (CAMBA)
- Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA)

2.2 COMMONWEALTH

- Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)
- National Biodiversity Strategy

2.3 STATE

- Environmental Planning and Assessment Act 1979 (EP&A Act)
- Threatened Species Conservation Act 1995 (TSC Act)
- Threatened Species Conservation Amendment (Special Provisions) Act 2008
- National Parks and Wildlife Act 1974
- Fisheries Management Act 1994 (FM Act)
- Native Vegetation Act 2003
- Noxious Weeds Act 1993
- State Environmental Planning Policy (Sydney Region Growth Centres) 2006
- Growth Centres Development Code 2006
- (Draft) Growth Centres Conservation Plan 2007
- Sydney Regional Environment Plan No 20 – Hawkesbury Nepean River (No 2 1997)
- Local Government Act (1993)
- Local Government Amendment (Ecologically Sustainable Development Act 1997
- NSW (Draft) Biodiversity Strategy 2010 – 2015
- NSW Rural Fires Act 1997
- Rural Fire Service Guidelines Planning for Bushfire Protection (2006)

2.4 LOCAL

- Blacktown Local Environmental Plan (1988)
- Blacktown Development Control Plan (2006)

3 Terrestrial Biodiversity Assessment

3.1 BIODIVERSITY CERTIFICATION

The Sydney Region Growth Centres State Environmental Planning Policy (SEPP) (referred to as the 'Growth Centres SEPP') has been 'Biodiversity Certified' by order of the Minister for the Environment under s.126G of the *TSC Act*. The mechanism for achieving this is outlined in the (*Draft) Growth Centres Conservation Plan* (Eco Logical Australia, 2007) and the conditions for biodiversity-certification are documented in the Ministers order for consent[1].

Biodiversity certification negates the requirement for impact assessment on threatened species under s.5A of the *Environmental Planning and Assessment Act, 1979* thus turning off the requirements for assessments of significance (i.e. seven part tests) or species impact statements on all certified land within the North West and South West Growth Centres.

The (*Draft) Growth Centres Conservation Plan* (2007) assessed native vegetation across the entire Growth Centres area and identified areas of Existing Native Vegetation (ENV). By definition (TSC Act 1995, biodiversity certification conditions) ENV means areas of indigenous trees (including mature and saplings) that:

a) had 10 % or greater over-storey canopy cover present,

b) were equal to or greater than 0.5 ha in area, and

c) were identified as "vegetation" on maps 4 and 5 of the (Draft) Growth Centres Conservation Plan, at the time the biodiversity certification order took effect, subject to condition 13.

Clause 13 of the biodiversity-certification details the ground-truthing requirements for ENV; namely, if new information becomes available after the biodiversity certification order took effect that demonstrates that the vegetation within an areas does not otherwise meet the definition of existing native vegetation, then for the purposes of conditions 7-8 and 11-12 only the area of ***validated*** existing native vegetation shall be considered.

The (Draft) Growth Centres Conservation Plan originally mapped a total of 30.5 ha of ENV occurring within the Townson Road study area. The fieldwork undertaken for this project has resulted in changes to the boundaries of mapped ENV and the mapping of new areas of Additional High Conservation Value Vegetation (AHCVV). AHCVV is defined as vegetation which meets criteria a) and b) above but was not mapped in the original conservation plan.

Figure 3 below shows the area of mapped ENV as well as the areas of Certified and Non-Certified land for the Townson Road study area. The Townson Road study area contains 26.4 ha of certified land and 7.4 ha of non-certified land (which corresponds to the corridor of Bonds Creek as it was originally mapped in the Certification Order). Within the non-certified lands, 6.7 ha of ENV was originally mapped in the study area. To maintain parity with the study area's contribution to protecting 2000ha of ENV

[1] http://www.environment.nsw.gov.au/resources/nature/biocertordwsgcentres.pdf

across all precincts of the study area, a minimum of 6.7 ha of ENV should therefore be retained within the Townson Road study area.

On Tuesday 28th February 2012, the Commonwealth Minister for the Environment announced the program of development related activities within the Growth Centres that had been approved under the Growth Centres Strategic Assessment. (This was the second stage of the approval of the Strategic Assessment of the Growth Centres under the Commonwealth EPBC Act 1999). Specifically, "All actions associated with the development of the Western Sydney Growth Centres as described in the Sydney Region Growth Centres Strategic Assessment Program Report (Nov 2010) have been assessed at the strategic level and approved in regards to their impact on the following matters of national environmental significance (MNES):

- World Heritage Properties
- National Heritage Places,
- Wetlands of International Importance,
- Listed threatened species, populations and communities, and
- Listed migratory species."

This approval essentially means that the Commonwealth is satisfied that the conservation and development outcomes that will be achieved through development of the Growth Centres Precincts will satisfy their requirements for environmental protection under the EPBC Act. So that, provided development activity proceeds in accordance with the Growth Centres requirements (such as the Biodiversity Certification Order, the Growth Centres SEPP and DCPs, Growth Centres Development Code etc) then there is ***no requirement*** to assess the impact of development activities on MNES and hence ***no requirement*** for referral of activities to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). The requirement for assessment and approval of threatened species and endangered ecological communities and the other MNES issues listed above under the EPBC Act has now been "turned off" by the approval of the Strategic Assessment.

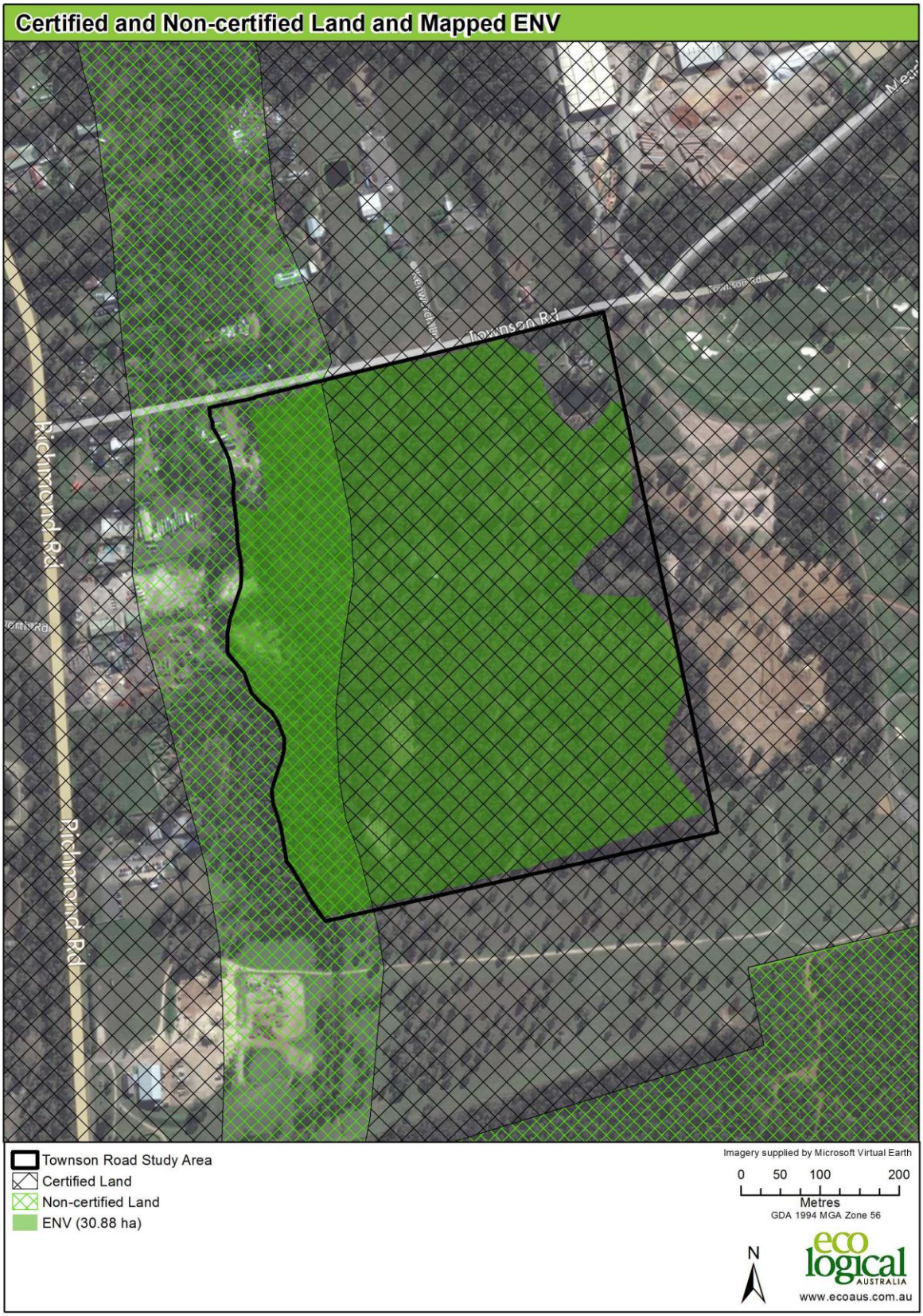

Figure 3: Certified and Non-Certified Land and originally mapped ENV within Townson Road study area

3.2 METHODS

3.2.1 Literature Review

A desktop literature review was undertaken by ELA to determine the location and extent of previous field surveys, identify the known constraints within the study area and evaluate the presence and likelihood of threatened species, populations and ecological communities listed under both the TSC Act and EPBC Act that could potentially occur within the precinct. The following documentation and data was reviewed;

- Topographic maps, digital elevation models and aerial photography of the study area
- Database searches of NSW OEH Wildlife Atlas
- EPBC online Protected Matters
- (*Draft) Growth Centres Conservation Plan*' prepared by Eco Logical Australia (2007) for NSW Growth Centres Commission
- Western Sydney Vegetation Mapping (NPWS 2002a)
- Western Sydney Condition and Conservation Significance Mapping (NPWS 2002b)
- 'Eco Logical Australia (2009) *Marsden Park Industrial Precinct Ecological Assessment.* Prepared for APP/Marsden Park Developments Pty Ltd.'

3.2.2 Field Survey

A basic floristic survey of the study area was undertaken to confirm the vegetation communities present. This survey included classification of native vegetation communities in accordance with the NSW OEH profiles. Full floristic quadrats were also taken at certain locations to allow for the identification of vegetation communities to EPBC Act level where relevant.

Additional targeted flora and fauna surveys were also undertaken and included random meander targeted flora searches, bird census, anabat recordings and frog surveys. Incidental flora and fauna records were recorded across the site. Detailed methodology can be found in Appendix B.

3.3 VEGETATION COMMUNITIES & CONDITION

The study area is dominated by remnant native vegetation, comprising Cumberland Plain Woodland (CPW) which grades to the Alluvial Woodland (AW) community along the western site edge in the vicinity of Bells Creek. The level of weed infestation varies on site in accordance with levels of previous and current site disturbance, and is generally highest in the immediate surrounds of the watercourse and also in areas subject to previous vegetation clearance and grazing activity. The characteristics of these two native vegetation communities, CPW and AW, their conservation significance and ecological condition are summarised in Table 1, discussed below in Sections 3.3.1 and 3.3.2 and presented in Figure 4 and Figure 5.

3.3.1 Cumberland Plain Woodland

The Cumberland Plain Woodland (CPW) Critically Endangered Ecological Community (CEEC) is listed under both the TSC and EPBC Acts. There are two sub-communities of CPW, being Shale Plains Woodland and Shale Hills Woodland. The species compositions of both sub-communities are generally identical on sites with some level of disturbance, and it is their position in landscape that predominantly determines whether an area is classified as Shale *Plains* or Shale *Hills* Woodland. Both sub-communities are equally protected under legislation and so have been considered together, as CPW, for this report.

CPW is the most widely distributed community on the Cumberland Plain, predominantly occurring on soils derived from Wianamatta Shale. CPW present within the study area consists of a mixture of good, moderate and poor condition vegetation due to the varying levels of disturbance to the site. The vast majority of CPW across the site is in good condition, particularly the stands in Lot 5 DP27536 and Lot 6 DP27536 with good levels of recruitment and areas with limited current or historical disturbance.

The canopy is dominated by Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*Eucalyptus tereticornis*), and Red Ironbark (*Eucalyptus fibrosa)*

The shrub layer over large parts of the study area has been and is currently subject to grazing and/or slashing. Native Blackthorn (*Bursaria spinosa*) and *Kunzea ambigua* are found sporadically in the shrub layer throughout the study area and varies in abundance from non-existent to dominant. Other native shrubs present in reasonable abundance across the site include *Grevillea juniperina* (Juniper-leaf Grevillea), Rice Flower (*Ozothamnus diosmifolius*) and *Dillwynia sieberi*.

Groundcover vegetation is typically dominated by a mixture of native and exotic grasses and herbs. Native groundcover species include Kangaroo Grass (*Themeda australis*), Wallaby Grass (*Austrodanthonia* sp.), Panicum *simile,* Speargrass (*Austrostipa* sp.), *Glycine clandestine,* Kidney Weed (*Dichondra repens*), and Plump Windmill Grass (*Chloris ventricosa*). Exotic groundcovers include Spear Thistle (*Cirsium vulgare*), Black-berry Nightshade (*Solanum nigrum*), Paddy's Lucerne (*Sida rhombifolia*), Paspalum (*Paspalum dilatatum*) and Fireweed (*Senecio madagascariensis*).

In 2009 both the Commonwealth and State Governments 'up-listed' Cumberland Plain Woodland (CPW) to the status of ***Critically*** Endangered Ecological Community (CEEC) under the EPBC and TSC Acts respectively. The criterion that must be met for vegetation to be captured by the new CEEC listing changed under both Acts. Under the EPBC Act, changes to both the vegetation characteristics and the assigning of condition classes have been introduced. Smaller scale changes to vegetation characteristics, such as the inclusion of derived native grassland in areas of CPW, were made under the TSC Act.

Consequently, vegetation mapping completed to illustrate areas of CPW that meet the TSC Act criteria and areas that meet the EPBC Act criteria have been included separately (Refer to Figure 4 and Figure 5). Condition classes have also been assigned for the maps, showing listed CPW vegetation relevant to the condition categories assigned for each Act.

The patches of remnant CPW on site contain a number of hollow bearing trees, an important resource for native fauna such as micro-chiropteran bats and hollow-nesting woodland birds in the highly cleared and fragmented landscape of North- Western Sydney. Clearing of hollow bearing trees is listed as a Key Threatening Process under the TSC Act.

3.3.2 Alluvial Woodland

The Alluvial Woodland (AW) within the study area comprises the endangered ecological community *River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* (River-Flat Eucalypt Forest), which is listed on Schedule 1 of the TSC Act. AW is not listed under the EPBC Act.

AW occurs exclusively along the main watercourse running south to north at the western edge of the Townson Road study area (refer to Figure 4).

The most common canopy species found within AW are Cabbage Gum (*Eucalyptus amplifolia*), Red Gum *(Eucalyptus tereticornis*) and Swamp Oak (*Casuarina glauca*) while Grey Box (*Eucalyptus*

molucanna) occurs less frequently. The shrub layer is quite variable with Native Blackthorn (*Bursaria spinosa*) and Broad-leaf Privet (*Ligustrum lucidum*) occurring frequently.

Groundcover vegetation is typically dominated by a mixture of native and exotic grasses and herbs. Native groundcover species dominated by Wallaby Grass (*Austrodanthonia sp.)*, Speargrass (*Austrostipa* sp.) and Couch (*Cynodon dactylon*). Exotic groundcovers are dominated by Wandering Jew (*Tradescantia fluminensis*) with a common occurrence of Prairie Grass (*Bromus catharticus*), Panic Veldtgrass (*Ehrharta erecta*), Plantain (*Plantago lanceolata*) and Paddy's Lucerne (*Sida rhombifolia*).

The area of AW within the Precinct measures approximately 4.3 ha. All AW present on site is in poor condition due to high levels of weed infestation at ground level.

3.3.3 Vegetation Community and Condition Assessment Area Calculations

Area calculations of each vegetation community within the study area are provided in Table 1 and Table 2. The area of AW vegetation and of CPW vegetation meeting the TSC Act criteria and the EPBC Act criteria is mapped for the whole Townson Road study area (i.e. both the certified and non-certified portions of the site) in Figure 4 and Figure 5.

Table 1: A summary of area occupied by TSC listed vegetation communities and their TSC condition.

VEGETATION COMMUNITY	CONDITION		
TSC Act listed vegetation communities (Non-Certified Land Only)	A, B, C (Good)	Tx (Poor)	**Total**
Cumberland Plain Woodland (including DNG)	2.6	-	**2.6**
Alluvial Woodland*	3.9		**3.9**
TSC Act Listed vegetation communities (Certified Land Only)	A, B, C (Good)	Tx (Poor)	**Total**
Cumberland Plain Woodland (including DNG)	23.4	-	**23.4**
Alluvial Woodland	0.4		**0.4**
Total (Certified and Non-Certified land)	**30.3**	**-**	**30.3**

*No condition classes exist for either Alluvial Woodland

Table 2: A Summary of area occupied by EPBC Listed vegetation communities and their EPBC Condition Class within the certified and non-certified portions of the study area.

EPBC ACT LISTED VEGETATION COMMUNITIES	CONDITION A	CONDITION B	CONDITION C	CONDITION D	TOTAL
Non-Certified Land Cumberland Plain Woodland	**2.6**	**-**	**-**	**-**	**2.6**
Certified Land Cumberland Plain Woodland	**23.4**	**-**	**-**	**-**	**23.4**
All Lands	**26.0**				**26.0**

NB. Appendix B provides an explanation of the condition codes assigned

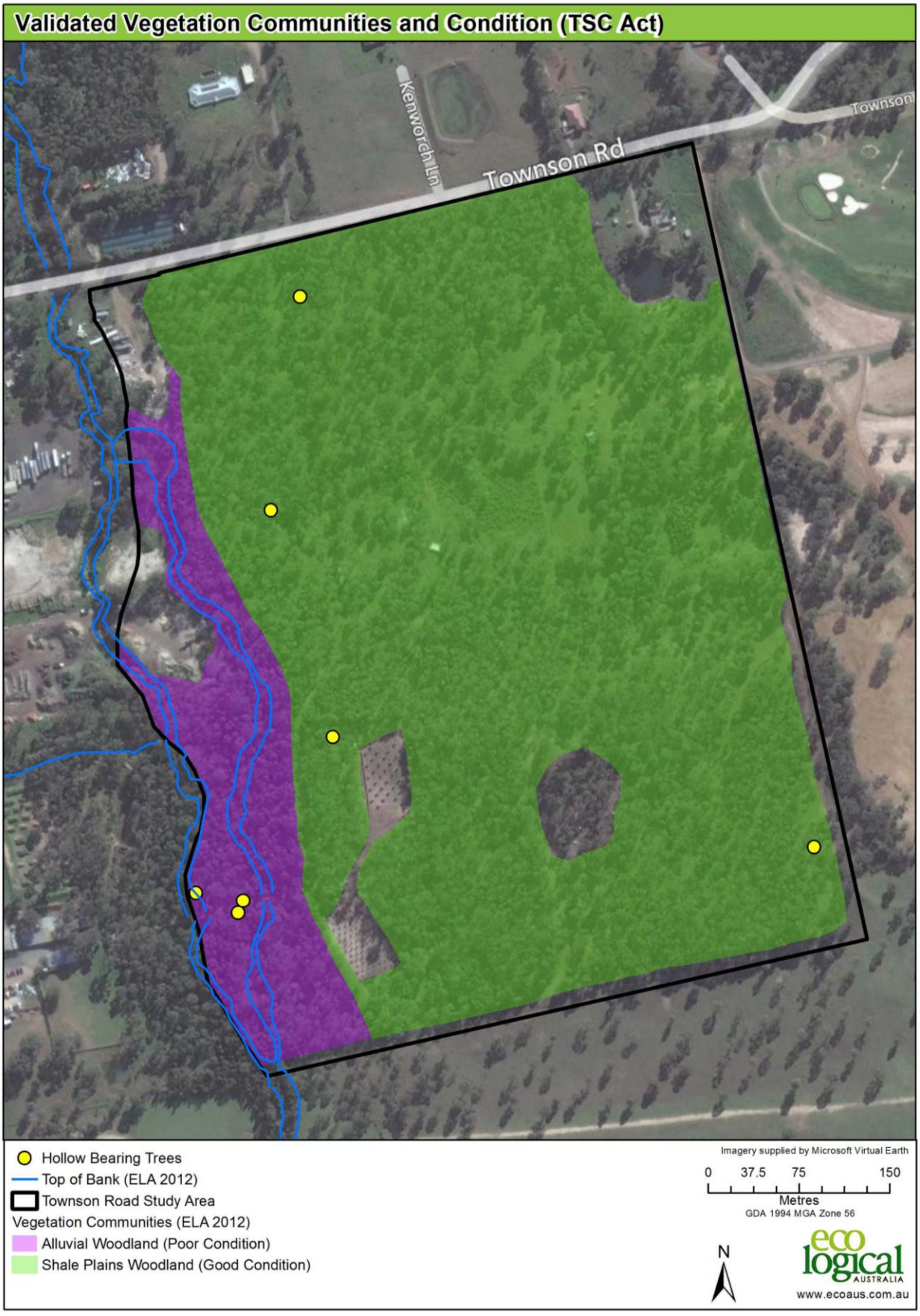

Figure 4:Validated vegetation communities on in Townson Road

Figure 5 : Validated vegetation communities as per EPBC Act

3.4 VALIDATED EXISTING NATIVE VEGETATION AREA CALCULATIONS

The (Draft) Growth Centres Conservation Plan (2007) mapped areas of Existing Native Vegetation (ENV) as per the results of the NSW National Parks and Wildlife Service (NPWS) Cumberland Plain Vegetation Mapping Project (2002). The original mapping showed the presence of two endangered ecological communities within the study area; Cumberland Plain Woodland (CPW) and Alluvial Woodland (AW).

The Conservation Plan mapped 30.5 ha of ENV within the entire Townson Road study area, with 6.7 ha located within non-certified areas and 23.8 ha within certified areas (see Figure 6). Subsequent site inspections have ***validated*** the presence of 28.7 ha of ENV within the Townson Road study area, which is comprised of 6.3 ha in the non-certified lands and 22.4 ha in the certified lands.

3.4.1 Additional High Conservation Value Vegetation

In addition to the originally mapped and now validated ENV, areas of vegetation were found on site and classified as Additional High Conservation Value Vegetation (AHCVV). AHCVV is defined as vegetation that was not mapped in the Conservation Plan but meets the specified ecological criteria (for ENV) of

a) having 10% or greater over-storey canopy cover present, and

b) patch size equal to or greater than 0.5ha.

Field inspections revealed an additional 1.3 ha of AHCVV within Townson Road, all of which occurs on certified lands.

3.4.2 ENV and AHCVV Calculations

The area of ENV validated on site plus the area of AHCVV identified on site is summarised in **Table 3**.

Table 3: Amount of ENV and AHCVV in Townson Road study area

TOWNSON ROAD PRECICNT	CERTIFIED LAND (ha)	NON-CERTIFIED LAND (ha)	TOTAL (ha)
Mapped ENV in Conservation Plan	23.8	6.7	30.5
Validated ENV in Conservation Plan	22.4	6.3	28.7
Additional Native Vegetation (AHCVV)	1.3	-	1.3
Total Validated ENV + Validated AHCVV	**23.7**	**6.3**	**30.0**

The area of validated ENV (28.7 ha) is 1.8 ha less than the original mapped ENV (30.5 ha). However, an additional 1.3 ha of AHCVV was identified on site, so that the overall total of vegetation currently present on site which meets the ecological criteria of ENV is 30.0ha (a difference of only 0.5 ha

compared to the original extent mapped). The amount of ENV originally mapped in the non-certified lands is 6.7 ha, however ground truthing only validated 6.3ha as being currently present on site.

The ENV mapped within the Conservation Plan was based on desktop analysis of the NPWS Cumberland Plain Vegetation Mapping Project (2002). Discrepancies between the Conservation Plan (mapped) ENV and the field validated ENV / AHCVV has likely occurred due to a number of factors, including:

- Changes in vegetation community boundaries due to increased accuracy of mapping afforded by ground truthing compared to desktop analysis at a broader scale,
- Potential vegetation clearing since the previous mapping was completed,
- Potential changes (increases) in vegetation extent and condition due to regrowth in some areas with recent wet years encouraging growth,
- Potential changes (reductions) in extent of vegetation due to several significant drought seasons prior to the recent wet years.

To maintain parity with the 2000 hectare target a total of 6.7 ha of ENV must be protected within the entire Townson Road study area. Figure 6 is an overlay of the originally mapped ENV areas from the Conservation Plan, the field validated ENV plus the AHCVV found on site.

The current Townson Road Master Plan proposes to retain 6.7 ha of field validated ENV/AHCVV, of which 6.3 ha is located within non-certified lands. Approximately 19.9 ha of ENV/AHCVV will be removed in certified areas, as shown in Figure 7. The loss of vegetation in non-certified lands is due to a detention basin outlets extending into that area.

Table 4: Mapped and validated ENV present, impacted and protected based on current Masterplan

	TOTAL IN TOWNSON ROAD	**TOTAL IN NON-CERTIFIED LANDS-**			**TOTAL IN CERTIFIED LANDS**			
		Protected	**Loss**	**Total**	**RE1/Passive Open Space**	**E2 Environmental Conservation**	**Loss**	**Total**
Conservation Plan mapped ENV	30.5	6.7	0.04	6.7	2.0	0.5	21.3	23.8
Field Validated ENV/AHCVV	28.7	6.3	0.04	6.3	2.0	0.5	19.9	22.4

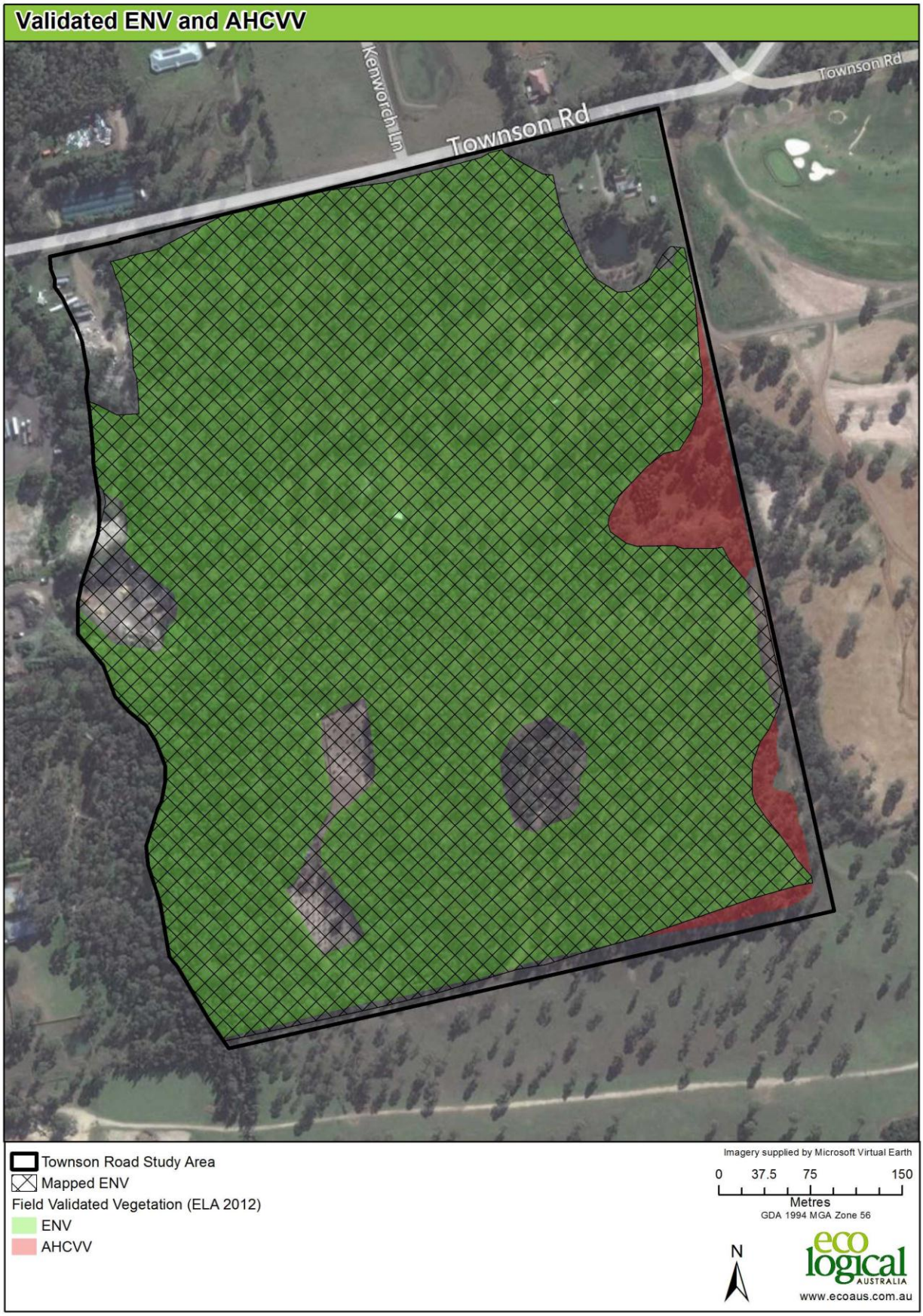

Figure 6: Mapped and validated ENV plus AHCVV within Townson Road

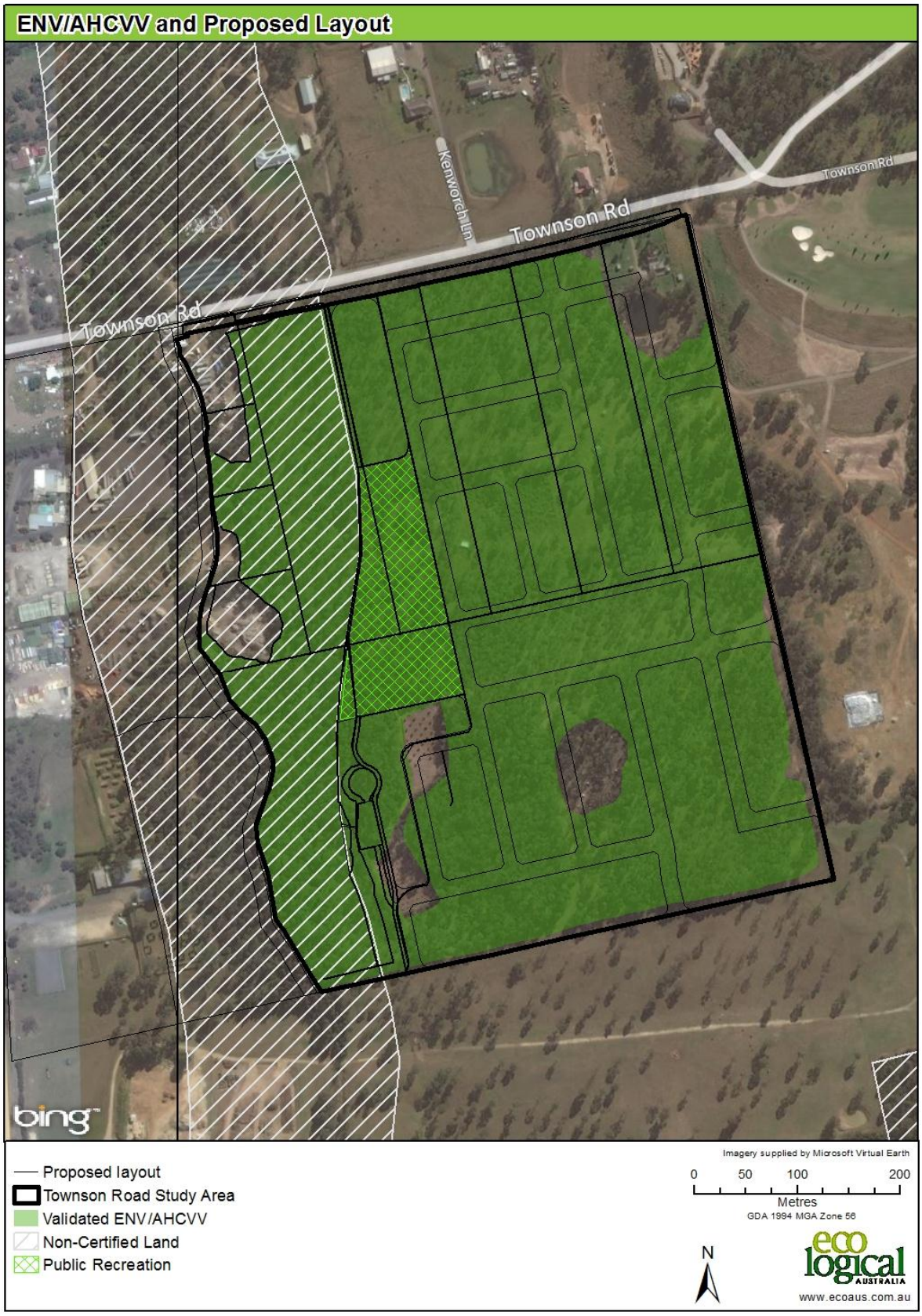

Figure 7 : Proposed site layout and ENV / AHCVV retention

3.5 FLORA

The field survey undertaken within the study area identified 61 flora species, comprised of 35 native and 26 exotic species. A flora list for the Precinct is presented in Appendix C. This is not a comprehensive list of all flora species likely to be present within the study area.

A list of threatened flora species known to occur within a 5 km radius of the study area has been collated (Appendix D). During the field survey, two threatened flora species listed as vulnerable under the TSC Act were recorded within the Precinct. The locations of the threatened flora species previously recorded within the study area as well as ELA's 2012 survey results are shown in Figure 8. The survey involved targeted searches for the species in areas of likely habitat. Surveyors stood side by side and undertook a random meander transect across the site. Due to the high number of plants recorded, the extent of the plants' distribution was recorded using a Differential GPS. The survey effort (GPS Tracks, plot locations and location of anabat recorders) is shown in Figure 9.

3.5.1 Threatened Flora Species

Grevillea juniperina subsp *juniperina*

Grevillea juniperina subsp *juniperina* (Juniper-leaved Grevillea) is a broad spreading, erect shrub growing up to 2.5m high. It has prickly narrow leaves, usually bright green which are clustered along short lateral branches. Its flowers are 'spider-like' and up to 3.5cm long and which range from green through pale orange, pink and red. It may flower sporadically during the year, but particularly between July and October. Individual plants are killed by fire, with replacement by germination of soil stored seed and consequently, if fires occur too frequently in an area it may not allow sufficient time for individual plants to mature and develop seeds. Other threats to this species include vegetation clearing and fragmentation, rubbish dumping, uncontrolled access, changes in drainage and weed invasion (OEH 2012).

The species grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary Alluvium with a shale influence. It has been recorded in Cumberland Plain and Castlereagh Scribbly Gum Woodlands as well as Shale Gravel Transition Forest. It is endemic to Western Sydney and its distribution is centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor. *Grevillea juniperina* subsp *juniperina* is listed Vulnerable under the NSW TSC Act (OEH 2012). It is not listed under the Commonwealth EPBC Act.

This species was found scattered across much of the study area, with over 375 individuals observed during the field survey (Figure 8). In the southern half of the study area the species was recorded in two distinct areas; 100 individuals were recorded in the Alluvial Woodland in the west and a further 100 individuals were recorded in the eastern portion of the site in Cumberland Plain Woodland. The species was recorded in four of the five lots across the northern portion of the study area, with at least 175 individuals in this area. The species was found scattered across the three western lots in this area (125 individuals) and the remaining 50 individuals were found at high density in the bottom corner of the north-eastern lot. The majority of individuals were in good condition, however the many of the individuals recorded in the south-eastern portion of the study area had been previously slashed. Individuals were recorded across a variety of age ranges and regeneration was apparent.

Dillywnia tenuifolia

Dillwynia tenuifolia is a low spreading pea flower growing up to 1m high. It has small and narrow leaves and wide yellow / orange / red coloured flowers. Flowering occurs sporadically between August to March dependant on the prevailing environmental conditions. Individual plants are estimated to live for 20 – 30 years, with reproductive maturity at 3 – 4 years. Threats to this species include vegetation clearance and fragmentation, inappropriate fire regimes, uncontrolled access, rubbish dumping and weed invasion (OEH 2012).

Its core distribution is the Cumberland Plain with several distinct occurrences within which it may be locally abundant, particularly when it occurs within the scrubby / dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest (OEH 2012). *Dillwynia tenuifolia* is listed as Vulnerable under the NSW TSC Act and not listed under the Commonwealth EPBC Act.

Dillwynia tenuifolia was found growing across much of the study area, with at least 450 individuals observed (Figure 8). This species was only found in the Cumberland Plain Woodland. The largest cluster of individuals (200) occurred in the south-eastern portion of the study area and the majority of these had been previously slashed. At least 250 individuals occur in the northern portion of the study area and were spread across four of the lots, the majority in the western portion of this area (200 +). Of the individuals remaining several had been grazed by goats and around 30 individuals were clustered together in a section of the north-eastern lot. Regeneration was apparent.

Other species

In addition to *Dillwynia tenuifolia* and *Grevillea juniperina* subsp*. juniperina* there are a number of threatened flora species that have been previously recorded within close proximity to the study area including; *Marsdenia viridiflora* subsp. *viridiflora, Micromyrtus minutiflora, Pimelea curviflora* var. *Curviflora, Pimelea spicata and Pultenaea parviflora.* These species were not identified during the field survey however the survey effort was not exhaustive.

3.5.2 Noxious Weeds

Eight plant species previously recorded within the study area are listed as noxious weeds within the Blacktown City Council Local Area. The noxious weeds present, their management class and whether they are a Weed of National Significance (WONS) is presented in Table 5 below. It is likely that other noxious weeds may occur within the Precinct that have not been previously recorded and were not detected during field survey.

Table 5: Noxious weeds and WONS present in the Townson Road study area

NOXIOUS WEED SPECIES	NOXIOUS WEED CLASS	WONS
Bridal Creeper (*Asparagus asparagoides)*	4	Y
Green Cestrum (*Cestrum parqui*)	3	-
African Boxthorn (*Lycium ferocissimum*)	4	-
Lantana (*Lantana camara)*	4	-
Broad-leaf Privet (*Ligustrum lucidum*)	4	Y
Prickly Pear (*Opuntia sp)*	4	
St John's Wort *(Hypericum perforatum)*	4	
Blackberry (*Rubus fruticosus*)	4	-

Class 3 = Regionally Controlled Weeds; That pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.

Class 4 – Locally Controlled Weeds; That pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.

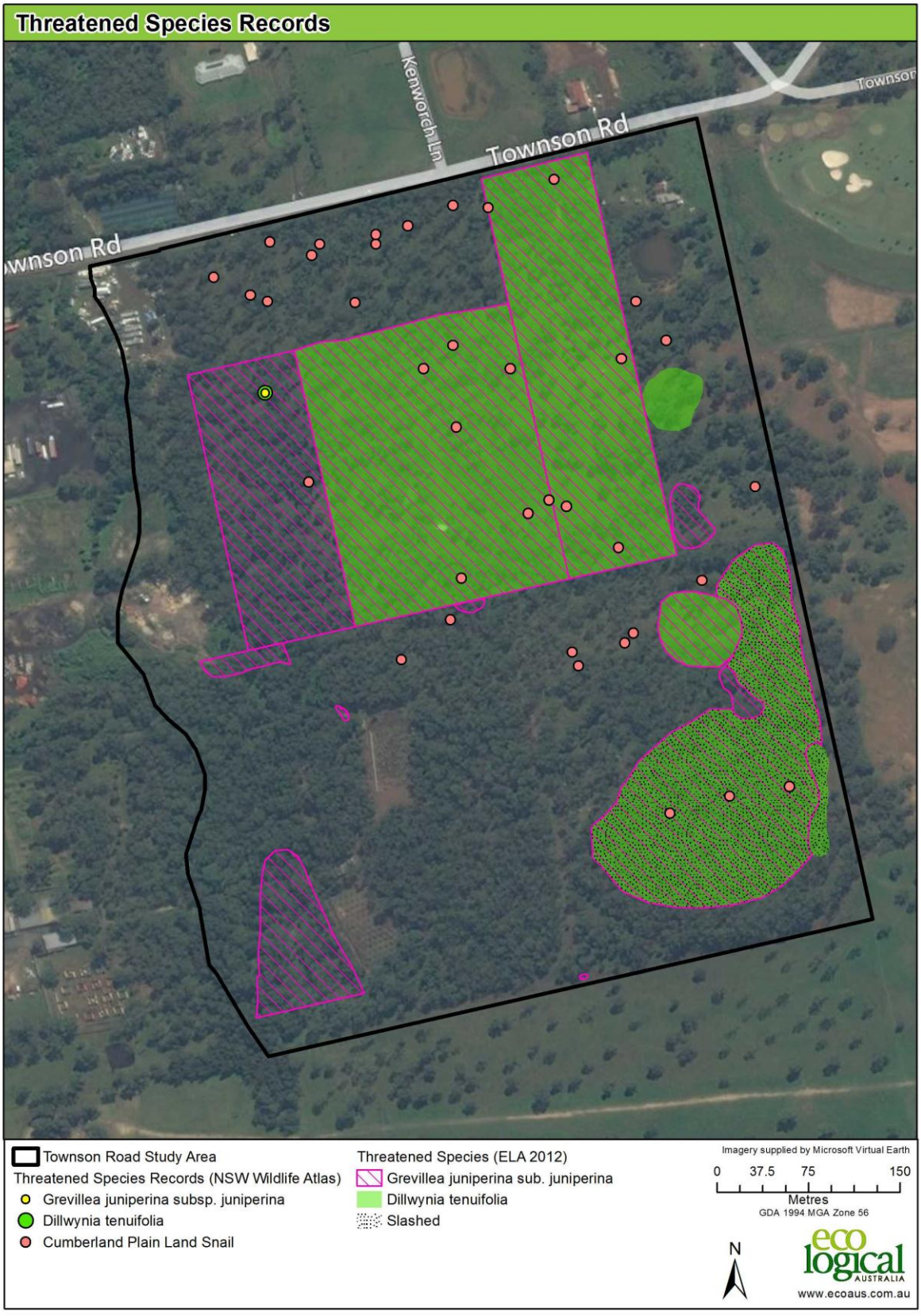

Figure 8: Location of threatened flora and fauna within the Townson Road Study Area

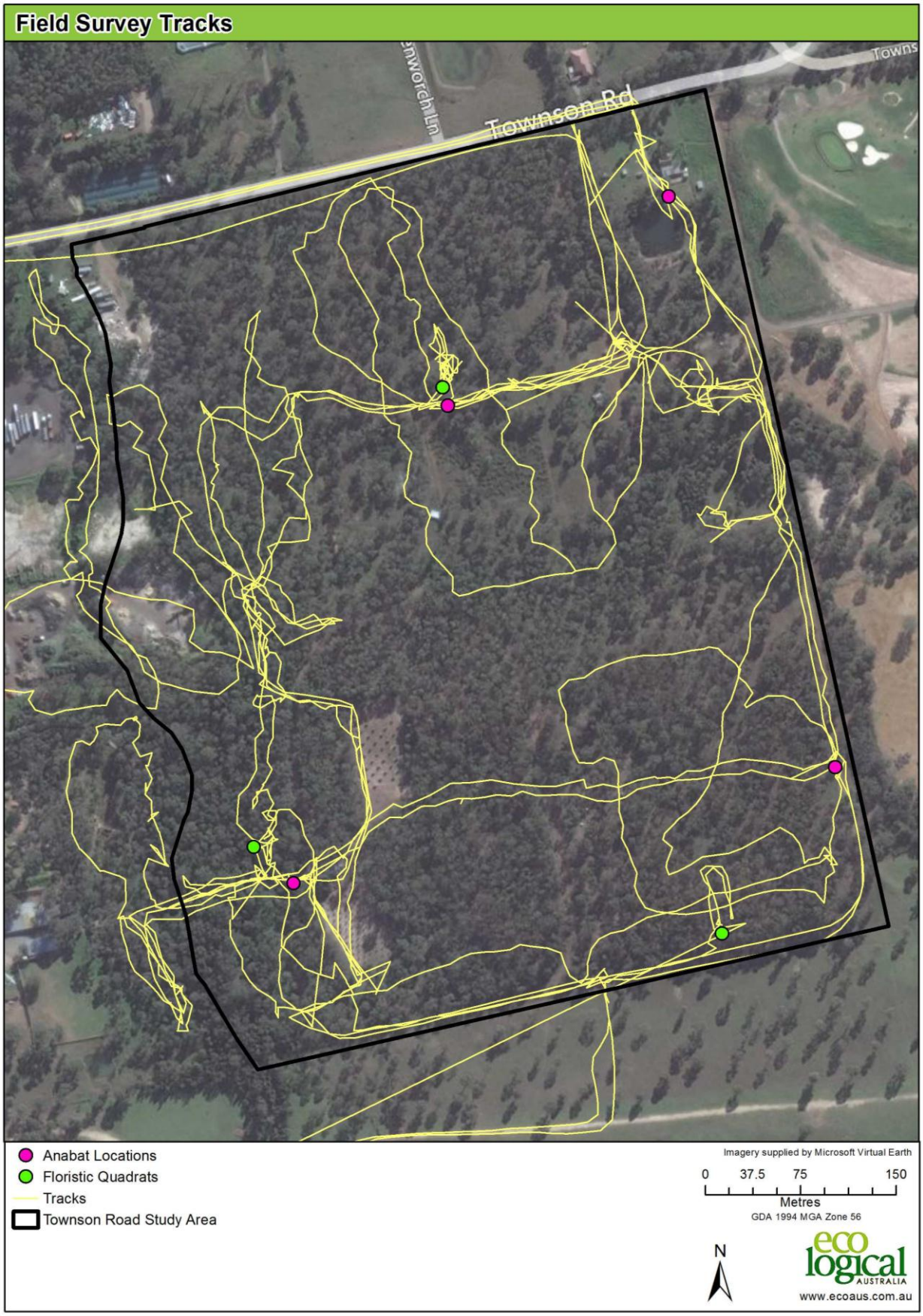

Figure 9: Survey tracks, anabat recorder locations and floristic quadrat survey locations

3.6 FAUNA

The field survey identified 53 fauna species, of which 41 were native species and 12 were introduced species. Of the native species, four amphibians, two reptiles, two mammals, nine bats and one fish were identified, while the remaining 23 species observed were birds. A fauna list for the study area is presented in Appendix C and a list of threatened fauna species known to occur within a 5 km radius of the study area has been collated (Appendix D).

The field survey identified the following species listed under the TSC Act and / or EPBC Act:

- Cattle Egret (*Ardea ibis*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*)
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Eastern Freetail Bat (*Mormopterus species)*

Ardea ibis, Cattle Egret

The Cattle Egret is widespread and common according to migration movements and breeding localities surveys (SEWPaC 2012a). In Australia the principal breeding sites for Cattle Egret are the central east coast from about Newcastle to Bundaberg as well as major inland wetlands in north NSW (notably the Macquarie Marshes) (SEWPaC 2012a). Non-breeding Cattle Egret may remain in breeding areas, but most migrate elsewhere. The total non-breeding range comprises east and south Australia from the far north-east of Queensland to Tasmania and the Eyre Peninsula and in inland regions it extends to the eastern parts of the Murray-Darling Basin (SEWPaC 2012a).

The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora (SEWPaC 2012a). High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass. The population estimate for Australia, New Guinea and New Zealand is 100 000 birds however there has been no systematic survey for the whole continent (SEWPaC 2012a).

Pteropus poliocephalus, Grey-headed Flying Fox

The Grey-headed Flying-fox is Australia's only endemic flying-fox and occurs in the coastal belt from Rockhampton in central Queensland to Melbourne in Victoria (SEWPaC 2012b). However, only a small proportion of this range is used at any one time, as the species selectively forages where food is available. As a result, patterns of occurrence and relative abundance within its distribution vary widely between seasons and between years. At a local scale, the species is generally present intermittently and irregularly. At a regional scale, broad trends in the distribution of plants with similar flowering and fruiting times support regular annual cycles of migration (SEWPaC 2012b).

Miniopterus schreibersii oceanensis, Eastern Bent-wing Bat

Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. They form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300 km range of maternity caves. They hunt in forested areas, catching moths and other flying insects above the tree tops (OEH 2012).

Mormopterus species, Eastern Freetail Bat

The Eastern Freetail Bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. While usually solitary they have been recorded roosting communally (OEH 2012).

Based on the Appendix D species list, the following threatened fauna species are known, likely or have the potential to occur on site.

Table 6: Threatened species considered known, likely or with the potential to occur in the Townson Road study area

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT
Ardea ibis	Cattle Egret	-	M
Ardea alba	Great Egret	-	M
Anthochaera phrygia	Regent Honeyeater	CE	E & M
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Erythrotriorchis radiatus	Red Goshawk	E4A	V
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-
Myotis macropus	Southern Myotis,	V	-
Mormopterus norfolkensis	Eastern Freetail Bat	V	-
Petroica boodang	Scarlet Robin	V	-
Pyrrholaemus sagittatus	Speckled Warbler	V	-
Hieraaetus morphnoides	Little Eagle	V	-
Lathamus discolor	Swift Parrot	E	E
Daphoenositta chrysoptera	Varied Sittella	V	-
Litoria aurea	Green and Golden Bell Frog	E	V
Meridolum corneovirens	Cumberland Plain Land Snail	E	-

3.7 ECOLOGICAL CONSTRAINTS ASSESSMENT

An ecological constraint ranking was derived applying an amended methodology that has been used elsewhere in Western Sydney (see Appendix B of this report) which combines size, condition, connectivity and recovery potential into a single ecological constraint value. This relates to the

ecological value of remnants within the study area without taking into account planning controls. The results of this analysis can be seen in Table 4 and Figure 10.

Broadly the rankings are as follows:

- High constraint = high ecological value, relatively large areas of good quality, well connected vegetation;
- Moderate constraint = moderate ecological value, smaller areas of good quality vegetation or large areas of poorer quality vegetation;
- Low constraint = low ecological value, all other native vegetated areas, generally isolated and small in size, with a low recovery potential.

Table 7: Extent of Ecological Constraints categories

Constraint Category	Area with Townson Road(ha)	% of Site Vegetation
High	27.0	89.4
Moderate	3.2	10.6
Low	-	-
TOTAL	30.2	100

3.8 OTHER MAJOR TERRESTRIAL ECOLOGY FACTORS

The southern boundary of the Townson Road site is approximately 250m north of the Colebee Nature Reserve. The Colebee Nature Reserve is part of the Colebee/Nurragingy Land Grant, a site of state heritage significance because of its combination of historical, social and cultural values. The site was the first land grant ever given to Aboriginal people in Australia. The land grant is associated with two significant Aboriginal figures from the early colonial period - Nurragingy and Colebee - to whom the land was jointly granted in 1816.

The land grant is valued by the contemporary Aboriginal community and the wider Australian community as a landmark in the history of cross-cultural engagement in Australia. The site is predominantly undeveloped rural land bound by Richmond Road on the west and surrounded by rural land parcels to the east and south. Immediately north of the site is an industrial complex. The site retains remnant vegetation across its eastern half and along Bells Creek, while clearing has had a greater effect across the western half of the property, towards Richmond Road.

In the highly fragmented landscape of north-west Sydney, the combined remnant vegetation extents in the Townson Road site and the Colebee Nature Reserve provide a significant area of relatively intact native habitat.

3.9 DISCUSSION / RECOMMENDATION

This section outlines the significant ecological matters which are relevant to the design of the Townson Road master plan. Two endangered ecological communities are present on site and make up all of the vegetation. The (Draft) Growth Centres Conservation Plan mapped the study area as having lower longterm management viability. The study area was also mapped as containing a threatened fauna population, presumably the Cumberland Plain Land Snail based on the number of previous records of

this species within the study area, however it was not detected during the 2012 survey despite more than 4 person hours of survey in the area where previous sightings had been made. The groundcover and leaf litter habitat currently onsite is very sparse and heavily trampled from the paintball activities, to the point that the site is now considered unsuitable due to the very low levels of leaf litter on the site.

Two (2) individual threatened flora species and four (4) threatened fauna species were located within the Precinct during field investigations. This section provides a brief summary of their ecological requirements, how these should be incorporated into future land use planning regimes and other ecological features of the site.

Juniper-leaved Grevillea: *Grevillea juniperina* var *juniperina*. Juniper-leaved Grevillea is a known threatened plant which occurs across a very wide proportion of the Townson Road study area. Multiple plants are present in each location and the total number of individuals found on site exceeds 375. Given the widespread distribution of this plant across the study area, the most likely scenario for securing the survival of individual plants is by locating areas of passive open space / environmental conservation in the locations with the highest population density. Collection of seed or propagation of vegetative material for planting in landscape areas or non-certified lands should also be considered.

Dillwynia tenuifolia: *Dillwynia tenuifolia* plants are similarly scattered across the study site in high numbers, with the number present on site estimated at 450. There is a significant positive correlation between areas which contain both *Grevillea juniperina* var *juniperina* and *Dillwynia tenuifolia*, therefore conservation measures designed for one species (such as locating open space / environmental conservation areas in areas which support these plants) will benefit both species. Collection of seed or propagation of vegetative material for planting in landscape areas or non-certified lands should also be considered.

Threatened Fauna*:* A number of hollow bearing trees were found on site and these are likely to form important breeding habitat for native fauna and are potentially being utilised by the three threatened bat species recorded on site. It is important that hollow bearing trees be retained wherever possible in open space / environmental conservation areas and areas of 'statement landscaping' such as entrances to the housing estate.

The riparian corridor at the west of the site is currently providing some level of aquatic habitat suitable for the Cattle Egret recorded onsite. Post development of the certified lands in the study area, the non-certified land of the riparian corridor will continue to provide aquatic habitat resources for this species. If the riparian corridor is enhanced and revegetated, there is potential for the area of suitable habitat to increase. The farm dam in the north-east corner of the site is also likely providing some level of aquatic habitat on site.

The riparian corridors will see the protection of the terrestrial vegetation along Bells Creek, however it is recommended that where these existing habitat features are to be cleared, removed or modified that compensatory habitat be incorporated into the detailed planning of the site. Examples of compensatory habitat may include wet basins which include areas of tall dense vegetation nearby to revegetated riparian corridors and/or providing reedy wetland ponding areas within the bed alignment of the creeks upon removal of existing online farm dams. The terrestrial and aquatic habitat linkages within and off site should be retained, enhanced and protected in the design of riparian corridors. Preliminary riparian corridor boundaries are included in Figure 11 and discussed further in the riparian assessment section following.

Figure 10: Ecological Constraint Analysis within the Townson Road Precinct

4 Riparian & Aquatic Assessment

4.1 CONTEXT

The Townson Road study area lies within the Hawkesbury-Nepean Catchment. The Hawkesbury-Nepean River system is the second-largest in NSW and has its headwaters located within largely pristine regions including the Blue Mountains World Heritage Area and Sydney Catchment Authority's lands in the NSW Southern Highlands. These upper reaches provide over 90% of Sydney's drinking water. Once into flatter, floodplain country, the Hawkesbury River flows eastward towards the ocean through rural and semi-rural areas of western Sydney. These middle and lower reaches of the system are highly impacted and degraded, both directly through waterway modifications and indirectly through adjacent land use practises.

As required by statutory authorities, this riparian assessment follows the methodology outlined by the NSW Office of Water (NOW). This methodology is based on a Strahler Stream Order classification which identifies Riparian Corridor (RC) widths as measured from the Top of Bank (TOB) and minimum Vegetated Riparian Zone (VRZ) widths.

This approach supersedes the categories outlined in the Growth Centres Development Code (GCDC) and provides greater integration of strategic planning and development application stages.

This riparian assessment includes:

- Mapping of Top of Bank using a differential GPS,
- Classification of the condition and recovery potential of stream reaches within the study area;
- Categorisation of each stream using the Strahler methodology
- Identification of heavily degraded streams or areas of overland flow that do not meet the definition of a 'river' and are suitable for removal
- Scoping of potential options for use of the non-certified lands.

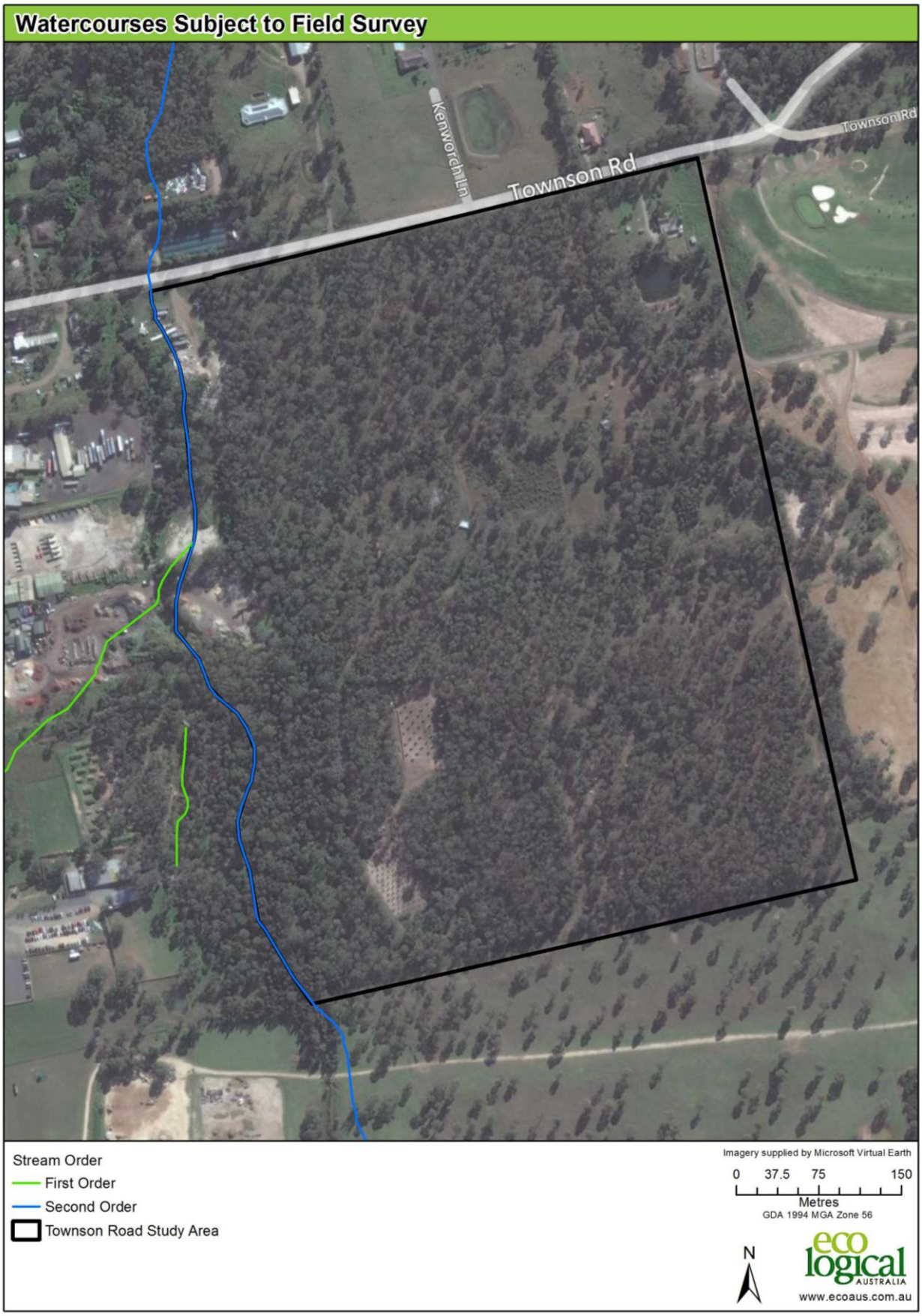

Figure 11: Watercourses locations subject to site survey within the Townson Road study area, based on NOW hydrolines

4.2 METHODS

4.2.1 Field Investigations and Top of Bank Mapping

The study area contains the floodplain of Bells Creek as well a farm dam in the north-east corner of the site (Figure 11). The key objective of this assessment is to classify watercourses that are to be retained into the Strahler stream orders and identify the appropriate riparian corridors as per the NOW guidelines (NOW 2012) summarised in Table 8. The assessment was based on all 'blue lines' appearing on the 1: 25 000 topographic map series, combined with field modelling and / or data analysis of the top of bank as shown in Figure 12.

Minimum riparian zone requirements in accordance with the NSW Office of Water controlled activity guidelines for Riparian Corridors are outlined in Table 8.

A survey of the Top of Bank (TOB) for all watercourses in the Precinct was conducted by a geomorphologist with a differential GPS (accuracy 50cm-70cm). The TOB mapping has been used as the basis for the initial riparian buffer delineation and riparian corridor boundary determination.

Table 8: NOW Strahler Stream Order Categories and required riparian buffers

WATERCOURSE TYPE	VRZ WIDTH (EACH SIDE OF WATERCOURSE)	TOTAL RIPARIAN CORRIDOR WIDTH
1st order	10 metres	20m + channel width
2nd order	20 metres	40m + channel width
3rd order	30 metres	60m + channel width
4th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80m + channel width

Watercourse reach identification numbers have been assigned to enable clear descriptions of the relevant sections of the Bells Creek watercourse. The condition of each reach was assessed, along with its recovery potential, using the method outlined in Geomorphic Categorisation of Streams in the Hawkesbury Nepean Catchment (DLWC 2000) document. The condition of each stream was classified into one of the following categories:

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

The recovery potential was classified into the following categories:

- Very High Recovery Potential
- High Recovery Potential
- Moderate Recovery Potential
- Low Recovery Potential

4.3 RESULTS

4.3.1 Field Investigations and Top of Bank Mapping

The results of the TOB mapping and initial delineation of riparian buffers is shown in Figure 12. Each stream was broken into reaches where within each reach the amount of native vegetation and condition or recovery potential was similar and was significantly different than the area adjacent. The condition of each stream reach is summarised in Table 9 and the full details of the riparian assessment are provided in Table 21 in Appendix B.

Field survey determined that the stream actually splits into two watercourses just south of the Townson Road study area southern boundary. The watercourse merges again in the north, just west of the Townson Road study area western boundary. The north-western portion of the western branch of the watercourse was in a degraded condition due to vegetation clearance, dominance of exotic species and channel modification. The remaining areas of the western watercourse and the entire eastern watercourse are considered to be in moderate condition with little previous channel modification observed.

Native canopy cover was quite good across the site, within the immediate vicinity of the streambanks, especially in the southern portion of the study area. Weed infestation was common, with all portions of the watercourse having at least one strata dominated by exotics. The entire length of the watercourse was subject to minor erosion, however this was most evident in the northern portion of the where 15% of the stream bank was subject to slumping erosion.

Inflows into the watercourse have been modified due to land clearance in the surrounding region. Modification to the channel bed and alignment has also occurred with small culverts, raised banks and a dam/wetland observed during the field survey. It is likely that some diversion of the watercourse has occurred to divert flows away from infrastructure built in the area. Natural recovery potential is generally moderate, but ranges from low to high across the site. The major factor limiting recovery is the degree of weed infestation.

One farm dam exists on site outside of the proposed riparian corridor. Loss of habitat from removal of this dam should be compensated through the provision of appropriately designed wet basins.

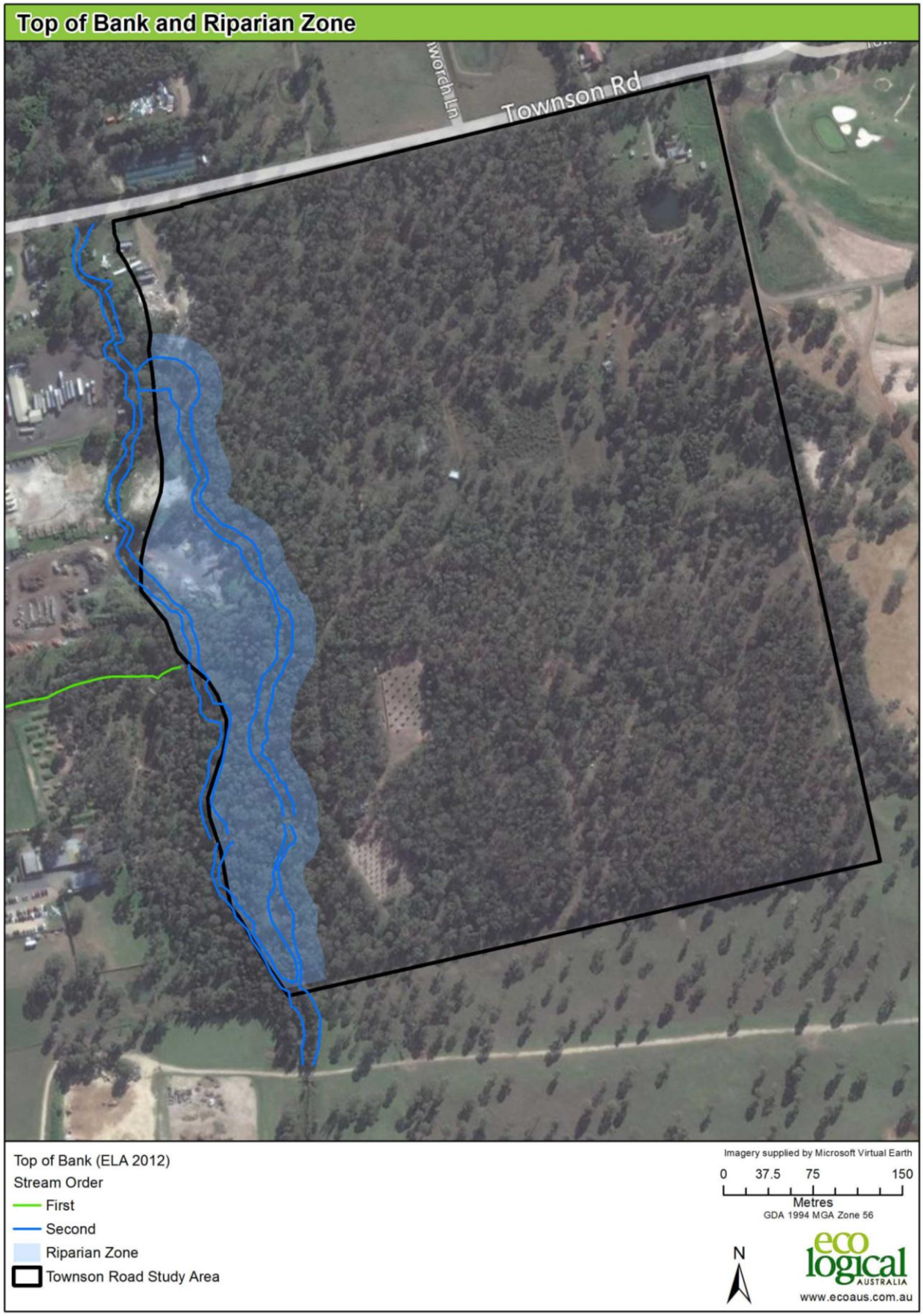

Figure 12: Top of Bank mapping and potential riparian corridor width

4.3.2 Stream Orders and Riparian Corridor Widths

Using the Strahler stream ordering methodology, the watercourses reaches can be categorised as follows (more detail on the condition of each reach is provided in Appendix B). These watercourse reaches are mapped in Figure 13.

Table 9: Summary of watercourse reach categories and required riparian corridors

WATERCOURSE REACH	STRAHLER STREAM ORDER	VRZ WIDTH (EACH SIDE OFWATERCOURSE)	TOTAL RIPARIAN CORRIDOR WIDTH
A	2nd Order	20 metres	40m + channel width
B	2nd Order	20 metres	40m + channel width
C	2nd Order	20 metres	40m + channel width

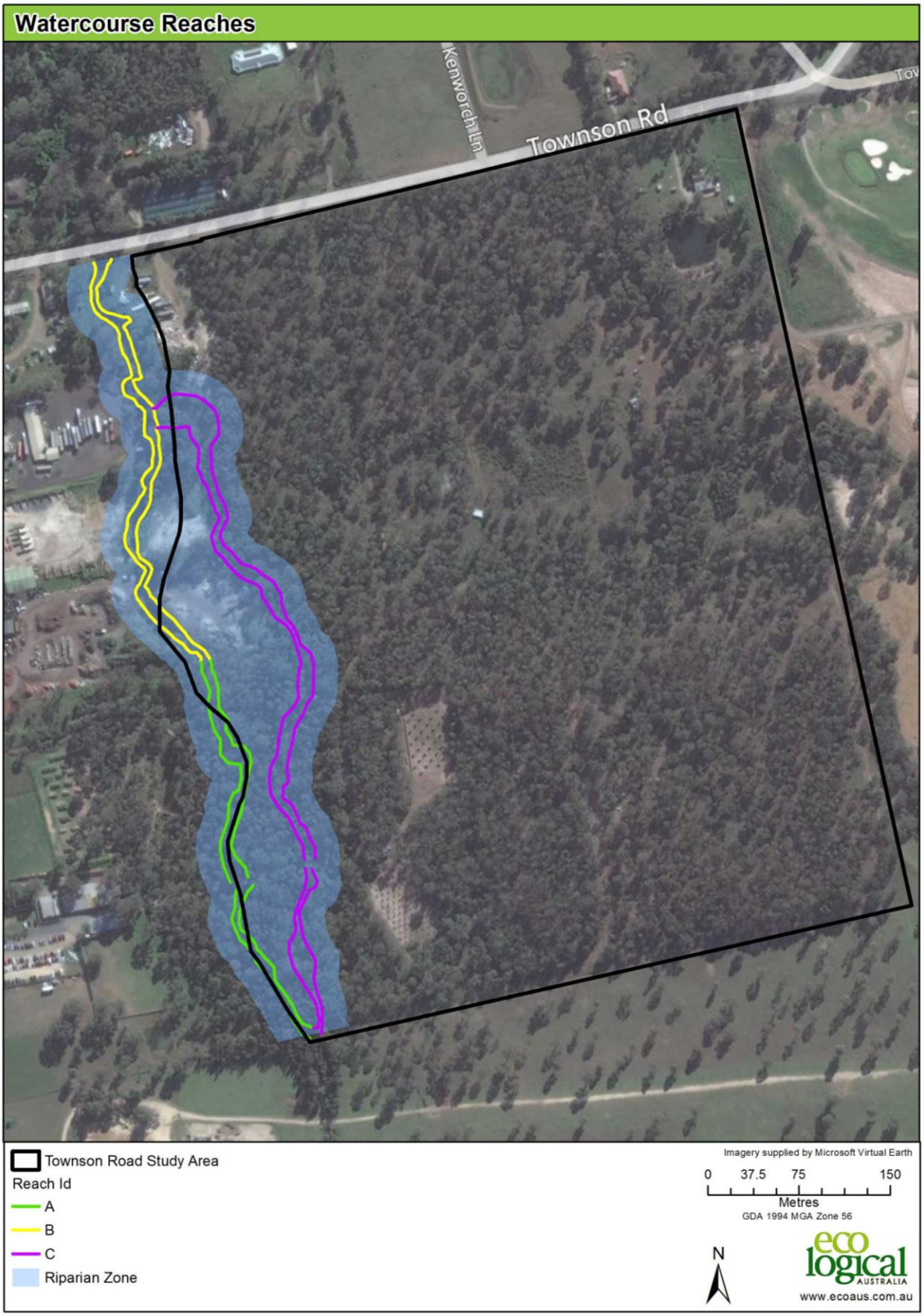

Figure 13: Watercourse reaches within Townson Road study area

4.4 AQUATIC ASSESSMENT AND THREATENED SPECIES

4.4.1 Aquatic Habitat Condition Assessment

Bells Creek has existing value as part of a semi-vegetated riparian corridor which is contributing aquatic and terrestrial habitat for local flora and fauna species and providing a link to habitat beyond the study area boundaries. Parts of the creek also provides in-stream habitat for fish species, aquatic macrophytes and macro-invertebrates which all contribute to overall ecosystem health. Planning requirements involving the restoration of riparian ecosystem values will be crucial to improving the condition of downstream environments.

4.4.2 Threatened Species

The database searches undertaken for the site revealed a number of aquatic or amphibian species that are known from the region (Table 10).

A review of listed threatened species dependant on instream habitat revealed that no threatened species are likely to occur within the aquatic habitats present in the study area. There are some areas of potential habitat for Green and Golden Bell Frog (*Litoria aurea*) such as the existing dam with fringing emergent vegetation, however the vast majority of the site is considered to provide marginal or unlikely habitat for this species.

Table 10: Listed aquatic and amphibious species recorded in the region

SPECIES	FM ACT STATUS / TSC ACT STATUS	EPBC ACT STATUS
Macquarie Perch, *Macquaria australica*	E	E
Australian Grayling, *Prototroctes maraena*	-	V
Giant Burrowing Frog, *Heleioporus australiacus*	V	V
Green and Golden Bell Frog, *Litoria aurea*	E	V
Littlejohn's Tree Frog, *Litoria littlejohni*	V	V
Southern Bell Frog, *Litoria raniformis*[2]	E	V
Giant Barred Frog, *Mixophyes iteratus*	E	E

Whilst it is unlikely that any threatened aquatic species utilise the habitat on the site, there are a host of common aquatic species including eels, frogs and macroinvertebrates that rely on the health of aquatic habitat for their ongoing survival. Aquatic habitat is an important component of overall ecosystem health and contributes to the diversity and viability of terrestrial habitat. It is highly recommended that future urban development considers the need to provide instream habitat, lateral connectivity (including removal of current barriers to fish passage) and fringing riparian vegetation. In addition, erosion and

[2] Record from Commonwealth database. Accuracy considered dubious

sediment control should be a key requirement during construction and Water Sensitive Urban Design (WSUD) structures should be constructed and maintained to improve the future quality of receiving waters.

It is noted that the existing channels are modified and contain a variety of obstructions to fish passage. However, as they are located on non-certified land and contain existing native vegetation it is unlikely that rehabilitation of these areas will be possible due to the absolute level of protection provided by the SEPP clauses relating to the Native Vegetation Protection Map. Similarly, it is unlikely that outlet structures from offline detention/WSUD basins will be able to be connected to the channels as this would most likely require clearing of native vegetation (unless otherwise offset), which is not permitted under SEPP clauses operating elsewhere in the Growth Centres. The unintended consequence is that existing channels will not be rehabilitated, obstructions to fish passage will not be removed and uncontrolled overland flows will be required from the basins, which will most likely cause erosion and sedimentation.

4.4.3 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.

GDEs have varying degrees of dependency on groundwater. These range from total to occasional dependence and include (SCCG 2006, SKM 2001):

- **Entirely dependent** – ecosystems for which only a slight change in the groundwater regime will have catastrophic effects,

- **Highly dependent** – ecosystems for which moderate changes in the groundwater regime will result in significant changes to ecosystem distribution, health and or diversity. These ecosystems utilise both ground and surface water resources.
- **Proportionally dependant** – ecosystems for which changes in the groundwater regime result in significant changes to the ecosystem characteristics,
- **Opportunistically or minimally dependant** – ecosystems for which the reliance on groundwater is limited to seasonal or climatic variations. These ecosystems use surface water predominantly and if access to groundwater is prolonged, declines in ecosystem distribution, health, species composition or diversity may result.

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.

GDEs mapped in the study Area (Figure 14) are confined to the Alluvial Woodland riparian vegetation that may utilise groundwater fed base flows of Bells Creek as freshwater wetlands located on low-lying land close to shallow aquifers. Vegetation communities that may be recognised as GDEs within Townson Road Precinct include:

- River Flat Eucalypt Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion – Alluvial Woodland.

The dependence on of a GDE on groundwater varies greatly with each community and its position in the landscape. There is little available information on level of groundwater dependency of the patch of Alluvial Woodland community within the precinct. However, as a safeguard for future planning, freshwater GDEs such as streams, riparian zones and wetlands can be grouped as highly dependent, particularly during base flows. The one potential GDE present on site is mapped by its Biometric Vegetation type in Figure 14.

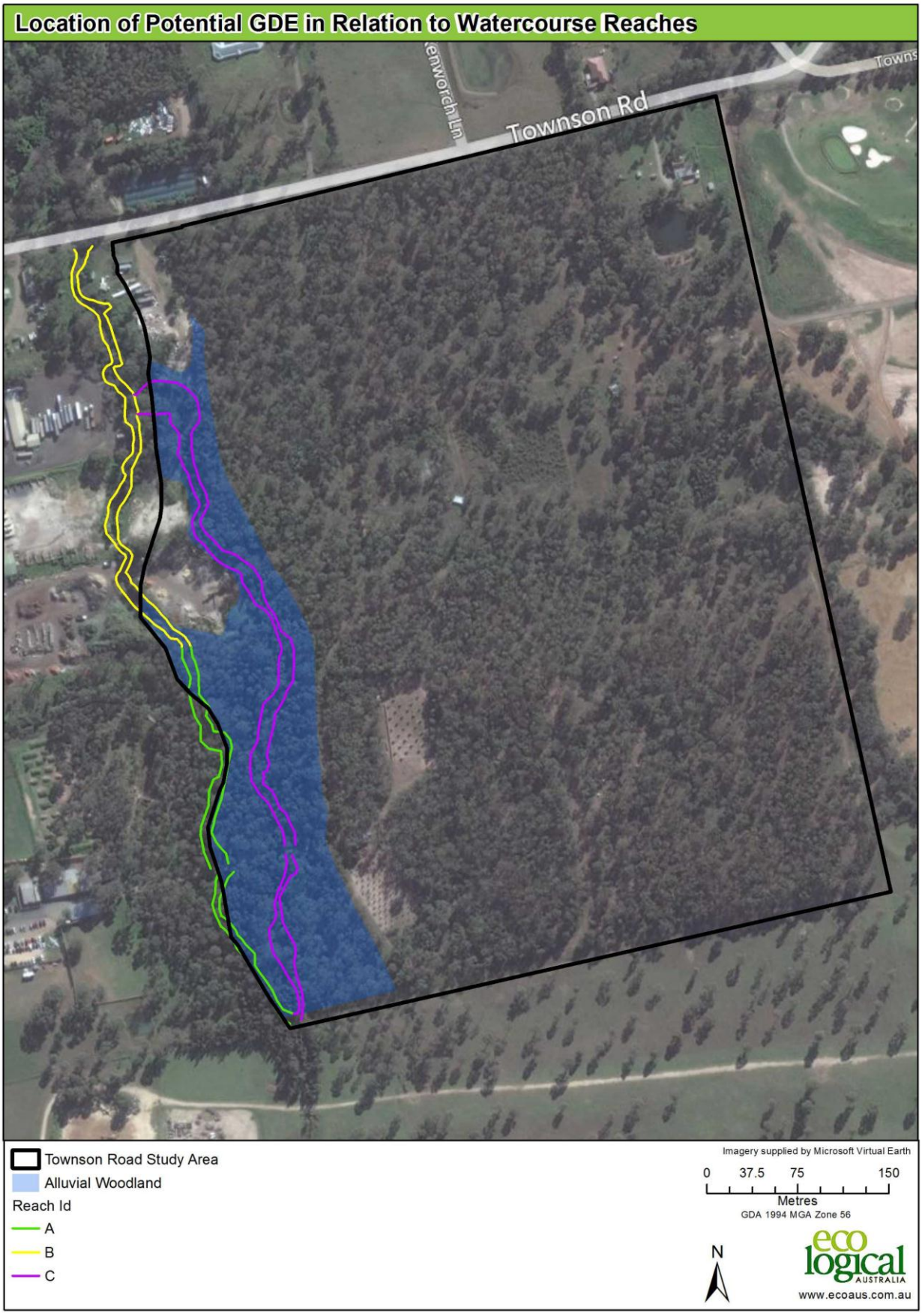

Figure 14: Aquatic Survey Reaches and location of Alluvial Woodland potential GDE

4.5 DISCUSSION / RECOMMENDATIONS

With the likely requirements of NOW for Riparian Corridor (RC) restoration the aquatic and riparian habitat of the existing watercourses within the precinct will improve over time as development works progress. It is likely that future development will require stormwater detention areas and other WSUD features that will provide a similar type of habitat as the farm dam does at present. Therefore there is potential for areas of new aquatic habitat to be created on site as development activity proceeds. If and when dewatering of the existing dam is to occur, detailed dewatering plans should be devised prior to works beginning so as to manage the aquatic flora and fauna. Examples of compensatory habitat could include appropriately designed wet basins containing similar habitat features to the dams which are removed.

The patches of potential GDE on site (Alluvial Woodland vegetation community) occur in close proximity to the Bells Creek channel, and it is recommended that this vegetation (which is also listed under the TSC Act as an endangered ecological community and also comprises areas of ENV) be retained within the riparian corridor network. If groundwater extraction is proposed as any part of future development proposals, impacts on this GDE would need to be further assessed.

4.5.1 Riparian Corridor Widths

In accordance with the results of the Strahler stream ordering methodology, all watercourse reaches were assigned as 2nd order streams. Required Riparian Corridors (RCs) and Vegetated Riparian Zones (VRZs) for 2nd order streams are 40m (plus the width of the channel) and 20m respectively.

For the majority of the Townson Road study area, two adjacent watercourses exist. If both watercourses are retained, the total width of the riparian corridor from the western side to the eastern side would be in the order of 130m (given that all land between the two watercourses would be treated as a riparian corridor and is wider than the minimum 20m required for 2nd order streams). If one watercourse was present through this area, then the minimum width riparian corridor required would be 40m plus the width of the channel. Presuming that the channel width would not exceed 10m if one channel was formed (so that the riparian corridor would be 50m in width), then retention of the two watercourse channels would result in the retention / creation of an additional 80m of riparian corridor.

If two channels are retained, then use of the 'Averaging Rule' in the riparian corridor guidelines could enable the vegetated riparian zones on the outer edge of each channel being reduced potentially to 10m for their entire length as more than 20m will be located on the opposite bank. It is noted that the flooding and biocertification lines influence the overall landuse plan in this area and that these areas generally extend beyond the minimum requirements of the NOW guidelines.

4.5.2 Zoning of Riparian Areas

The zoning of the site provides an opportunity to ensure riparian areas are identified so that the above management regime can be implemented and development does not encroach onto the riparian area. Zoning should prevent landuses that are inconsistent with the protection of riparian values and should be applied to the riparian corridor in Figure 12 which is based on the requirements of Table 11 Riparian corridor matrix.

Use of the E2 Environmental Conservation, E4 Environmental Living or SP2 Infrastructure zones for the riparian corridors will provide for the protection of terrestrial and aquatic habitats as a primary objective.

4.5.3 Riparian Ownership Options

Rehabilitation of riparian zones requires willingness on behalf of a landowner as well as the resources and expertise to undertake the rehabilitation. Whilst this can occur on privately owned land, the

effectiveness of rehabilitation efforts are often diminished when ownership is fragmented. This is primarily due to a lack of interest or resources from some landholders jeopardising the efforts of the willing landholders.

Public ownership is preferred (to avoid fragmentation) however this needs to be accompanied by resources for management of the riparian zones. Management would include weed removal, stabilisation of eroding banks and replanting of native vegetation. Blacktown City Council for example may accept the handover of riparian areas following appropriate rehabilitation works in accordance with a site specific vegetation management plan.

Where public ownership is not possible, lots should be kept as large as possible to avoid fragmentation and lessen the impact of different management regimes. Vegetation management plans will be required to be prepared to the satisfaction of NOW and Blacktown City Council for future development applications which impact on these areas.

4.5.4 Riparian Management

The objective for riparian corridor management as stated in the NOW Guidelines for riparian corridors on waterfront land (NOW 2012) is to establish and preserve the integrity of the riparian corridor. This can be achieved by the following principles:

- Maintaining or rehabilitating the riparian corridor (RC) and vegetated riparian zone (VRZ) with fully structured native vegetation in accordance with Table 11 below,
- Minimise any disturbance and harm to the recommended RC/ VRZs
- Minimise the number of creek crossings and provide a perimeter road separating development from the RC/VRS (which will also assist with bushfire management)
- Locate all services and infrastructure outside of the RC/VRZ. Within the RC/VRZ combine multiple service installations into one easement and / or utilise road crossings for service installations where possible.
- Ensure all stormwater is treated before discharging into the RC/VRZ.

NOW does allow for a range of works and land uses within the outer (landward) edge of riparian corridors so long as they have minimal environmental harm. Activities which may be permissible are presented in Table 11 below. The following principles are contained within the NOW guidelines and are to be considered in conjunction with the matrix presented in Table 8.

- Riparian Corridor offsetting for non-riparian corridor uses: Non-riparian uses, such as Asset Protection Zones are allowed in the outer 50% of the vegetated riparian zone, so long as offsets are provided in accordance with the averaging rule (see Figure 15)
- Cycleways and Paths: Cycleways or pedestrian paths no wider than 4m (total disturbance footprint) can be built in the outer 50% of the vegetated riparian zone
- Detention Basins: detention basins can be built in the outer 50% of the vegetated riparian zones or online (where indicated in the NOW Controlled Activity Guidelines for a) Outlet structures and b) Instream work. Online basins must:
  - Be dry and vegetated,
  - Be for temporary flood detention only with no permanent water holding,
  - Have an equivalent vegetated riparian zone for the corresponding watercourse order, and
  - Not be used for water quality treatment purposes.
- Stormwater outlet structures and essential services: Stormwater outlets or essential services are allowed in the riparian corridor. Works for essential services on a 4th order or greater stream are to be undertaken by directional drilling or tied to existing crossings

(refer to NOW Controlled Activity Guidelines for a) Laying pipes and cables in watercourses and b) Outlet Structures).

- Stream alignment: Indicates that a watercourse may be re-aligned (refer to NOW Controlled Activity Guidelines for Instream Works)
- Road Crossings: Indicates permitted road crossing methods (refer to NOW Controlled Activity Guidelines for Watercourse Crossings and DPW Fisheries Policy and Guidelines for Fish Friendly Waterway Crossings for Class 1 and 2 Waterways).

Works not associated with the establishment and maintenance of riparian corridors can be authorised within the outer riparian corridor provided that the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. That is, where appropriate, 50% of the outer vegetated riparian zone width may be used for non-riparian uses provided that an equivalent area is offset on site and is adequately connected to the riparian corridor vegetation. The inner 50% of the vegetated riparian zone is required to be fully protected and vegetated with native endemic riparian species, and satisfy the minimum area requirements to maintain bed and bank stability. The averaging rule (Figure 15) should generally be applied to cleared waterfront land. Development proposals involving waterfront lands that contain existing native vegetation should seek to preserve the existing vegetation in accordance with the minimum riparian corridor widths outlined in Table 11.

4.5.5 Water Management Act

It is possible for NSW DP & I to seek an exemption, on a precinct-wide basis, from the requirement under the NSW Water Management Act (2000) to obtain Controlled Activity Approvals (CAAs). This would streamline the development assessment process through the removal of the need for referral to NOW under the NSW EP & A Act provisions for Integrated Development. This has been achieved for the south-west growth centre precincts of Oran Park and Turner Road through the development of a waterfront land strategy.

Further review of appropriate planning mechanisms (zoning and development controls) will need to be carried out by NOW, Blacktown City Council and NSW DP & I in order to determine a set of controls which will be appropriate for Townson Road study area and the broader West Schofields Precinct.

It is recommended that the Riparian Protection Area Map that will be included with the SEPP amendment is linked to the Water Management Act 2000 in a way that defines waterfront land within the precinct as being limited to the extent of the Riparian Protection Area.

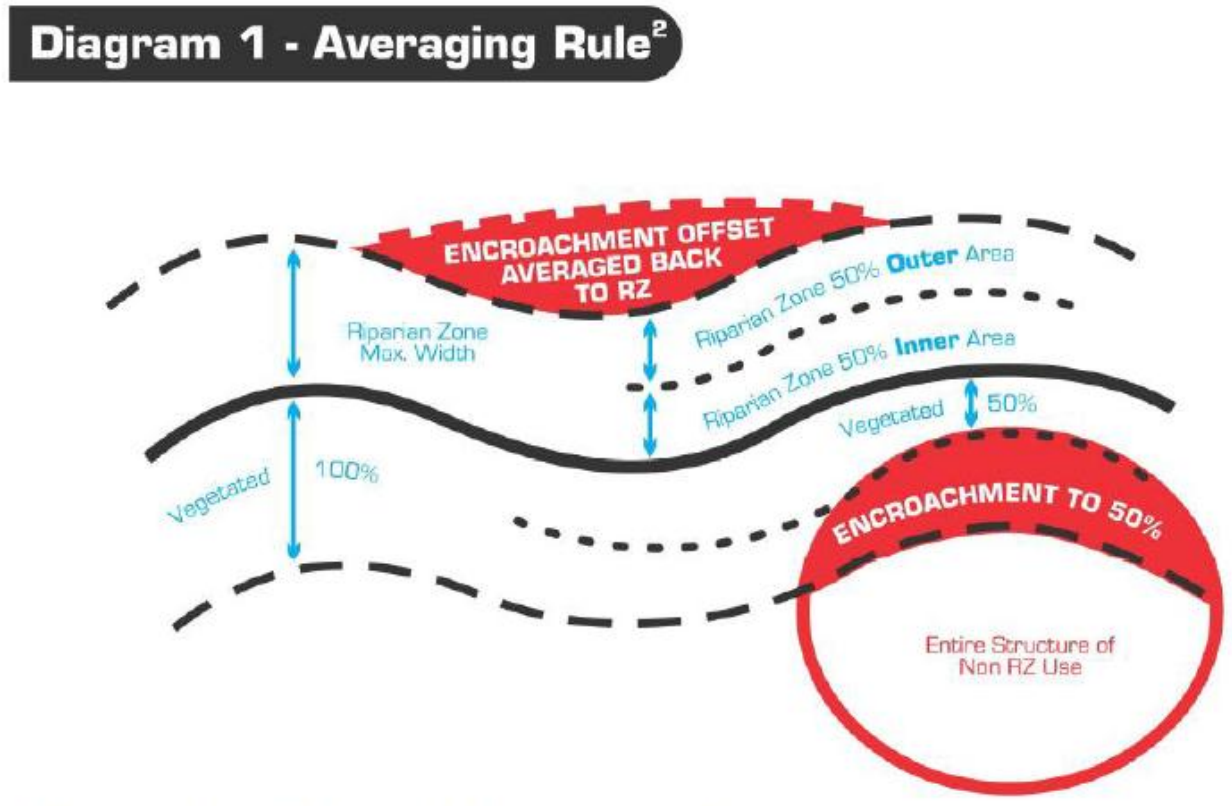

Figure 15: Averaging Rule. Source NOW Controlled Activity Riparian Corridor Guidelines

Table 11: NOW Riparian Corridor Matrix

REQUIREMENTS & ALLOWABLE USES	STREAM ORDER			
	1st	2nd	3rd	4th +
Vegetated Riparian Zone (VRZ) Width	10m each bank	20m each bank	30m each bank	40 m each bank
Riparian Corridor Offsetting for Non-Riparian Corridor uses	✓	✓	✓	✓
Cycleways and Pathways	✓	✓	✓	✓
Detention Basins - **Only within outer 50% VRZ** - **Online**	 ✓ ✓	 ✓ ✓	 ✓	 ✓
Stormwater Outlet Structures & Essential Services	✓	✓	✓	✓
Stream Re-alignment	✓			
Road Crossings - **Any** - **Culvert** - **Bridge**	 ✓	 ✓	 ✓ ✓	 ✓ ✓

5 Bushfire

5.1 AIMS AND STRUCTURE OF REPORT

The overarching objective of this section of the report is to identify all potential bushfire constraints to the future urban development of the Townson Road study area to inform the land use planning process. The report will inform the planning process for this part of the West Schofields Precinct and be included in the eventual rezoning application presented to the NSW Department of Planning and Infrastructure (DP & I). The results of this assessment will directly support the preparation of subsequent necessary planning documentation.

The objectives of this section of the report are to:

1. Ensure the statutory requirements for bushfire protection are identified and can be adequately met; and
2. Achieve innovative management frameworks across bushfire, vegetation and riparian issues which enable long term conservation and management of these environmental values while facilitating safe urban development outcomes for the site.

This section assesses the potential bushfire hazard across the site, in the context of existing remnant vegetation. It then identifies planning requirements as per NSW Rural Fire Service *Planning for Bushfire Protection Guidelines* (NSW RFS 2006). The NSW Rural Fire Service is reviewing this document but an expected release date has not been advised.

Establishment and ongoing management of future Asset Protection Zones (APZ) and environmental areas are considered. The location of existing emergency response services is mapped and the potential need for additional emergency response resources in the future is discussed. APZs are a key component of bushfire planning and the risk management solution which often has the greatest impact on development yields and subdivision design. Based on the bushfire hazard analysis, APZs suitable for residential and Special Fire Protection Purposes (SFPP) have been recommended according to the specifications contained within PBP 2006.

Any land identified as falling under bushfire prone land automatically triggers an assessment process under Section 79BA of the *Environmental Planning and Assessment Act, 1979* and/or Section 100B of the *Rural Fires Act, 1997* and is subject to complying to the requirements set by NSW Rural Fire Service *Planning for Bushfire Protection Guidelines* (NSW RFS 2006). The Bushfire risk assessment identifies that bushfire prone land (BPL) occurs on and adjoining the Townson Road study area as mapped by Blacktown City Council (Figure 16).

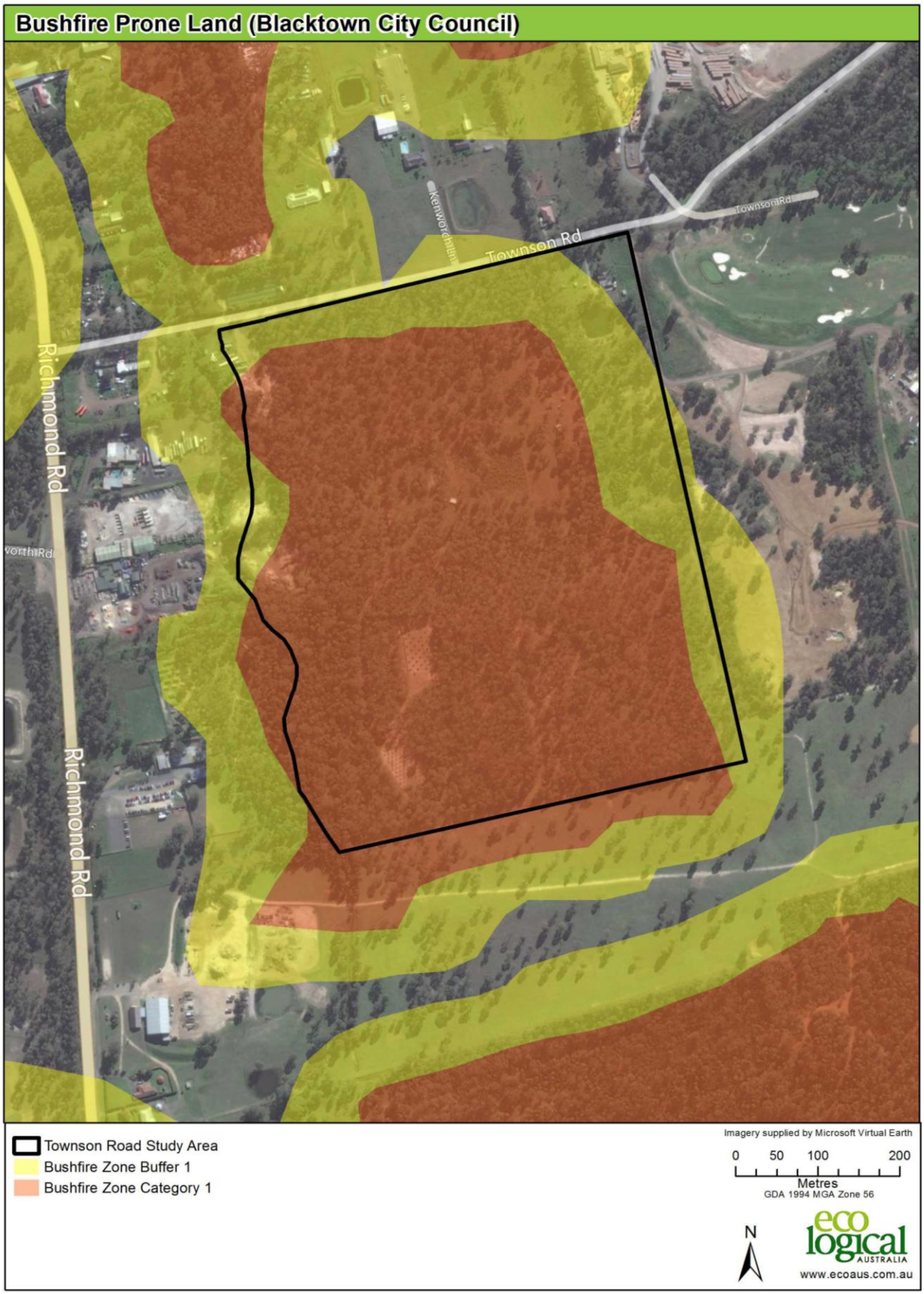

Figure 16: **Blacktown City Council Bushfire Prone Land**

5.2 PROPOSED LAND USES

The North West Structure Plan (Source: www.gcc.nsw.gov.au October 2009) has identified the Precincts in the North West Growth Centre area as suitable for housing and industry. The entire West Schofields Precinct has been identified as providing approximately 2000 dwellings for approximately 5,600 people and to have 2 – 3 neighbourhood centres.

While the range of land uses within the Townson Road study area is yet to be determined, it has been assumed that most of the study area will be given a residential zoning. Other likely land use zones will include open space, environmental conservation / environmental living and special infrastructure.

5.3 LEGISLATIVE REQUIREMENTS

5.3.1 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 assessment of development proposals. A variety of other legislation and environmental planning instruments, such as the NSW *Threatened Species Conservation Act 1995* (TSC Act), *NSW Water Management Act* (2000) and *Rural Fires Act 1997* (RF Act), are integrated with the EP & A Act.

5.3.2 Threatened Species Conservation Act 1995

The *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 (assessed under Part 4 of the EP & A Act) is likely to significantly affect threatened species, populations and ecological communities or their habitat.

In relation to bushfire, the TSC Act also identifies high frequency fire regimes as a key threatening process due to the potential disruption of key life cycle processes in plants and animals, the loss of vegetation structure and species composition.

5.3.3 Rural Fires Act, 1997

Bushfire issues are regulated by the *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. 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 APZs, landscaping and any retained vegetation when developing land (NSW RFS 2006b).

5.3.4 Planning For Bushfire Protection Guidelines 2006

Precinct Planning requires consultation with the NSW RFS as the lead agency for managing bushfire issues. As such, Precinct Planning aims to satisfy the requirements of *Planning for Bushfire Protection* (NSW RFS, 2006) which includes having regard to the planning principles of PBP (NSW RFS 2006b) as follows:

- Provision of a perimeter road with adequate two way access which delineates the extent of the intended development;
- Provision, at the urban bushland interface, for the establishment of adequate asset protection zones for future housing;
- Specifying minimum residential lot depths to accommodate asset protection zones for lots on perimeter roads;
- Minimising the perimeter of the area of land, interfacing the hazard, which may be developed;
- Introduction of controls which avoid placing inappropriate developments in hazardous areas; and
- Introduction of controls on the placement of combustible materials in asset protection zones.

5.4 BUSHFIRE HAZARD ASSESSMENT

The bushfire hazard affecting the Townson Road study area was assessed during site inspections and using recent aerial photographs for at least a distance of 140m from the perimeters of the subject site (in line with PBP 2006). This assessment identifies the potential bushfire threat from both within and outside of the study area and allows for a prediction of required asset protection zones for future development. The method used for this assessment relies on consideration of vegetation and slope and is outlined below along with results.

The Bushfire risk assessment identifies that bushfire prone land (BPL) occurs on and adjoining the Townson Road study area as mapped by Blacktown City Council (Figure 16). The area to the east of the site has not been classed as bushfire prone, however bushfire prone land occurs in all other directions from the site.

5.4.1 Vegetation

Vegetation was assessed according to Keith (2004). The largest areas of vegetation influencing the subject land are the Cumberland Plain Woodland (CPW) covering the majority of the site and the Alluvial Woodland (AW) occurring within and adjacent to the riparian corridor of Bells Creek.

The vast majority of vegetation in the study area consists of remnant woodland vegetation with a grassy understorey. Overall, vegetation is in good condition across the site, especially in the southern portion of the study area. According to the vegetation formation categories for the purposes of determining hazard levels of vegetation communities, CPW is considered “Woodland (Grassy)” while AW is considered “Forested Wetlands”.

It has been assumed that the majority of existing vegetation within the certified lands of the study area will be removed or, where it is retained (in pocket parks for open space etc) substantially reduced in extent so that it can be considered low hazard. It is further assumed that the riparian corridor will be subject to further riparian planting and rehabilitation works as development of the adjacent lands occurs (on both side of the watercourse) and that a relatively continuous and consistent vegetated riparian area will remain post-development which resembles the structural characteristics of Forested Wetlands.

In addition to the significant vegetation onsite, there are large areas of CPW outside the study area, especially beyond the southern and northern boundaries and areas of AW adjacent to the western boundary along the Bells Creek corridor. The vegetation to the north is separated from the study area by Townson Road and the vegetation to the south by cleared farming land. There are also smaller, somewhat discontinuous patches of remnant bushland on lands to the west of the study area within the Marsden Park Industrial Precinct (west of Richmond Road). The eastern boundary of the study area

borders Stone Cutters Ridge Golf Course and an area of land subject to recent earth works and urban development.

Much of the land to the north and north-east has already been cleared or substantially modified for business or residential development. These bushfire hazards may be further reduced by clearing of vegetation for development works in the surrounding precincts as many of the currently vegetated areas to the south, west and north are likely to be cleared as part of the ongoing development of the Marsden Park Industrial, Colebee and West Schofields Precincts of the North West Growth Centre.

The vegetation located within the Colebee Nature Reserve approximately 250m to the south of the study area is very likely to remain and continue to present a level of bushfire threat to lands and subsequent urban development within Townson Road study area and have been considered as potential constraints to the study area due to their proximity. The majority of vegetation to the south in the Colebee Nature Reserve is non-certified, while a portion of that to the north is non-certified in the vicinity of Bells Creek. Therefore, any future clearing of these areas/hazards is unlikely.

5.4.2 Slope

Slope was assessed via a desktop analysis across the site using 1m contour data supplied by Cardno (Figure 17). Slope measurements were further verified on site during the field investigations.

Slope was generally less than 5 degrees across the entire site, except for the steeper portions along the western boundary of the study area, where slopes of up to 14 degrees occur in very small areas on the banks of the Bells Creek watercourse. The majority of the site slopes down towards the western boundary and Bells Creek. Figure 17 shows the vegetation formations both within and beyond the Townson Road study area as well as the slope categories across the site.

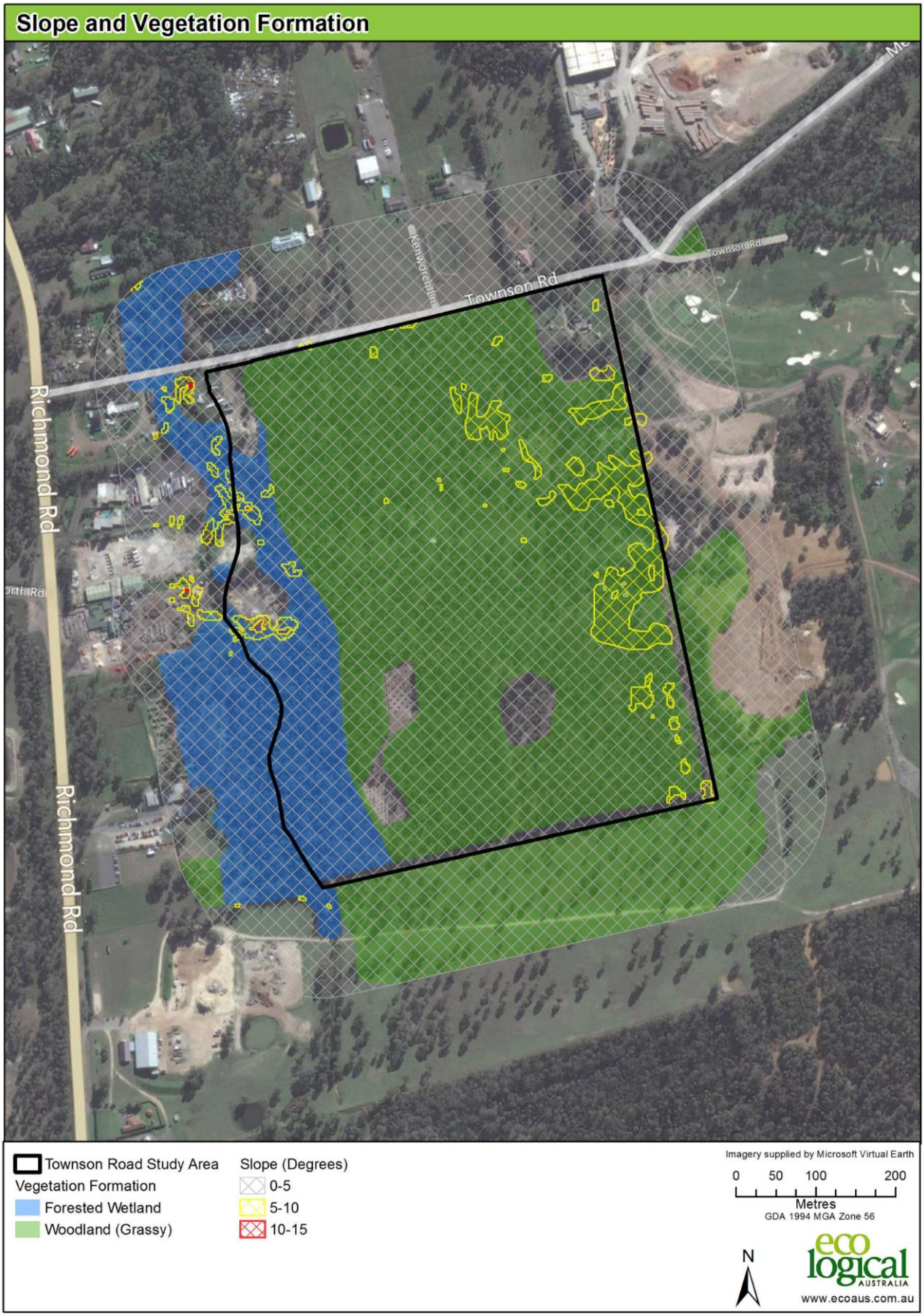

Figure 17: Slope categories and vegetation formations across the Townson Road study area

5.5 BUSHFIRE HAZARD SUMMARY

In comparing the assessed bushfire hazard for the site with other vegetated environments across the state, the site is considered to have a moderate relative hazard rating. Relative hazard for the site has been assessed based on the slope, vegetation (both type, amount and configuration) and required APZs according to PBP 2006. Figure 17 shows the relative hazard rating across the site as well as the vegetation formations for these issues.

Table 12, Table 15 and Table 16 have been used together to estimate indicative bushfire APZ distances for different areas across the site and these are shown in Figure 18 and Figure 19.

The hazard analysis has also considered the topographic position within the landscape of the bushfire prone vegetation that is likely to be retained, relative to the topographic position of areas of potential future urban development. The hazard rating assumes that the bushland is downslope from future development and therefore provides a greater hazard. This is the case for the vegetation to be retained (and restored) within the Bells Creek corridor.

As fires burn much slower and at a much lower intensity when travelling downhill, in areas where vegetation is located upslope from development a 'very low' hazard ranking is appropriate and required APZ setbacks are substantially lower.

The hazard assessment is based on the current vegetation situation onsite. In interpreting the hazard assessment map, consideration needs to be given to both retained stands of vegetation as well as *potential future stands* of vegetation. It is assumed that during the rezoning process, development begins, some areas will be reserved for vegetation conservation, some cleared, and others regenerated and expanded. Accordingly, if currently cleared areas are identified for regeneration during development proposals, then bushfire issues will need to be adequately incorporated into planning those regeneration areas if it is expected that they will be restored to a level that would in future constitute a bushfire hazard.

5.6 PLANNING FOR BUSHFIRE PROTECTION (2006) ASSESSMENT

5.6.1 Assessment Framework

The following section outlines how the various types of development proposed for the Townson Road study area (through the rezoning) will be assessed if the proposed rezoning is approved.

5.6.2 Residential

Residential subdivision will be assessed under section 100B of the RF Act and a Bush Fire Safety Authority (BFSA) must be obtained from the NSW Rural Fire Service at subdivision and/or DA stage. Section 100B of the RF Act specifies conformance with the intent and performance criteria of the Bushfire Protection Measures outlined in PBP. The bushfire protection measures relevant to 100B of the RF Act within PBP 2006 are listed below:

- *The provision of clear separation of buildings and bushfire hazards, in the form of fuel-reduced APZs and defendable space;*
- *Building construction standards and design;*
- *Appropriate internal and external access standards for residents, fire fighters, emergency service workers and those involved in evacuation;*
- *Adequate water supply and pressure;*
- *Emergency management arrangements for fire protection and/or evacuation; and*
- *Suitable landscaping, to limit fire spreading to a building.*

5.6.3 Special Fire Protection Purpose (SFPP)

SFPP developments include developments where occupants may be more vulnerable to bushfire attack. These developments require considerably larger APZs than residential developments and include the following types of uses:

- *schools,*
- *child care centres,*
- *hospitals (including a hospital for the mentally ill or mentally disordered),*
- *hotels, motels or other tourist accommodation,*
- *a building wholly or principally used as a home or other establishment for mentally incapacitated persons,*
- *housing for older people or people with disabilities within the meaning of State Environmental Planning Policy (Seniors Living)*
- *group homes within the meaning of State Environmental Planning Policy No 9 – Group Homes,*
- *retirement villages,*
- *any other purpose prescribed by the regulations. (Section 100B (6) of the RF Act).*

The specific objectives for SFPP developments are:

- *Provide for the special characteristics and needs of occupants. Unlike residential subdivisions, which can be built to a construction standard to withstand the fire event, enabling occupants and firefighters to provide property protection after the passage of fire, occupants of SFPP developments may not be able to assist in property protection. They are more likely to be adversely affected by smoke or heat while being evacuated.*
- *Provide for safe emergency evacuation procedures. SFPP Developments are highly dependent on suitable emergency evacuation arrangements, which require greater separation from bushfire threats. During emergencies, the risk to firefighters and other emergency services personnel can be high through prolonged exposure, where door-to-door warnings are being given and exposure to the bushfire is imminent*

5.6.4 Industrial, Commercial, Other Development

There is potential for the Townson Road study area to contain a range of industrial, commercial or other categories of land use. Commercial, employment and/or industrial uses are classified in PBP 2006 as 'Other Development'. As such these developments need to satisfy the aims and objectives of PBP and the proposal will need to incorporate these considerations along with an adequate combination of relevant Bushfire Protection Measures (BPMs). Generally, the BPMs listed in PBP 2006 for residential development can be used as a guide and are discussed in the following sections. The aim and objectives of PBP 2006 are as follows.

Aim of PBP

to use the NSW development assessment system to provide for the protection of human life (including firefighters) and to minimise impacts on property from the threat of bush fire, while having due regard to development potential, on-site amenity and protection of the environment.

Objectives of PBP

5 *afford occupants of any building adequate protection from exposure to a bush fire;*

(ii) provide for a defendable space to be located around buildings;

(iii) provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;

(iv) ensure that safe operational access and egress for emergency service personnel and residents is available;

(v) provide for ongoing management and maintenance of bush fire protection measures, including fuel loads in the asset protection zone (APZ); and

(vi) ensure that utility services are adequate to meet the needs of firefighters (and others assisting in bush fire fighting).

5.7 BUSHFIRE PROTECTION MEASURES

The bushfire protection measures described in PBP are an effective way to design developments to minimise the risks from bushfire and to ensure that the aims and objectives of PBP are met.

The following key elements are required to be addressed in bushfire assessments;

- Asset Protection Zones (APZs);
- Evacuation and emergency management (including emergency access/egress arrangements);
- Water supplies;
- Building construction standards;
- Infrastructure (including access road provisions and other services); and
- Landscape management.

5.7.1 Asset Protection Zones (APZs)

APZs are areas located between unmanaged bushfire hazards and urban development to provide a defendable space in which to undertake emergency operations and to provide a buffer from direct flame contact and the impacts of radiant heat, smoke and embers.

The width of APZs is based on a combination of;

- Vegetation structure classification;
- Effective slope (influencing fire behaviour);
- Siting or topographic position relative to the hazardous vegetation (i.e. is the asset is above or below the hazard); and
- Fire Danger Index (FDI)

The appropriate fire (weather) area for the site was assessed, according to Table A2.3 in PBP. An FDI rating of 100 has been applied to the Greater Sydney Region of NSW, including this study area. The FDI index is a relative number (1 to 100) providing an evaluation of the suppression difficulty or rate of spread of bushfires under specific combinations of wind speed, fuel and fuel moisture.

Vegetation across the study area currently consists predominantly of bushfire prone vegetation of a moderate hazard level. The bulk of the vegetation meets the 'Woodland (Grassy)' vegetation formation classification according to Keith (2004) while the band of vegetation within the riparian corridor of Bells Creek is the 'Forested Wetland' vegetation formation. If the riparian corridor is substantially restored in the future the vegetation structure, quality and density may approach a 'Forest' vegetation formation, however this can be avoided through careful design of the replanting schedule.

APZs meeting 'acceptable solution' requirements for residential development have been assessed across the study area based on the widths in Table 12 below and are shown in Figure 18.

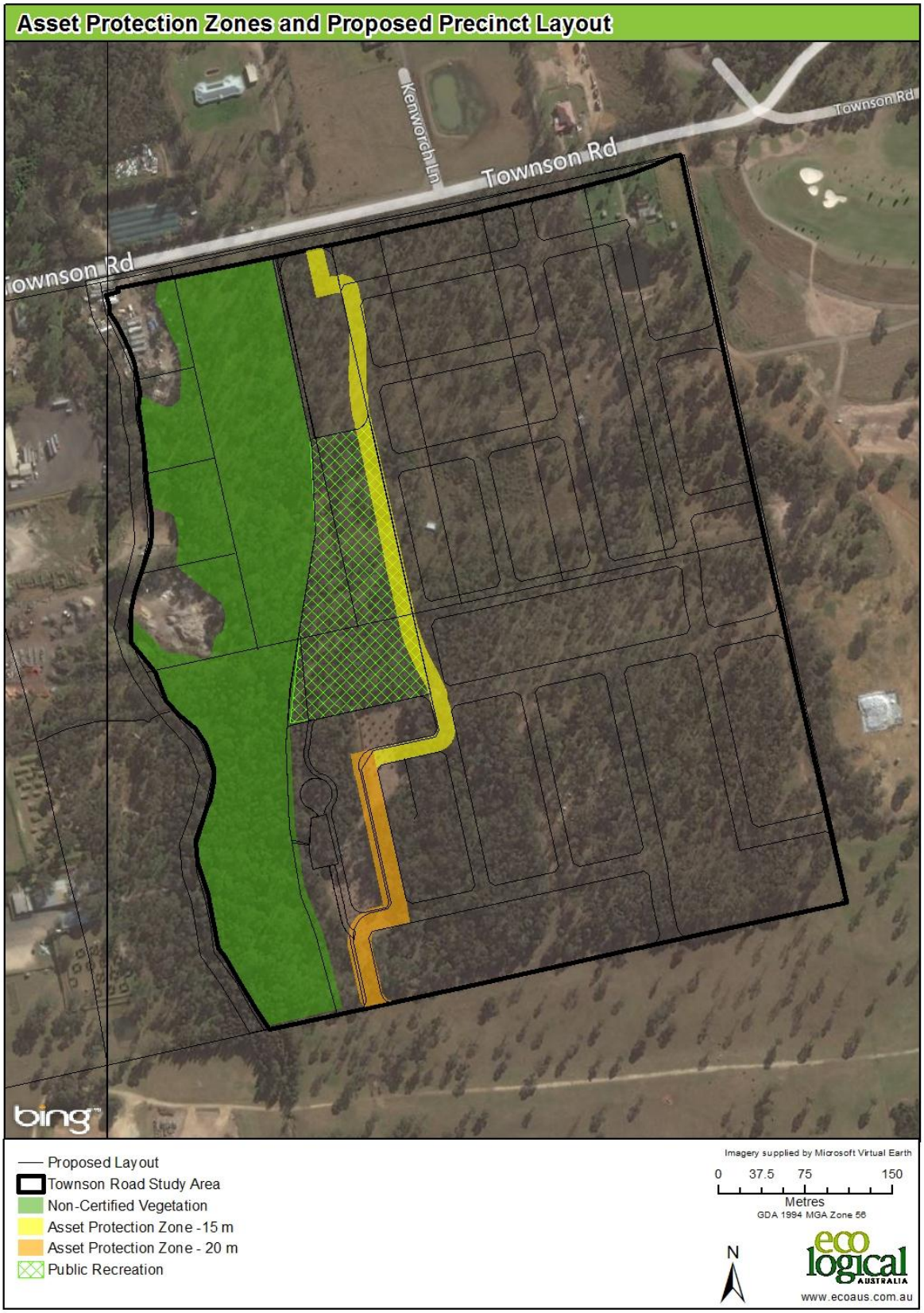

Figure 18: Bushfire Hazard Assessment and Asset Protection Zones based on draft Masterplan

Most of the study area is certified land and there is potential for most or all of the vegetation to be cleared. It is unlikely that any vegetation within the Bells Creek riparian corridor would be cleared, and an APZ would still be required against this vegetation. In addition, any areas of open space / environmental conservation which both exceed 1ha in size and 50m width will require an APZ between the retained bushland and future developments. This scenario is presented in Figure 18.

All APZs are required to be located within the study area boundary (i.e. and within the bounds of any proposed development lands).

It is understood the new APZ requirements will not be substantially different to the current requirements, but may vary by widths being increased by a few metres. It is recommended that this bushfire protection assessment be revised after the release of the new guidelines as all rezoning and development applications submitted after the guideline is released will be assessed according to the requirements of these new guidelines.

The increase in APZ width provides a higher level of bushfire protection and reduces the likelihood that future home owners are not impacted by the additional costs associated with construction of a dwelling at a higher BAL (e.g. BAL-40 and BAL-FZ).

It is important to note that the APZ calculations quoted in this assessment are indicative only and have been determined at a landscape scale. This level of detail is suitable for the development of an ILP / Site Masterplan whereby the aim is to demonstrate whether a parcel of land can accommodate the bushfire hazard, the expected APZ and future development. The final APZ dimensions for any future subdivision or development depends on the accuracy of a site-specific assessment and therefore the APZ dimensions quoted in this assessment should be relied upon as a guide only.

Table 12: PBP 2006 APZ Requirements for Residential Development and SFPP Development

Slope (degrees)	Woodland (Grassy) (Keith 2004)	Forested Wetland (Keith 2004)	Forest (Keith 2004)
Upslope/flat	10m (40m SFPP)	15m (50m SFPP)	20m (60m SFPP)
Downslope			
>0 – 5	15m (50m SFPP)	20m (60m SFPP)	25m (70m SFPP)
>5 – 10	20m (60m SFPP)	25m (75m SFPP)	35m (85m SFPP)
>10 - 15	25m (70m SFPP)	35m (90m SFPP)	50m (100m SFPP)
>15 - 18	30m (75m SFPP)	45m (95m SFPP	60m (100m SFPP)

Under PBP 2006, APZs for Forest vegetation consist of both an Inner Protection Area (IPA) and an Outer Protection Area (OPA), whilst APZs for other vegetation structures comprise only of an IPA. In the instance of residential development, the APZ is generally 50% IPA – situated closest to the asset, and 50% OPA – situated closest to the unmanaged hazard. Provided that the restoration of the Bells Creek Riparian Corridor is appropriately designed (plant species, planting density and vegetation community structure), the fuel level and bushfire hazard level within the corridor should not approach that of a Forest community and the APZs required will all be managed accordance with the requirements for IPAs.

If the minimum APZs identified below in Table 12 are implemented, residential buildings immediately adjacent to the APZ will require construction to BAL-40 of AS3959-2009, adding significant costs to dwelling construction. If lower construction standards are desirable, APZ widths should be increased.

Generally the implementation of required APZs should be wholly contained within the proposed lot or subject land for which they are benefitting or protecting. However, there are certain circumstances where APZs can consist of managed areas outside of a given location – with managed open space areas, managed service easements and established infrastructure, such as roadways or transmission lines, all suitable for consideration as part of a required APZ. Essentially Townson Road along the northern site boundary is forming the required APZ for any remaining bushfire hazard offsite to the north.

Across the site, it is likely that minimum APZ requirements will be met or exceeded within perimeter road easements and front/rear/side lot setbacks.

5.7.2 Emergency Access/Egress

Emergency access/egress relates to the provision of safe access, egress and defendable spaces for emergency services. It also relates to emergency management arrangements such as procedures and routines for evacuation and consideration of safe havens.

Specific management and evacuation plans may be required at a later stage especially where SFPP developments are proposed. Additionally, emergency management arrangements may need to be discussed with the RFS specifically in regard to the capacity of existing resources to service the study area.

For this study area, the provision of a simple layout for a perimeter road along the Bells Creek Riparian Corridor with frequent direct access to the internal road system will provide easy and rapid access/egress in the case of an emergency. In addition, the perimeter road should radiate away from the bushfire hazard. Specifications for public roads and property access roads are outlined in the following sections.

Public roads

Public roads include both the perimeter road and the internal road system. The intent is to provide safe operational access to structures and water supply for emergency services personnel, while residents are seeking to evacuate from an area. Key requirements include size (safe/efficient access/egress) and suitable location of water supply points (such that they are readily accessible during bushfire events).

Internal roads must comply with the widths specified in *AS2890.2-2002* reproduced in Table 13 below.

Table 13: Internal Road Specifications

Curve Radius (inside edge) (metres)	Swept path (metres width)	Single lane (metres width)	Two way (metres width)
<40	3.5	4.5	8.0
40-69	3.0	3.9	7.5
70-100	2.7	3.6	6.9
>100	2.5	3.5	6.5

Perimeter road requirements are identified below and full specifications are included in Appendix E;

(i) Location:

The perimeter road is required to lie between (or within) the Asset Protection Zone and the boundary of the allotments. A perimeter road should be the preferred option where possible.

(ii) Purpose:

- Provide fire fighters with easier access to structures, allowing more efficient use of fire fighting resources
- Provide a safe retreat for fire fighters; and
- Provide a clear control line from which to conduct hazard reduction or back burning operations

(iii) Specifications:

- The perimeter road should preferably provide 2 way access (carriageway 8 metres kerb to kerb)

Comply with the design specifications relating to slope, capacity etc identified in PBP 2006 (reproduced in Appendix E).

Property Access

PBP 2006 states that property access is access from the public road system onto private land and to the habitable building by fire fighters. The intent is to provide safe access to/from the public road system for fire fighters providing property protection during a bushfire and for occupants faced with evacuation.

Property access road requirements are identified below and full specifications are included in Appendix F:

- Short access roads are preferable; therefore buildings should be located as close as possible to the public road system
- No access requirements apply to an urban development where the furthest part of the building is no farther than 70 m (unobstructed) from the public road system
- Any building located more than 200 m from a public through road must provide one alternative property access road; and
- Access roads should have a minimum width of 4 m

5.7.3 Supply of Services

The purpose of this measure is to provide adequate supply of water for the protection of buildings during and after the passage of a bushfire, and to locate gas and electricity services so as not to contribute to the risk of fire to a building.

It is anticipated that the water supply to the site will be provided via a reticulated ring main system. The ring main system must be of sufficient pressure and fire hydrants located to comply with *AS 2419.1-2005 Fire Hydrant Installations (SAI Global, 2005)*.

If the reticulated water supply is unable to attain the required pressure, then a dedicated static water supply reserve must be created and maintained. The quantity of water required is determined on the basis of lot size and density and is shown in Table 14 below.

Table 14: Static Water Requirements

Development Type	Water Requirements
Residential Lots (<1,000m2)	5,000 l/lot
Rural-residential Lots (1,000m2 - 10,000 m2)	10,000 l/lot
Large Rural/Lifestyle Lots (>10,000m2)	20,000 l/lot

Electricity and gas services should be located such that they do not pose a hazard to surrounding bushland and buildings, or provide an obstacle for emergency service personnel. Ideally they would be located underground. Overhead powerlines must undergo regular inspection to ensure that no part of a tree is closer than the distances set out in 'Vegetation safety clearances' issued by energy Australia (NS179, April 2002)

5.7.4 Building Construction Standards

Construction of new residential dwellings must comply with the Appendix 3 of PBP 2006 and *AS3959-2009 Construction of Building in Bushfire Prone Areas (SAI Global, 2009)*. The APZs recommended in Table 12 provide the minimum setback required to keep development outside of the flame zone. As such, if lower construction standards are desirable, setback/APZ widths should be increased beyond those shown. Required setbacks for various construction levels are shown in Table 16 and Table 16 below.

Table 15: *AS3959* Bushfire Attack Level (BAL) Construction Requirements for Residential Development adjacent to Forest and Forested Wetland Vegetation

Slope	BAL - FZ	BAL - 40	BAL - 29	BAL - 19	BAL – 12.5
Upslope/flat					
All	<19m	19m - <25m	25m - <35m	35m - <48m	48m - <100m
Downslope					
>0 – 5 degrees	<24m	24m - <32m	32m - <43m	43m - <57m	57m - <100m
>5 – 10 degrees	<31m	31m - <39m	39m - <53m	53m - <69m	69m - <100m
>10 - 15 degrees	<39m	39m - <49m	49m - <64m	64m - <82m	82m - <100m

Table 16: *AS3959* Bushfire Attack Level (BAL) Construction Requirements for Residential Development adjacent to Woodland (Grassy) Vegetation

Slope	BAL - FZ	BAL - 40	BAL - 29	BAL - 19	BAL – 12.5
Upslope/flat					
All	<12m	12m - <16m	16m - <24m	24m - <33m	33m - <100m
Downslope					
>0 – 5 degrees	<15m	15m - <21m	21m - <29m	29m - <41m	41m - <100m
>5 – 10 degrees	<20m	20m - <26m	26m - <37m	37m - <50m	50m - <100m
>10 - 15 degrees	<25m	25m - <33m	33m - <45m	45m - <60m	60m - <100m

The assessment of construction standards will be required for any development application concerning individual residential dwellings.

5.8 MANAGEMENT REQUIREMENTS

The best bushfire mitigation measures and design can be undone by poor landscaping and property maintenance. It is recommended that the measures described in Appendix 5 of PBP 2006 be adopted in all lots within 100m of bushland. These measures are equally important for residential, industrial and public zoned lots. A summary of these measures is described below.

APZ Creation/Maintenance

The site is currently dominated by Woodland (Grassy) vegetation with patches of Forested Wetland vegetation along Bells Creek along the western boundary of the site. Vegetation within the APZ area and any remnants or landscaping within the development area should be managed by the owner of the land in line with the following:

- Tree canopy separation (by at least 2 metres where possible);
- Discontinuous shrub layer (clumps or islands of shrubs not rows);
- Vertical separation between vegetation stratums;
- Tree canopies not overhanging structures;
- Management and trimming of trees and other vegetation in the vicinity of power lines and tower lines in accordance with the specifications in "Vegetation Safety Clearances" issued by Energy Australia (NS179, April 2002);
- Retain low ground covers;
- Mowing / brush cutting / slashing during the summer months;
- Use of non-combustible mulch e.g. stones.

Where landscaping is to include plantings, local providence stock is recommended. Emphasis should be placed on species that are less flammable, particularly in close proximity to any buildings.

Vegetation Management

Landscaping around buildings should adhere to the following:

- maintaining a clear area of low cut lawn or pavement adjacent to the house;
- keeping areas under fences, fence posts and gates and trees raked and cleared of fuel;
- utilising non-combustible fencing and retaining walls
- breaking up the canopy of trees and shrubs with defined garden beds;
- organic mulch should not be used in bush fire prone areas and non flammable material should be used as ground cover, eg Scoria, pebbles, recycled crushed bricks.
- planting trees and shrubs such that:
    - the branches will not overhang the roof;
    - the tree canopy is not continuous; and
    - there is a windbreak in the direction from which fires are likely to approach.

Building Maintenance

- Removal of material such as litter from the roof and gutters
- Ensure painted surfaces are in good condition with decaying timbers being given particular attention to prevent the lodging of embers within gaps
- Check pumps and water supplies are available and in working order
- Driveways are in good condition with trees not being too close and forming an obstacle during smoky conditions
- Check roof lines for broken tiles or dislodged roofing materials

- Screens on windows and doors are in good condition without breaks or holes in flyscreen material and frames are well fitting into sills and window frames
- Drenching or spray systems are regularly tested before the commencement of the fire season
- Hoses and hose reels are not perished and fittings are tight and in good order
- Doors are fitted with draught seals and well maintained; and
- Woodpiles, chemical storage, sheds and other combustible materials are located downslope and well away from buildings

5.9 PROTECTED VEGETATION

Vegetation occurring within the riparian corridor, and potentially within other portions of the study area, will be retained and in some cases restored. Vegetation that is retained and / or restored is to be managed for biodiversity conservation and as such APZs are not permitted within these areas. Fire is an important ecological process, and as such must be integrated with long term environmental management. As such, it is recommended that a conservation and bushfire management plan be prepared for these areas prior to any construction.

The main factors contributing to bushfire management relate to;

- Fire frequency
- Fire seasonality
- Fire intensity

It is important to ensure that fire regimes are varied spatially across the site, and temporally at any one point, the objectives being;

- Ensuring a variety of fire interval periods are present across the site
- Ensuring that the season, intensity and frequency of burns are varied at any one area

This is referred to as mosaic management and is aimed at ensuring a diversity of life cycles are present across the site and that a homogenous fire regime is avoided that may benefit certain species at the expense of others.

Given the existence of two threatened species within the Precinct, any fuel management prescriptions developed for the site should take care to avoid impacting on these populations, where possible.

Fire Frequency

Fire frequency is usually presented as fire interval periods. The minimum fire interval period is the minimum amount of time between fires that will enable sufficient recruitment and recharge of seed banks. Maximum fire interval period refers to the maximum amount of time between fires before senescence may begin.

Table 17 below provides the recommended minimum and maximum fire intervals for the vegetation communities within the study area. Successive fires at the minimum recommended fire interval may have a severe impact on species diversity, therefore, fire regimes erring towards the maximum interval are recommended.

Any areas within the Precinct that will be actively regenerated should be excluded from fire for a minimum of 15 years to allow for the development of a soil seed bank of native species.

Table 17: Recommended Interfire Periods

Keith (2004) Classification	Minimum Fire Interval	Maximum Fire Interval	Source
Grassy Woodland	5 years	40years	DEC 2004 "Guidelines for Ecologically Sustainable Fire Management. NSW NP&WS
Shrubby Dry Sclerophyll Forests	7 years	30 years	DEC 2004 "Guidelines for Ecologically Sustainable Fire Management. NSW NP&WS
Wet Sclerophyll Forests	25 years	60 years	DEC 2004 "Guidelines for Ecologically Sustainable Fire Management. NSW NP&WS

Fire Seasonality

Fire seasonality needs to integrate with the lifecycles of native species, and preferably be counter to the requirements of exotic species. As such ecological burns are recommended between the periods of August and January to coincide with native plant life cycles (DEC 2005). However, due to bushfire danger periods it may not be practical to burn over the summer months, hence the window of opportunity narrows to August – November. Occasional autumn burns may also be implemented.

Burning may also be complemented with slashing of grasses, preferably immediately prior to flowering of exotic annual grasses.

Fire Intensity

Hotter burns are preferable as they may encourage native species over exotic species. However, this will be significantly limited by the amount of fuel available for burning and constraints on burning during the hotter months. More moderate burns are recommended for steeper slopes to reduce the potential for exposure of mineral earth and subsequent erosion.

5.10 EMERGENCY RESPONSE

An assessment of the NSW Rural Fire Service (RFS) and NSW Fire & Rescue (NSW F & R) brigade stations surrounding the study area was completed in order to determine their proximity and emergency response and capability to the subject site (see Table 18 and Figure 19 below).

Table 18 : Local NSW RFS and NSW F & R stations

Name	Location	Distance*
Plumpton (RFS)	Florence Street, Oakhurst	3.3 km
Marsden Park (RFS)	Garfield Rd West, Marsden Park	3.9 km
Schofields (RFS)	Railway Terrace, Schofields	5.3 km
Blacktown Fire (Fire and Rescue)	222 Richmond Road, Blacktown	6.3 km
Riverstone (Fire and Rescue)	Riverstone Parade, Riverstone	7.1 km
Schofields (Fire and Rescue)	58 Hambledon Road, Schofields	8.7 km
Mount Druitt (Fire and Rescue)	Cnr Belmore and Varian St, Mt Druitt	8.7 km
Eastern Creek (RFS)	Cnr Great Western Highway and Root Hill Road South, Eastern Creek	9.0 km
Shanes Park (RFS)	Palmyra Avenue, Willmot	9.6 km
Berkshire Park (RFS)	Sixth Road, Berkshire Park	10.1 km

Notes: *Distance approximate from the station location, via the current road network, to the closest point of the site.

The location of fire stations in relation to the study site is indicated in Figure 19. In the current emergency response situation the Blacktown F & R Brigade, being a full time station is likely to be the first station to reach the Precinct. Crews from this station have easy access to the site via Richmond Road.

The proximity of emergency services to the precinct seems adequate, however consultation with the RFS and NSW Fire Brigade will be required to confirm whether existing stations can adequately service the proposed development site (or otherwise) as well as the need for additional resources at these existing stations. The RFS will also need to be consulted to confirm their Strategic Plan for covering the next 10 years and how that will impact upon the proposed development.

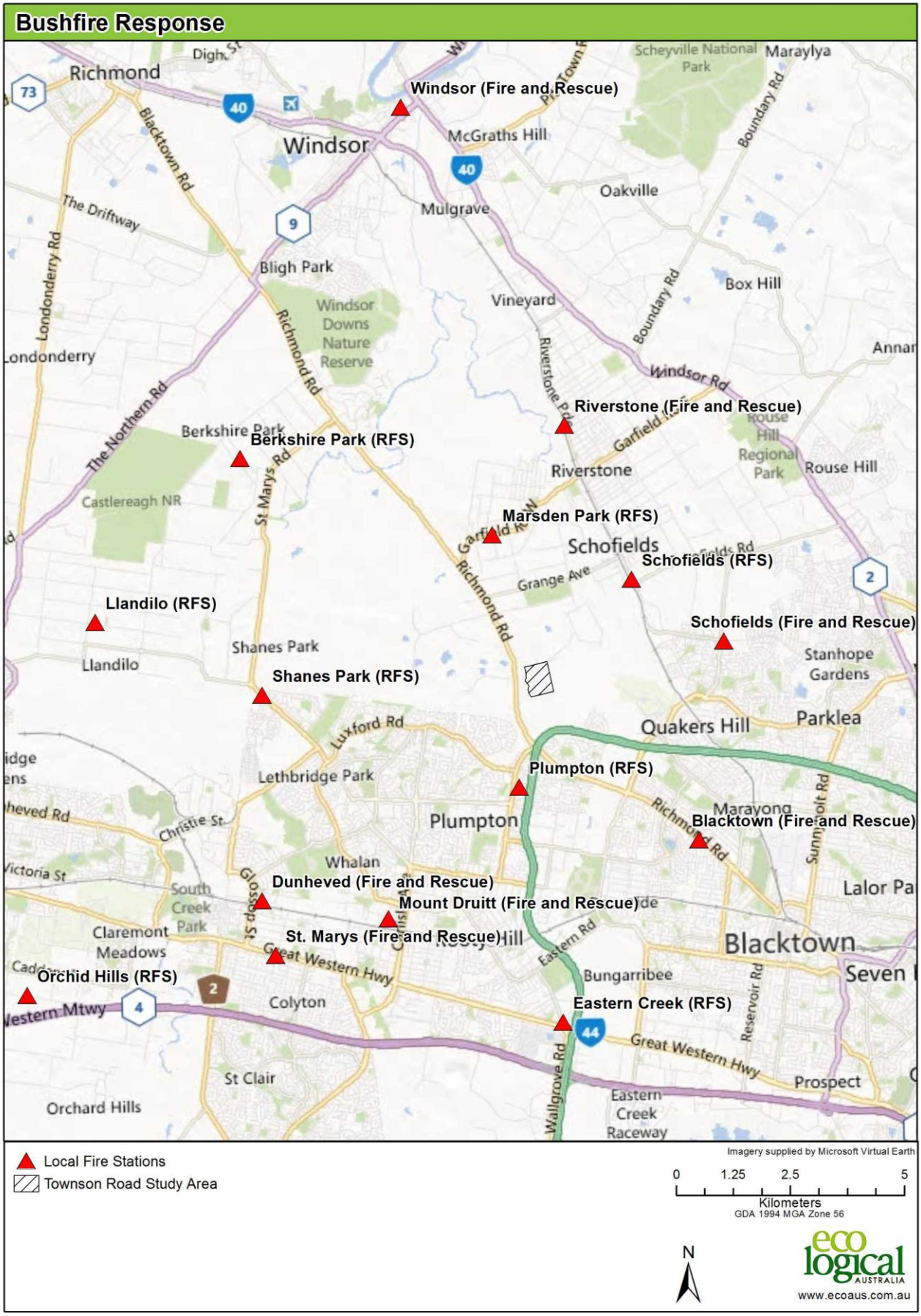

Figure 19: Emergency Response, NSW RFS and NSW Fire and Rescue Stations

5.11 PLANNING CONTROLS

Based on the recommendations contained within PBP 2006 the following planning principles are recommended for the development of the Draft ILP / Master Plan and the potential future rezoning of the study area for residential and other purposes:

- Provision of a perimeter road on the western side with two way access which delineates the extent of the intended development;
- Provision, at the interface, for the establishment of adequate APZs for future housing (and SFPPs if required);
- Specifying minimum residential lot depths to accommodate APZs for lots fronting any perimeter roads;
- Minimising the perimeter of the area of developable land interfacing the hazard;
- Introduce controls which avoid placing inappropriate developments in hazardous areas; and
- Introduce controls on the placement of combustible materials in APZs.

It is strongly recommended that APZ widths are **not** prescribed within the precinct DCP as PBP 2006 and AS3959 are routinely updated and it is likely that the DCP will become inconsistent with the requirements of the RF Act in the future.

5.12 DEVELOPMENT STAGING

The staging of any development should be considered from a bushfire perspective so as to minimise the risks to the development during construction. Ideally, lots fronting the bushland interface along the western edge of the study area would be developed first and adequate APZs established upfront.

Where relevant (i.e. adjacent to retained bushland), temporary APZs should be established around each stage of the development and identified in a section 88b instrument (in accordance with the *Conveyancing Act 1919*), which would then cease once the adjacent stage of the development is undertaken. APZ widths could be identified on a site by site basis, based on the APZ requirements (Figure 18) which corresponds directly with the APZ categories identified in Table 12.

The bushfire hazard present at any one time will change based on various factors, including:

- the extent of vegetation present in the study area and beyond the study area,
- the restoration of vegetation within the Riparian Corridor,
- the creation of new lots and,
- the creation of other infrastructure.

Accordingly, periodically as required by the RFS methodology, the Bushfire Prone Mapping will also change and subsequently the trigger for assessment under the EP&A Act and the RF Act will also change. It is recommended that Blacktown City Council review BPL mapping following completion for significant development stages.

5.13 CONCLUSIONS

Bushfire hazard has been assessed across the study area and found to be moderate. While the site is heavily vegetated, the relatively open grassy woodland formation with limited shrub layer influences generally creates a lower fire intensity and the relatively flat topography across the majority of the site and influence of the riparian corridor combine to reduce the potential wildfire intensity. On the basis of this assessment, indicative APZ requirements have been provided in Table 12 and have been mapped for the current extent of vegetation on site and for one scenario where all certified lands are cleared of their existing vegetation. APZ widths and locations will need to be revised once an indicative layout plan is developed for the Townson Road study area.

A number of existing fire stations are in close proximity to the study area and are considered likely to be able to adequately service the area. A number of strategies have been provided in the form of planning controls to enable the risk from bushfire to be minimised and further that the subsequent approvals process can be streamlined. Further, it has been found that development is possible at the subject site from a bushfire planning perspective.

The main strategies suggested include:

- Ensure adequate setback from bushfire prone vegetation (APZs);
- Integrate non-combustible infrastructure within APZs such as roads, easements and parking areas. The majority of APZs will be able to be contained within perimeter roads and front yard setbacks given the gentle slopes across the site;
- Ensure adequate access and egress from the study area through a well designed road system;
- Consider the adequacy of water supply and the delivery of other services (gas and electricity);
- Provide temporary APZs during any staged development;
- Consider SFPP and other development types;
- Provide for effective and ongoing management of APZs; and
- Consider construction standards (AS3959) with any proposed residential developments.

Formalised bushfire assessments will be required to facilitate the development approvals process if the proposed rezoning is approved and proceeds to subdivision.

6 Overall Site Constraints

The Townson Road study area contains a variety of natural and constructed constraints. Ecological, riparian and bushfire constraints include:

- Validated ENV (Existing Native Vegetation) within the non-certified lands,
- The presence of significant stands of good quality CPW vegetation and threatened plants within certified lands that should be incorporated into sympathetic landuses where possible,
- Other remnant vegetation such as Alluvial Woodland along the Bells Creek watercourse
- A Riparian Corridor which occurs along the western boundary of the study area and will need protection and restoration works,
- The presence of two parallel watercourses within the riparian corridor which at present expand the total corridor width to approximately 130m in some parts,
- Bushfire Prone Vegetation which is currently present within the study area as well as areas that will be subject to restoration and revegetation in the future which will increase the fire hazard compared to present day conditions,
- Asset Protection Zones will be required along the riparian corridor and around all areas of retained vegetation which are greater than 1ha in size and greater than 50m in width.

In light of the potential impact of CPW clearing across the site, it is recommended that efforts be made to retain as much CPW within non-certified areas as possible and that CPW in certified areas also be retained and protected wherever possible. Priority for retention should be areas of CPW which are in the best condition, have good structural integrity, good species diversity and are not currently being disturbed by slashing or mowing.

7 Conservation and Management Recommendations for Indicative Layout Plan

7.1 BIODIVERSITY

There are a number of terrestrial and aquatic habitat features to consider in design of the Indicative Layout Plan / Masterplan .

It is recommended that:

- Hollow bearing trees be retained in open space areas such as pocket parks or as street trees;
- Existing habitat for the cattle Egret, Grey-headed Flying Fox, Eastern Freetail Bat and Eastern Bentwing Bat be retained wherever possible including aquatic habitat with adjacent ;
- Existing blockages and ground level crossings should be removed to improve aquatic connectivity and fish passage;
- Terrestrial and aquatic habitat linkages within and off site should be retained, enhanced and protected in the design of riparian corridors.

To maintain parity with the Growth Centres Conservation plan and the Biodiversity Certification order, the Townson Road study area needs to protect 6.7ha of Existing Native Vegetation (ENV). The following sections recommend how this should be achieved. Three mechanisms are recommended: zoning, development controls and rehabilitation. These recommendations focus on the ENV in non-certified land as protection of this vegetation is necessary for consistency with the Biodiversity Certification Order.

All preliminary site constraints have been combined to provide 3 constraint categories for the Townson Road study area, each of which are linked to specific recommendations for the design of the Indicative Layout Plan / Site Masterplan. Figure 10 illustrates the layout of each of these categories, and they are:

1. **Non-certified Lands**: Lands specified in the Growth Centres SEPP as non-certified areas. These lands are not covered by the Biodiversity-certification Order and form offsetting sites for the development of all Growth Centres Precincts. Two non-certified categories have been identified;

a. Non-certified and contains ENV (as per the GCC ENV definition)

b. Non-certified and does not contain ENV. (Note these areas may be used for development subject to consideration of flooding constraints however are restricted to a very small section in the north west of the study area.)

2. **Existing Native Vegetation**: ENV as specified in the Growth Centres SEPP on certified lands. These areas are exempt from further consideration under the TSC and EPBC Acts and may be cleared for urban development. However they are also suitable offsets for clearing of non-certified ENV and should be retained where possible.

3. **Riparian Corridors:** Bells Creek currently exists as two parallel streams for much of its length in this study area, with both watercourses classified as 2nd Order watercourses under the Strahler system. The riparian corridor requirements for these watercourses require a 20m wide vegetated riparian zone on each bank, and if the two parallel watercourses are retained on site will create a riparian corridor with a total width of up to 130 m in some places. In addition, these areas may be subject to future revegetation to a fully structured riparian community in order to protect the bed and bank stability of the watercourses. Uses within these areas are likely to be considerably restricted and controlled.

7.2 RIPARIAN

7.2.1 Riparian Management and Ownership

Riparian areas should be retained in public ownership to improve the likelihood of good environmental outcomes and provide integrated uses for the community. If Blacktown City Council will not accept handover of the riparian areas, use of appropriate large lot sizes and land use zonings such as environmental living, environmental management or environmental conservation should be considered.

Drainage and detention areas will likely remain in public ownership with Blacktown City Council owning and managing this land. These areas will be revegetated and managed as a natural feature. It is understood that a vegetation management plan will be required to be prepared to the satisfaction of NOW / OEH / Blacktown City Council for future DA's detailing management of these areas.

7.2.2 Exemptions under the Water Management Act

It is possible for the DP&I to seek an exemption from the Controlled Activity Approval (CAA) requirements for Development Approvals (DA's) under the WM Act for precincts within the Growth Centres, in order to streamline the otherwise integrated DA's for waterfront land through just one approval authority (local council). This was achieved for the adjacent precincts (Oran Park and Turner Road in the South West Growth Centre), through a Waterfront Land Strategy.

Further review of appropriate planning mechanisms and planning controls will need to be carried out by NOW, Blacktown City Council and DP & I in order to find a set of controls which would be appropriate for each major stakeholder.

7.2.3 Management of Riparian Areas

The riparian areas within the Growth Centres Precincts were assessed according to the methodology included in the NOW controlled activity guidelines for riparian corridors which includes Stream Orders 1, 2, 3 and 4+ based on the Strahler Stream Order Methodology (Figure 2).

On 1 July 2012 new guidelines have commenced regarding controlled activities within riparian corridors. The new guidelines amend the riparian corridor widths that apply to watercourses, providing more flexibility in how riparian corridors can be used and making it easier for applicants to determine NOW controlled activity approval requirements. These changes will simplify the controlled activities application and assessment process, provide greater flexibility, help make more land available for housing, support floodplain, stormwater and bush fire management, and allow riparian corridors to be used for public amenity, whilst continuing to deliver environmental outcomes required under the WMA.

7.2.4 Planning Controls and Management Principles

The guidelines do not encompass specific planning controls, however they do contain objectives and a guide to works and activities allowable on waterfront land. The overarching objective of the controlled activities provisions of the WMA is to establish and preserve the integrity of riparian corridors.

Ideally the environmental functions of riparian corridors should be maintained or rehabilitated by applying the following principles:

- Maintaining or rehabilitating the riparian corridor (RC) and vegetated riparian zone (VRZ) with fully structured native vegetation in accordance with Table 11 below,
- Minimise any disturbance and harm to the recommended RC/ VRZs
- Minimise the number of creek crossings and provide a perimeter road separating development from the RC/VRS (which will also assist with bushfire management)
- Locate all services and infrastructure outside of the RC/VRZ. Within the RC/VRZ combine multiple service installations into one easement and / or utilise road crossings for service installations where possible.
- Ensure all stormwater is treated before discharging into the RC/VRZ

NOW however, does allow for a range of works and activities on waterfront land and in riparian corridors to better meet the needs of the community, so long as they have minimal harm as outlined the Riparian Corridor Matrix (Table 4).

Non riparian corridor works and activities can be authorised within the outer riparian corridor so long as the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. That is, where appropriate 50% of the outer vegetated riparian zone width may be used for non-riparian uses including asset protection zones, cycleways, paths, roads and development lots.

An equivalent area is required to be offset on the site and must be connected to the riparian corridor (see Figure 15). The inner 50% of the vegetated riparian zone is required to be fully protected and vegetated with native endemic riparian plant species in order to satisfy the minimum setback requirements to maintain bed and bank stability and minimal harm.

The averaging rule should generally be applied to cleared waterfront land. Development proposals involving waterfront lands that contain existing native vegetation should seek to preserve that riparian vegetation in accordance with the minimum RC requirements outlined in Table 9.

7.2.5 Bushfire

Bushfire hazard has been assessed across the study area and found to be moderate, based on the gentle slopes and low fuel accumulation of the vegetation present. On the basis of this assessment, indicative APZ requirements have been mapped across the study areas for two scenarios. A number of strategies have been provided in the form of planning controls such that the risk from bushfire can be minimised and further that the approvals process can be streamlined.

A number of existing fire stations are in close proximity to the Precinct and are considered likely to be able to adequately service the area. It is recognised that as the North-West Growth Centre is developed the area will transition from rural to urban and the primary source of fire fighting resources will be the NSW Fire and Rescue.

A number of strategies have been provided in this report such that the risk from bushfire can be mitigated. The main strategies suggested include:

- Ensure adequate setback from bushfire prone vegetation (APZs);
- Integrate non-combustible infrastructure within APZs such as roads, easements and parking areas. The majority of APZs will be able to be contained within perimeter roads and front yard setbacks;
- Ensure adequate access and egress from the site through a well-designed road system;
- Consider the adequacy of water supply and the delivery of other services (gas and
- electricity);
- Provide temporary APZs during any staged development;
- Consider SFPP and other development types;
- Provide for effective and ongoing management of APZs; and
- Consider construction standards (AS3959) with any proposed residential developments.

7.3 RECOMMENDATIONS

7.3.1 Biodiversity

Zoning

Townson Road study area contains ENV that needs to be protected in order to achieve good biodiversity outcomes and maintain parity with the Biodiversity Certification Order. The NSW Office of Environment and Heritage have issued advice on the preferred mechanisms to be used for protecting ENV. These identify a preferred land zoning and tenure as follows:

- *Protect non-certified ENV using an E2 zone (Environmental Conservation) with permissible landuses consistent with the conservation of biodiversity values in public ownership. Where this is not possible, consider the following alternatives in descending order of preference:*

- *Zone E3 (Environmental Management) with permissible uses consistent with conservation of biodiversity values and public ownership*

- *Zone RE1 (Public Recreation) with management of the conservation values of the land as a primary objective. OEH recommends requirement for the preparation of a Plan of Management (PoM), perhaps through a requirement in the DCP.*

- *Zone SP2 (Infrastructure) with management of the conservation values of the land as a primary objective. OEH recommends a requirement for the preparation of a PoM, perhaps through a requirement in the DCP*
- *E2 (Environmental Conservation) with permissible uses consistent with conservation of biodiversity in private ownership*

The first four of these options all recommend public ownership of the land as a means of securing long-term conservation management. Where the land is not already in public ownership, a willing recipient is required. Due to changes to section 94 Contributions under the EP & A Act, many local governments will no longer become an acquiring authority or even accept land dedications if it is for environmental protection purposes. If a public authority is not willing to accept ownership of land to be conserved, the ENV should be zoned E2 and sub-division minimised where-ever possible so that patches of the ENV are retained in single ownership.

Development Controls

The zoning of land does not necessarily fully protect the vegetation from being cleared as there are a number of permissible uses that can lead to clearing. Other precincts in the Growth Centres have addressed this by including a clause in the SEPP that states a consent authority must not grant consent to development on land to which the clause applies unless the consent authority is satisfied that the development will not result in the clearing of ENV. (See clause 6.5 in Marsden Park Industrial Precinct for example.)

Development controls should be applied to both ENV and AHCVV vegetation on non-certified land within the riparian corridors of Bells Creek. This approach has been used in other precincts where the SEPP prevents the clearing of "Existing Native Vegetation Areas". Consent for clearing this vegetation cannot be provided. Whilst this provides a high level of protection, it has the unintended consequence in that it precludes environmental management and drainage works that would require clearing and subsequent rehabilitation from being undertaken.

Rehabilitation and Management

Zoning and development controls are useful tools for preventing actions (such as clearing) that may be damaging to native vegetation and biodiversity, however they are not particularly useful in ensuring the biodiversity values are managed in the long term. Management includes activities such as removal of weeds, rehabilitation, planting and maintenance. As it is difficult to require private land owners to undertake these activities, where possible, areas of high conservation value should be placed in public ownership with a funding source for management. Riparian areas are discussed in the following sections.

7.3.2 Riparian

Based on the riparian study ELA recommend the following for the riparian protection area within the Townson Road study area:

- Future development to be in accordance with NOW Controlled Activity Guidelines for Riparian Corridors.
- The riparian corridor is rehabilitated and managed in accordance with a Management Plan and in accordance with the indicative plan and cross section in Appendix D.
- Removal of farm dams and/or ensuring that dams are 'offline' in order to prevent any adverse impact to the riparian corridor or water quality.
- Consider the location of new utility corridors and existing buildings/existing use issues in the proposed riparian areas.
- Structures for water quality and detention must be located outside the inner riparian corridor area unless agreed on with NOW.
- At pinch points the watercourse must be adequately stabilised to prevent excessive erosion which may impact on surrounding land uses.
- Local provenance species should be used in the rehabilitation works within the riparian protection area.
- Consideration of fish passage requirements when designing future creek crossings, water detention and water quality features in line with NOW guidelines.
- Incentives are offered for landowners to manage land to retain, rehabilitate and manage the ecological values within riparian corridor.
- Incentives are offered for landowners to manage land within the riparian corridor to minimise water quality impacts on the streams within the precinct.

- All ENV within the environmental conservation area is included in the native vegetation protection map which will accompany the SEPP amendment.

7.3.3 Bushfire

Based on the recommendations contained within PBP 2006 the following planning principles are recommended for rezoning the Townson Road study area to urban uses;

- Provision of an 8 meter wide perimeter road with two way access which delineates the extent of the intended development;
- Provision, at the interface, for the establishment of adequate asset protection zones for future housing;
- Specifying minimum residential lot depths to accommodate asset protection zones for lots on perimeter roads;
- Minimising the perimeter of the area of land, interfacing the hazard which may be developed;
- Introduce controls which avoid placing inappropriate developments in hazardous areas; and
- Introduce controls on the placement of combustible materials in asset protection zones.

8 References

Allison, F.R. and Hoye, G.A. (1998) 'Eastern Freetail-bat', In: Strahan, R. (Ed.) *The Mammals of Australia*, pp. 484-485, Australian Museum/ Reed Publications, Sydney.

Benson, D. And Howell, J. 1994. 'The natural vegetation of the Sydney 1:100,000 map sheet.' *Cunninghamia* 3(4).

Black Town City Council (2012) Black Town Maps: Available: http://maps.blacktown.nsw.gov.au/WebSpatial/pages/DesktopClientV221.faces

Blakers, M., Davies, S., and Reilly, P.N (1984) *The Atlas of Australian Birds*. RAOU Melbourne University Press.

Churchill, S. (1998) *Australian Bats*, Reed New Holland, Sydney.

DEC (2005) Department of Environment and Conservation (NSW) 2005. Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland. Department of Environment and Conservation (NSW), Sydney.

DECC (2009). *Biobanking Assessment Methodology and Credit Calculator Operational Manual.* NSW Department of Environment and Climate Change, Sydney.

DECC (2007). 'Order to confer biodiversity certification on the State Environmental Planning Policy (Sydney Region Growth Centres) 2006' http://www.environment.nsw.gov.au/resources/nature/biocertordwsgcentres.pdf

DIPNR (2004) *Riparian Corridor Management Study*, (Department of Infrastructure, Planning and Natural Resources).

DLWC (2000). *Geomorphic Categorisation of Streams in the Hawkesbury Nepean Catchment.* Department of Land and Water Conservation.

Dresel, PE, Clark, R., Cheng, X., Reid, M, Fawcett, J. and Cochraine, D. (2010) Mapping Terrestrial Groundwater Dependant Ecosystems: Method development and example output. Victoria Department of Primary Industries, Melbourne, Victoria.

Dwyer, P.D. (1981) 'Common Bent-wing Bat, *Miniopterus schreibersii'*, *ANH*, 20(6):187-190.

Dwyer, P.D. (1995) 'Common Bent-wing Bat (Miniopterus schreibersii)', In: R. Strahan (Ed.) *The Australian Museum Complete Book of Australian Mammals*, pp494-495, Angus and Robertson Publishers, Sydney.

Eamus, D (2009) Identifying Groundwater Dependant Ecosystems – A guide for Land and Water Managers, Land and Water Australia, Canberra.

Eby, P. (1998) 'An analysis of the diet specialisation in frugivorous *Pteropus poliocephalus* in Australian subtropical rainforest', *Austral Ecology*, 23:443-456

Eco Logical Australia (2006) Western Sydney Growth Centres Conservation Plan (Final Draft), Report for Growth Centres Commission

Eco Logical Australia (2011). Due Diligence Ecology and Bushfire. Project 74: East Leppington Precinct. Prepared for Stockland

Ehmann, E. (1997) *Threatened Frogs of New South Wales: Habitats, status and conservation*, Frog and Tadpole Study Group, Sydney.

Energy Australia (2002) "Vegetation Safety Clearances" (NS179).

Growth Centres Commission (GCC) (2006). *Growth Centres Development Code. G*rowth Centres Commission.

Hatton, T and Evans R. (1998) Dependence of Groundwater and its significance to Australia. LWRRDC Occasional Papers No 12/98. Land and water Resources Research and Development Corporation, Canberra.

Hoye, G. and Richards, G. (1998) 'Greater Broad-nosed Bat', In: Strahan, R. (ed.) *The Australian Museum Complete Book of Australian Mammals*, Angus and Robertson Publishers, Sydney.

Keith (2004) *Ocean Shores to Desert Dunes*. Department of Environment and Conservation. Hurstville NSW.

Law, B. S., Anderson, J., and Chidel, M. (1999). 'Bat communities in a fragmented forest landscape on the south-west slopes of New South Wales, Australia.' *Biological Conservation 88, 333-345*.

Lloyd, A.M., Law, B.S., and Goldingay, R. (2006) 'Bat activity on riparian zones and upper slopes in Australian timber production forests and the effectiveness of riparian buffers.' *Biological Conservation 129, 207-220*.

Mahony, M. (1999) 'Review of the declines and disappearances in the Bell frog species group (*Litoria aurea* species group) in Australia', In: Campbell, A. (Ed.) *Declines and Disappearances of Australian Frogs*, pp 81-93, Biodiversity Group Environment Australia, Canberra.

Marchant and Higgins (1993) *Handbook of Australian, New Zealand and Antarctic Birds*. Oxford University Press, Melbourne.

McKenzie, N. L., Stuart, A. N., and Bullen, R. D. (2002). 'Foraging ecology and organisation of a desert bat fauna.' *Australian Journal of Zoology 50, 529-548.*

Mills, D. J., Norton, T. W., Parnaby, H. E., Cunningham, R. B., and Nix, H. A. (1996). 'Designing surveys for microchiropteran bats in complex forest landscapes - a pilot study from south-east Australia.' Special issue*: Conservation of biological diversity in temperate and boreal forest ecosystems 85, 149-161*.

Morcombe, M. (2004) *Field Guide to Australian Birds*, Steve Parish Publishing.

Ngh environmental (2010) *Ecological Assessment – Assessment of Significance. Camden Valley Way. Cobbitty Road to Cowpasture Road Upgrade*. Prepared for the NSW RTA.

NSW NPWS (2002a). Interpretation Guidelines for the native vegetation maps of the Cumberland Plain, Western Sydney. Threatened Species Unit, Hurstville.

NSW NPWS (2002). Native vegetation of the Cumberland Plain, Western Sydney Vegetation Community, Condition and Conservation Significance Mapping.

NPWS 2004. *Guidelines for Ecologically Sustainable Fire Management,* NSW Biodiversity Strategy.
NSW Department of Water and Energy (February 2008). *Guidelines for controlled activities: Riparian corridors.*

NPWS (1997) *Urban Bushland Biodiversity Study - Western Sydney,* National Parks and Wildlife Service.

NSW RFS, 2001. *Planning for Bushfire Protection. A guide for Councils, Planners, Fire Authorities, Developers and Home Owners.*

NSW RFS, 2006a. *Guideline for Bush Fire Prone Land Mapping.* Version 3. NSW Rural Fire Service.

NSW RFS, 2006b. *Planning for Bushfire Protection. A guide for Councils, Planners, Fire Authorities and Developers.*

NSW RFS (2006c). *The Bush Fire Environmental Assessment Code for New South Wales*.

OEH (2012) NSW BioNET - Atlas of NSW Wildlife. Available: http://www.bionet.nsw.gov.au/

Parnaby, H. (1992). *An interim guide to identification of insectivorous bats of south-eastern Australia.* Technical Reports of the Australian Museum Number 8.

Pennay, M., Law, B., and Rhinhold, L. (2004). *Bat calls of New South Wales: Region based guide to echolocation calls of Microchiropteran bats.* NSW Department of Environment and Conservation, Hurstville.

Pizzey, G. and Knight, F. (1997) *Field Guide to the Birds of Australia*, Harper Collins Publishers, Sydney.

Pyke, G.H and White, A.W. (1996) 'Habitat requirements for the Green and Golden Bell Frog *Litoria aurea* (Anura:Hylidae), *Australian Zoologist*, 30(2):177-189.

Reed, P.C., Lunney, D. and Walker, P. (1990*)* 'A 1986-7 survey of the Koala Phascolarctos cinereus in NSW and an ecological interpretation of its distribution', In: *Biology of the Koala*, pp: 55-74.

Reinhold, L., Law, B., Ford, G., and Pennay, M*. Key to the bat calls of south-east Queensland and north-east New South Wales. 2001.* Queensland, DNR.

Robinson, M. (1993) *A Field Guide to Frogs of Australia: from Port Augusta to Fraser Island including Tasmania*, Australian Museum/Reed New Holland, Chatswood.

SAI Global (1994). AS 2419.1-1994 Fire Hydrant Installations.

SAI Global (2009). AS3959-2009 Construction of Building in Bushfire Prone Areas.

Schodde, R. and Tidemann, S. (Eds) (1986). *Readers Digest complete book of Australian Birds*, 2nd Edn., Reader's Digest Services Pty Ltd, Sydney.

SEWPaC (2012) EPBC Online Protected Matters Database Search. Available httip://www.environment.gov.au/erin/ert/epbc/imap/map.html

SEWPaC 2012a – Commonwealth Listing Advice on Ardea ibis (Cattle Egret) at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59542

SEWPaC 2012b – Commonwealth Listing Advice on Ardea ibis (Grey Headed Flying Fox) at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186

Simpson, K. and Day, N. (1999). *Field guide to the birds of Australia 6th edn.,* Penguin Books Australia Ltd, Ringwood Victoria.

Simpson, K. and Day, N. (2004). *Field guide to the birds of Australia 7th edn.,* Penguin Books Australia Ltd, Ringwood Victoria.

Sinclair Knight Merz (2001). *Environmental Water Requirements of Groundwater Dependant Ecosystems*. Environmental Flows Initiative Technical Report Number 2, Commonwealth of Australia.

Strahan, R. (Ed.) (1998) *The Australian Museum Complete Book of Australian Mammals*, Angus and Robertson Publishers, Sydney.

Sydney Coastal Councils Group (2006) *Groundwater Management Handbook – a Guide for Local Government*.

Tozer, MG, Turner, K, Simpson, C, Keith, DA, Beukers, P, MacKenzie, B, Tindall, D & Pennay, C (2006) *Native vegetation of Southeast NSW*: *A revised classification and map for the coast and eastern tablelands*. Version 1.0. NSW Department of Environment and Conservation and NSW Department of Natural Resources.

Appendix A: Detailed Statutory Framework

Commonwealth

Environment Protection & Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (*EPBC Act*) establishes a process for assessing the environmental impact of activities and developments where 'matters of national environmental significance' (MNES) may be affected. The *EPBC Act* lists endangered ecological communities, threatened and migratory species that have the potential to occur, or are known to occur on a site.

The approval of both stages of the strategic assessment occurred on the 28th February, 2012. This approval essentially means that the Commonwealth is satisfied that the conservation and development outcomes that will be achieved through development of the Growth Centres Precincts will satisfy their requirements for environmental protection under the EPBC Act. So that, provided development activity proceeds in accordance with the Growth Centres requirements (such as the Biodiversity Certification Order, the Growth Centres SEPP and DCPs, Growth Centres Development Code etc) then there is ***no requirement*** to assess the impact of development activities on matters of National Environmental Significance (NES) and hence ***no requirement*** for referral of activities to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). The requirement for assessment and approval of threatened species and endangered ecological communities under the EPBC Act has now been "turned off" by the approval of the Strategic Assessment.

State

Environmental Planning and Assessment Act 1979 (EP&A Act)

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 assessment of development proposals. Various legislative instruments, such as the NSW *Threatened Species Conservation Act 1995* (TSC Act), are integrated with EP&A Act and have been reviewed separately.

In determining a development application, the consent authority is required to take into consideration the matters listed under Section 79C of the EP&A Act that are relevant to the application. Key considerations include:

- Any environmental planning instrument, including drafts
- The likely impacts of the development
- The suitability of the site for the development
- Any submissions made in accordance with the EP&A Act or regulations
- The public interest

Threatened Species Conservation Act 1995 (TSC Act)

The *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 1974) or an activity (Part 5 of the EP&A Act) is likely to significantly affect threatened species, populations and ecological communities or their habitat.

The schedules of the Act list species, populations and communities as endangered or vulnerable. New species, populations and communities are continually being added to the schedules of the TSC Act. All developments, land use changes or activities need to be assessed to determine if they will have the potential to significantly impact on species, populations or communities listed under the Act.

Bio-certification was introduced under the TSC Act (s.126G) to confer certification on an environmental planning instrument if the Minister is satisfied that it will lead to the overall improvement or maintenance of biodiversity values – typically at a landscape scale. The effect of granting certification is that any development or activity requiring consent (Under Part 4 and 5 of the EP&A Act respectively) is automatically – development that is not likely to significantly affect threatened species. This certification removes the need to address threatened species considerations and the assessment of significance or seven part tests (s.5A of the EP&A Act), including the prepare species impact statements (SIS).

Where Parts 3A, 4 or 5 are not applicable, a licence under s.91 of the TSC Act from Office of Environment and Heritage must be obtained for actions (such as bush regeneration) that have the potential impact on threatened species.

The Growth Centres SEPP (see below) impacts the application of the TSC Act within Townson Road Precinct, which is discussed further below.

Threatened Species Conservation Amendment (Special Provisions) Act 2008

This Act passed by NSW Parliament on 24 June 2008 confirms bio-certification of the Growth Centres SEPP by amending the TSC Act. The Act also amends the Local Government Act 1993 with respect to rates payable on land subject to conservation agreements within the Growth Centres.

State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (Growth Centres SEPP)

The Growth Centres State Environmental Planning Policy (SEPP) (referred to as the 'Growth Centres SEPP') has been 'bio-certified' by order of the Minister for the Environment under s.126G of the *TSC Act*. The mechanism for achieving this is outlined in the *Growth Centres Conservation Plan* (Eco Logical Australia, 2007) and the conditions for bio-certification are documented in the Ministers order for consent[3]. Bio-certification negates the requirement for impact assessment under s.5A of the *Environmental Planning and Assessment Act, 1979* thus turning off the requirements for seven part tests or species impact statements.

The areas within Townson Road that are non-certified are shown in Figure 3 of the report. The site contains 2 Endangered Ecological Communities (Cumberland Plain Woodland and Alluvial Woodland) as well as threatened flora and fauna species.

[3] http://www.environment.nsw.gov.au/resources/nature/biocertordwsgcentres.pdf

Each precinct needs to be assessed against the conditions of the Biodiversity Conservation Order to ensure that the planned rezoning and subsequent development of the precinct complies. This is undertaken through the completion of a Biodiversity Certification Consistency Report.

Fisheries Management Act 1994 (FM Act)

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. The FM Act defines 'fish' as any marine, estuarine or freshwater fish or other aquatic animal life at any stage of their life history. This includes insects, molluscs (eg. Oysters), crustaceans, echinoderms, and aquatic polychaetes (eg. Beachworms), but does not include whales, mammals, reptiles, birds, amphibians or species specifically excluded (eg. Some dragonflies are protected under the TSC Act instead of the FM Act). Under this act, if any activity occurs that will block fish passage, then a permit under this Act will be required.

Water Management Act 2000

The NSW *Water Management Act 2000* has replaced the provisions of the *Rivers and Foreshores Improvement Act 1948*. The *Water Management Act 2000* and *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 New South Wales. 'Water sources' are defined very broadly and include any river, lake, estuary, place where water occurs naturally on or below the surface of the ground and coastal waters.

If a 'controlled activity' is proposed on 'waterfront land', an approval is required under the Water Management Act (s91). '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.

'Waterfront land' is defined as the bed of any river or lake, and any land lying between the river or lake and a line drawn parallel to and forty metres (40m) inland from either the highest bank or shore (in relation to non-tidal waters) or the mean high water mark (in relation to tidal waters). It is an offence to carry out a controlled activity on waterfront land except in accordance with an approval.

Noxious Weed Act 1993

The objectives of the NSW *Noxious Weeds Act 1993* are to identify which noxious weeds require control measures, identify control measures suitable to those species and to specify the responsibilities of both public and private landholders for noxious weed control.

Rural Fires Act 1997

The objectives of the NSW *Rural Fires Act 1997* (RF Act) are to provide for:

- The prevention, mitigation and suppression of fires
- Coordination of bushfire fighting and prevention
- Protection of people and property from fires
- Protection of the environment

Section 100B of the RF Act provides for the Commissioner to issue a bushfire safety authority for subdivision of bushfire prone land that could lawfully be used for residential or rural residential purposes or for development of bushfire prone land for a special fire protection purpose.

A Bushfire Safety Authority permits development to the extent that it complies with bushfire protection standards. Application for a Bushfire Safety Authority must be lodged as part of the development application process and must demonstrate compliance with the Planning for Bushfire Protection Guidelines (RFS 2006).

The RF Act also outlines the responsibilities of land owners to manage their land for bushfire protection and provides a mechanism for the approval of hazard reduction works, through the issue of a bushfire hazard reduction certificate.

Rural Fires and Environmental Assessment Legislation Amendment Act 2002

The NSW *Rural Fires and Environmental Assessment Legislation Amendment Act 2002* amends the RF Act and the EP&A Act with respect to bushfire prone lands, bushfire hazards and bushfire emergencies.

Planning for Bushfire Protection 2006

This guide (Planning for Bushfire Protection: a Guide for Councils, Planners, Fire Authorities, Developers and Home Owners, NSW Rural Fire Service 2006) is the key bushfire planning document for the state. The document identifies requirements and strategies for new developments to help protect from bushfire hazards. It details the location and depth of asset protection zones, fire trails and perimeter roads, water supply and building standards in bushfire risk areas. This document is given legal force through the *Rural Fires and Environmental Assessment Legislation Amendment Act 2002*.

State Environmental Planning Policy No.19 – Bushland in Urban Areas

This NSW State Environmental Planning Policy (SEPP) aims to protect and preserve bushland within selected local government areas. The policy recognises the recreational, educational and scientific significance of such bushland and aims to protect the flora, fauna, significant geological features, landforms and archaeological relics in such areas. It encourages management to protect and enhance the quality of the bushland and facilitate public enjoyment, compatible with its conservation. The policy states that a person shall not disturb bushland zoned or reserved for public open space purposes without the consent of the council.

Development Code

The Growth Centres Development Code was produced by the former Growth Centres Commission (GCC) in 2006. The Development Code was produced to guide the planning and urban design in the North West and South West Growth Centres.

The Development Code includes objectives and provisions that support the retention of as much native vegetation, habitat and riparian areas within the precinct through incorporation into land use planning outcomes such as lower density development in these areas, subdivision patterns, road design, local parks, and other areas required to be set aside for community uses without adversely affecting the development yield of areas.

As a requirement under the Development Code, the Townson Road precinct will need to demonstrate how the biodiversity and other values of areas identified by the SEPP will be protected, maintained and

enhanced. Key issues will include boundary management (eg. Buffers to surrounding development), bush fire and water sensitive urban design (WSUD) (GCC 2006).

Growth Centres Conservation Plan

Under the GCC Conservation Plan (January 2007), the vegetation within Townson Road Precinct has been identified as 'Lower Long Term Management Viability (LMV)' and has already been considered for offset as part of the Improve or Maintain test (i.e. is not designated for conservation as part of the larger regional plan for Western Sydney). It should be noted however that while the Improve or Maintain test has already been considered, it can and should be supplemented by other relevant considerations as recommended by the Conservation Plan. By applying the precautionary principle, the Conservation Plan recommends that some residual areas identified as LMV should be further examined and addressed, for any potential for habitat conservation to contribute to the broader habitat values of the area at the planning stage.

Appendix B: Methodology

Literature Review

A desktop literature review was undertaken by ELA to determine the location and extent of previous surveys, identify the representative spectrum of flora and fauna within the study area and identify the presence of any threatened species, populations and ecological communities listed under the TSC Act and the Commonwealth EPBC Act that could potentially occur within the study area. To this end, the following documentation and mapping was reviewed:

- Topographic maps
- Aerial photography of the study area
- A search of the NSW DECC Wildlife Atlas database
- EPBC online Protected Matters Database Search
- Preliminary results from Draft Part 3A project: Water related Services for the North West and South West Growth Centres Cumberland Ecology (2010)
- 'Growth Centres Conservation Plan' prepared by Eco Logical Australia (2007) for NSW Growth Centres Commission;
- Western Sydney Vegetation Mapping (NPWS 2002a); and
- Western Sydney Condition and Conservation Significance Mapping (NPWS 2002b).

Likelihood of Occurrence

Appendix D identifies the threatened species returned by the NSW DECCW Wildlife Atlas database and EPBC online Protected Matters database searches (based on a 10km radius from the study area) together with an assessment of the likelihood of occurrence for each species. Each species likely occurrence was determined by records in the area, habitat availability and knowledge of the species' ecology.

Five terms for the likelihood of occurrence of species are used in this report. The terms for likelihood of occurrence are defined below:

- "yes" = the species was or has been observed on the site.
- "likely" = a medium to high probability that a species uses the site.
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur.
- "unlikely" = a very low to low probability that a species uses the site.
- "no" = habitat on site and in the vicinity is unsuitable for the species.

Terrestrial Biodiversity Assessment

METHODS

Field survey across the study area was conducted on the 25th, 26th, and 29th of October 2012. Field survey consisted of validating ENV, vegetation communities and their condition, opportunistic fauna sightings and fauna habitat assessment. The field survey was undertaken by Rebecca Dwyer, Kimberly McCallum, Lucas McKinnon and Ian Dickson of Eco Logical Australia. Approximately 44 person hours were utilised in completing the survey.

Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) were targeted during this survey period.

Weather conditions during field surveys

Date	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)
25 – 26 October	13.7-14.3	23	0mm
29 October	10.7	30	0mm

Weather observations were taken from www.bom.gov.au Seven Hills Weather Station 068257)

The survey involved validating the mapped vegetation communities, delineating the boundaries of mapped vegetation and assessment of community condition, and searching for threatened flora and fauna. Six survey techniques were used during the field surveys. These techniques included:

- Floristic quadrats
- Random meander targeted flora searches
- Incidental fauna sightings
- Targeted fauna searches

The survey techniques were based on those outlined within the Threatened *Biodiversity Survey and Assessment: Guidelines for Development and Activities (Working Draft)* by DEC (2004). Vegetation quadrats and transect habitat assessments followed the NSW Biobanking Methodology (DECC 2009).

Quadrats included 0.04ha (20m x 20m) surveys to record presence of all vascular flora species, along with cover and abundance for each species using a modified Braun-Blanquet scale (measures of cover and abundance taken to determine species dominating each stratum). In some locations, habitat features were determined over 0.1 ha survey (50m x 20m quadrats); measures included number of hollow bearing trees and length of fallen dead timber greater than 10 cm diameter. Within the 0.1 ha quadrats, projected foliage cover of each strata level and exotic flora was assessed along a 50m transect.

The physical characteristics (such as aspect, slope and disturbance) of each location were noted and photos were taken of the quadrats along the 50 m transect line as well at points along the random meander traverses. Species were identified to the lowest taxonomic level possible, following the Flora of NSW (Harden 1992-2002) and NSW Flora online (www.plantnet.rbgsyd.nsw.gov.au). Targeted threatened plant searches were performed during vegetation survey for species deemed as potentially or likely to occur on the basis of suitable habitat.

Incidental observations of fauna and indirect evidence of fauna, such as scats, tracks and other traces, were recorded during survey. Habitat searches were undertaken for hollow bearing trees, coarse woody debris, defoliating bark and watercourses with potential to provide aquatic habitat.

VEGETATION COMMUNITY AND CONDITION ASSESSMENT

Vegetation mapping was undertaken using aerial photography, ground-truthing of the 'Native Vegetation of the Southeast of NSW (Tozer et al. 2006)', NPWS Western Sydney Mapping Project and traversing of cleared land surrounding currently mapped vegetation remnants. Vegetation community information, canopy density and understorey condition were assigned to each vegetation polygon.

Field surveys were carried out to assess the accuracy of the mapped boundaries and attributed information and where delineation of boundaries in the field was not obvious from the aerial photography, boundaries were marked using a Global Positioning System (GPS).

Field validation of vegetation remnants was undertaken to identify correlations with areas of Cumberland Plain Woodland that meet the criteria for the critically endangered ecological community listed under the EPBC Act, and areas of vegetation that have been cleared since aerial photos were taken.

NSW Cumberland Plain Condition Criteria

Table below outlines the classification rules used to determine canopy and understorey condition. This table is a modification of Table 4 in the Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney (NPWS 2002). Each area of remnant vegetation was given a condition rating according to the rule-set identified in the table below of canopy and condition codes.

CODE	CANOPY DENSITY	DESCRIPTION
A	>10%	Relatively intact native tree canopy
B	<10%	Larger areas of remnant vegetation with a low or discontinuous canopy. Often found on the disturbed edges of larger remnants.
C	<10%	Areas of native vegetation that do not have a Eucalypt canopy cover.
TX	<10%	Areas of native trees with very discontinuous canopy cover.
TXr	<10%	Areas of Tx (as above) located in areas where there is a combination of urban and rural activities such as rural residential development.
Txu	<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).

Commonwealth Cumberland Plain Woodland and Shale Gravel Transition Forest Condition Criteria

The condition assessment criteria under the EPBC Act differs from that of the TSC Act. Condition is assigned based on patch size and perennial understorey cover. The table below outlines the EPBC Act condition criteria which were applied to vegetation within the study area to determine the condition code.

Condition Thresholds for Patches that meet the Description for the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community.

CATEGORY AND RATIONALE	THRESHOLDS
A. 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[3] size is ≥0.5ha; **AND** ≥50% of the perennial understorey vegetation cover[4] is made up of native species.
OR	
B. Larger patches which are inherently valuable due to their rarity.	The patch size is ≥5ha; **AND** ≥30% of the perennial understorey vegetation cover is made up of native species.
OR	
C. Patches with connectivity to other large native vegetation remnants in the landscape.	The patch size is ≥0.5 ha; **AND** ≥30% of the perennial understorey vegetation cover is made up of native species; **AND** The patch is contiguous[5] with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is ≥5ha in area.
OR	
D. 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; **AND** ≥30% of the perennial understorey vegetation cover is made up of native species; **AND** 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.

[3] 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.

[4] 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 no alter functionality as per footnote 3 and the Description and Condition Thresholds are met).

[5] 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 (2009a) 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 community validation

During field visits random meanders were undertaken to determine the community present and full floristic lists were recorded and compared against the description of each community.

A rapid assessment was undertaken to determine if the patch was likely to meet the EPBC listing of CPSW & SGTF. Based on the results of this rapid assessment, floristic quadrats (20m x 20m) were conducted in several locations to validate and determine the floristic structure of the vegetation community. A full floristic list was compiled within each quadrat.

For each quadrat, diagnostic species for each community were identified and compared against the minimum number of diagnostic species expected to occur in a 20 x 20m quadrat for that community. Consideration was also given to those more disturbed sites where weed species were common and native species were low in abundance making the classification process more difficult as those sites containing fewer native species are less likely to contain high numbers of diagnostic species.

Threatened Flora Surveys

Random meander surveys were conducted within the vegetation communities located within the site, and other areas of potential habitat for threatened flora species. MNES flora species that were targeted during the field survey included:

- *Micromyrtus minutiflora*
- *Pimelea curviflora* var. *curviflora*
- *Pimelea spicata*
- *Pultenaea parviflora*

In addition, *Grevillea juniperina* and *Dillwynia tenuifolia,* listed under the TSC Act was also targeted as it has previously been recorded within the locality.

Threatened Fauna Surveys

Habitat assessment for threatened fauna surveys were undertaken within the study area to determine whether any MNES species were likely to be found within the Townson Road Precinct. Incidental fauna sightings were recorded. Targeted surveys were undertaken in the study area for the following and results incorporated into the assessment:

Diurnal Birds

Survey for diurnal birds was opportunistic with observers moving through vegetation communities supporting potential habitat for diurnal birds over the entire survey period.

Nocturnal Birds

Nocturnal bird survey focused on identifying potential roosting / nesting trees during the survey period, through the incidence of large hollow bearing trees, owl wash and faecal pellets. Stag watching and spotlighting was conducted at dusk for a total of 4 person hours.

Ground dwelling and arboreal mammals

Faunal habitat assessments were initially undertaken remotely using aerial photography, with waterbodies, woodland remnants, grasslands and manmade structures delineated in order to target survey accordingly. Additional habitat assessments and opportunistic surveys were undertaken continuously during daytime hours throughout the survey period whilst traversing suitable habitat within the study area. Any indirect evidence of fauna present was recorded including, fur, tracks, dens, scratches, and chew marks.

Reptiles and Amphibians

Opportunistic observations and habitat assessment for reptiles and amphibians were undertaken throughout the survey period. Green and Golden Bell Frog was targeted during the survey period. Survey locations focused on large waterbodies and fallen logs. Diurnal searches and nocturnal spotlighting was undertaken for a total of 8 person hours.

Gastropods

Habitat assessments and surveys for *Meridolum corneovirens* (Cumberland Plain Land Snail) were undertaken throughout the survey period. Searches were undertaken in areas of vegetation with notable leaf litter accumulation, where leaf and bark accumulations around tree bases were excavated using a hand trowel. Careful consideration was used to ensure all natural substrate was restored upon completion.

Microchiropteran bat species

Survey for Microchiropteran (microbats) bat species included the use of ultrasonic Anabat detectors equipped with ZCAIM recording devices in four locations across the study area for one night at each site.

Survey locations focused on larger remnants of vegetation, flyways (powerline easements and access tracks) and major waterbodies. On each night of survey the Anabats were turned on between 1630 hours and 1800 hours and then turned off the following morning between 0730 hours and 0900 hours. Anabat calls were downloaded in the office and analysed by Alicia Scanlon (Ecologist, Eco Logical Australia, Coffs Harbour).

Bat calls were analysed using the program AnalookW (Version 3.3q 03 October 2006, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay *et al*. 2004); and south-east Queensland and north-east New South Wales (Reinhold *et al*. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW (http://www.forest.nsw.gov.au/research/bats/default.asp).

Bat calls are analysed using species-specific parameters of the call profile such as call shape, characteristic frequency, initial slope and time between calls (Reinhold *et al*. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd *et. al*. 2006) were followed:

- Search phase calls were used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al. 2002)
- Recordings containing less than three pulses were not analysed and these sequences were labeled as short (Law et al. 1999)
- Four categories of confidence in species identification were used (Mills et al. 1996):
  - definite – identity not in doubt
  - probable – low probability of confusion with species of similar calls
  - possible – medium to high probability of confusion with species with similar calls
  - unidentifiable – calls made by bats which cannot be identified to even a species group.

- Nyctophilus spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay et al. 2004)
- Sequences not attributed to microbat echolocation calls were labeled as junk or non-bat calls and don't represent microbat activity at the site
- Sequences labeled as low were of poor quality and therefore not able to be identified to any microbat species, they can however be used as an indicator of microbat activity at the site

A total of 380 sequences were submitted for analysis from two Anabat detectors placed at separate sites on 25 October within the Townson Road Precinct study area. Microbat calls accounted for 49% of sequences submitted with the remainder being too short or of low quality, preventing positive identification of species. General microbat activity on site was moderate with calls recorded more often than every ten minutes throughout the evening. Feeding buzzes were commonly recorded indicating that microbats were foraging within the study area.

There were a minimum of eight species identified from the recordings including two species listed as **vulnerable** under the NSW TSC Act 1987 (Table 19 and Table 20). The two vulnerable species detected were ***Miniopterus schreibersii oceanensis*** (Eastern Bentwing bat) and ***Mormopterus norfolkensis*** (East Coast Freetail bat).

Calls of the Eastern Bentwing bat overlap in frequency with those of *Vepsadelus darlingtoni* (and *V. regulus*). Calls were identified as *M.s.oceanensis* when there was a down-sweeping tail, drop of more than 2kHz in the pre-characteristic section, and the pulse shape and time between calls was variable.

Calls of the Eastern Broad-nosed Bat (*Scotorepens orion*) are very similar to those of the threatened Eastern falsistrelle (Falsistrellus tasmaniensis), and Greater Broad-nosed Bat *(Scoteanax rueppellii).* Calls were identified as Eastern Broad-nosed Bat based upon knowledge of the preferred habitat of each species and also on call characteristics such as frequency of the knee higher than 37kHz, drop of less than 3kHz in the pre-characteristic section and length of pre-characteristic section.

Table 19: Summary of anabat results for Townson Road 25 October 2012 (Recorder 1)

DATE	SPECIES NAME	NUMBER OF CALLS	DEFINITE	PROBABLE	POSSIBLE
25/10/2012	*Chalinolobus gouldii*	23	23		
25/10/2012	*Miniopterus schreibersii oceanensis*	11	1	2	8
25/10/2012	*Mormopterus norfolkensis*	6	3	1	2
25/10/2012	*Mormopterus species 2*	8	7		1
25/10/2012	Nyctophilus spp.	3	2		1
25/10/2012	*Scotorepens orion*	12		4	8
25/10/2012	*Tadarida australis*	14	14		
25/10/2012	*Vespadelus vulturnus*	8	7	1	

DATE	SPECIES NAME	NUMBER OF CALLS	DEFINITE	PROBABLE	POSSIBLE
25/10/2012	Low	29			
25/10/2012	Short	46			
	Total sequences	160			

Table 20: Summary of Anabat recorder results at Townson Road 25 October 2012

DATE	SPECIES NAME	NUMBER OF CALLS	DEFINITE	PROBABLE	POSSIBLE
25/10/2012	*Chalinolobus gouldii*	6	6		
25/10/2012	*Miniopterus schreibersii oceanensis*	1			1
25/10/2012	*Mormopterus norfolkensis*	1	1		
25/10/2012	Nyctophilus spp.	58	31	15	12
25/10/2012	*Scotorepens orion*	5			5
25/10/2012	*Vespadelus vulturnus*	23	22	1	
25/10/2012	Low	99			
25/10/2012	Short	27			
	Total sequences	220			

Aquatic Habitat Assessment

STUDY AREA

Bells Creek is the dominant watercourse running approximately south to north along the western boundary of the precinct. Bells Creek has been classified as a Category 1 creek by NOW and ELA.
Bells Creek is a reasonably sized tributary of the Hawkesbury-Nepean catchment. The catchment is shale-based with no gorges or sandstone dominated landscapes. The majority of the streams are "meandering vertical" river channel types streams, which are under great threat as they are confined largely to the Cumberland Plain in the Hawkesbury Nepean catchment. Hydrological and sediment regimes have been dramatically altered due to vegetation clearance and increasing urbanisation. Increasing impervious surfaces in the catchment are causing changes to hydrology which has greatly altered the geomorphology and ecology of the watercourses.

PRELIMINARY ASSESSMENT

A preliminary assessment of all types of water features within the study was carried out to assist with developing an appropriate methodology to highlight values and conditions of aquatic areas, defining 'Top of Bank' along watercourses and appraising the hydrological regime.

THREATENED SPECIES

Threatened species listed under the *Fisheries Management Act 1995* and the *Environmental Protection and Biodiversity Conservation Act 1999* were considered for their potential to occur within the study area by assessing habitat quality and availability as well as previous records. The following databases informed this process:

- NSW Fisheries Threatened Species Profiles
- NSW DECCW Wildlife Atlas database
- EPBC online Protected Matters Database Search
- NSW Government BioNET Database

STREAM CATEGORISATION

Watercourses within the study area were categorised using guidelines developed by the former NSW Department of Water and Energy (now part of NSW Office of Water) (NSW DWE 2008). All watercourses in the Study Area are Second Order Streams.

The objectives for Core Riparian Zones under the guidelines include maintenance or development of fully structured native vegetation and the absence of infrastructure within the zone.

CONDITION ASSESSMENT

Brief field surveys were conducted along the length of the watercourse. A number of key indicators were used to assess condition along the watercourse. The chosen indicators recognise key components of watercourse health and function. The level of assessment conducted was chosen to assist with future management of watercourse and riparian environments within the study area by highlighting current values, threats and limits to potential improvements along the watercourse.

STREAM HEALTH COMPONENT	INDICATOR
Hydrology	Presence of artificial barriers.
	Comparison to natural hydrological regime.
Streamside Vegetation	Width, condition and connectivity of riparian vegetation.
	Recruitment of native canopy species.
Physical Form	Bank stability.

	Fish passage.
Water Quality and Aquatic Habitat	Observed turbidity and algal growth.
	Instream native woody debris and snags.
	Instream macrophytes – habitat and condition of any macrophyte assemblage as based on presence of native and exotic species, diversity, and basis for occurrence.
	Potential land management problems within adjacent riparian areas likely to be contributing to poor water quality.

A final overall condition class was assigned to each reach of the watercourse consistent with the guidelines used by the NSW Department of Land and Water Conservation within the Hawkesbury Nepean Catchment (NSW DLWC 2000) as specified below:

Near Intact Condition: Streams in a natural or near natural condition. Indicative characteristics are: intact range of native vegetation, slow rate of geomorphic change and hydrologic conditions unaltered.

Good Condition: Streams with self adjusting river forms and processes and relatively intact vegetation associations. Streams with character and behaviour that befit their setting with high potential for ecological diversity. Dams, reservoirs and weirs may alter hydrologic conditions.

Moderate Condition: Streams with localised degradation of character and behaviour, typically marked by modified patterns of geomorphic units. Vegetation associations and coverage are poor and hydrologic conditions have been altered.

Degraded Condition: These reaches generally have one or more of the following characteristics: abnormal or accelerated geomorphic instability (i.e. prone to planform change and / or bank or bed erosion), excessively high volumes of coarse bedload which blankets the bed reducing habitat diversity, low levels of bank vegetation, heavy weed infestation and artificially modified channel.

Table 21: Watercourse Reach Condition and Natural Recovery Potential

REACH NO.	HYDROLOGY	STREAMSIDE VEGETATION	PHYSICAL FORM	WATER QUALITY AND AQUATIC HABITAT	OVERALL RATING
A	2nd Order Stream (Strahler). Channel mostly unmodified, but with small culverts. Inflows modified due to regionally cleared land use.	No or little evidence of broad-scale loss of native vegetation. One or more strata dominated by exotic species, 'high threat' species present. Cover within one stratum up to 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and/or only two age classes present. Quantities and cover similar to reference.	Clay banks with slope 30-70°. Approximately 5% of banks with minor erosion. Remainder of banks well stabilised by groundcover and riparian trees. Channel narrow, mostly <2 m with small banks. Culverts may restrict connectivity in low flows.	Stagnant at time of survey. Water very turbid with some algal growth where canopy opens. Limited aquatic habitat in narrow, shallow channel, but provides connectivity with upstream/downstream habitats.	Moderate
B	2nd Order Stream (Strahler). Channel often modified with culverts and raised banks Inflows modified due to regionally cleared land use.	About 50% of the native vegetation remains, either in strips or patches. Most strata dominated by exotic species, 'high threat' species abundant. One stratum missing or extra, cover within remaining strata 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and only one age class present. Quantities and/or cover 50% higher or lower than reference.	Clay banks with slope 30-70°. Approximately 15% of banks with slumping erosion. Remainder of banks well stabilised by groundcover and riparian trees. Channel width variable between 1-4 m, mostly with small banks, but adjacent land development has raised several sections of banks.	Stagnant at time of survey. Water very turbid with some algal growth where canopy opens. Some aquatic habitat with many logs and macrophytes. Several large Carp observed in pools. Provides connectivity with upstream/downstream habitats.	Degraded

REACH NO.	HYDROLOGY	STREAMSIDE VEGETATION	PHYSICAL FORM	WATER QUALITY AND AQUATIC HABITAT	OVERALL RATING
			Culverts may restrict connectivity in low flows.		
C	2nd Order Stream (Strahler). Channel mostly unmodified, but with small culverts and one wetland/dam instream near northern confluence. Inflows modified due to regionally cleared land use.	Evidence of localised loss of native vegetation in northern portion. One or more strata dominated by exotic species, 'high threat' species present. Cover within one stratum up to 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and/or only two age classes present. Quantities and cover similar to reference.	Clay banks with slope 30-70°. Approximately 5% of banks with minor erosion. Remainder of banks well stabilised by groundcover and riparian trees. Channel width variable between 1-10 m, mostly with small banks. Culverts may restrict connectivity in low flows.	Stagnant at time of survey. Water very turbid with some algal growth where canopy opens. Limited aquatic habitat in narrow, shallow channel, but provides connectivity with upstream/downstream habitats. Many frogs present around reeds and emergent logs.	Moderate

Appendix C: Flora and Fauna Lists

FLORA LIST

FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	BB01	BB02	BB03
	Vegetation Community		SPW	Alluvial	SPW
Asclepiadaceae	*Araujia hortorum**	Moth Vine		x	
Apiaceae	*Daucus glochidiatus*	Native Carrot		x	
	Centella asiatica	Indian Pennwort			x
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper			
Asteraceae	*Bidens pilosa**	Cobblers Pegs	x	x	x
	Ozothamnus diosmifolius	Rice Flower	x		
	*Cirsium vulgare**	Spear Thistle	x	x	x
	*Gamochaeta coarctata**	Gray Everlasting	x		
	*Hypochaeris radicata**	Catsear	x		x
	*Senecio madagascariensis**	Fireweed		x	x
	*Sonchus oleraceus**	Common Sowthistle		x	x
	Verbena sp.*	-		x	x
Caryophyllaceae	*Stellaria media**	Common Chickweed		x	x
Casuarinaceae	*Casuarina glauca*	Swamp Oak		x	
Cactaceae	*Opuntia stricta*	Prickly Pear			
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush	x		x
Clusiaceae	*Hypericum perforatum*	St. Johns Wort			
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew		x	
Convolvulaceae	*Convolvulus erubescens*	Blushing Bindweed			x
	Dichondra repens	Kidney Weed	x	x	x
	Cyperus sp.*	-		x	x

	Lepidospera laterale	-	x		
Fabaceae subf. Faboideae	*Desmodium varians*	Slender Tick-trefoil	x		
	Dillwynia sericea	-	x		x
	Dillwynia sieberi	-	x		x
	Glycine clandestina	-	x	x	x
	Glycine tabacina	-	x	x	x
	Hardenbergia violacea	Purple Coral Pea	x		
	Pultenaea sp.	-			x
	*Trifolium dubium**	Yellow Suckling Clover			x
Fabaceae subf. Mimosoidea	*Acacia falcata*	-		x	x
Haloragaceae	*Gonocarpus micranthus*	-		x	x
Juncaceae	*Juncus subsecundus*	-	x		
	Juncus sp.	-		x	x
Liliaceae	*Asphodelus fistulosus**	Onion Weed		x	
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush	x		
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne		x	x
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum		x	
	Eucalyptus fibrosa	Red Ironbark	x		
	Eucalyptus moluccana	Grey Box	x	x	x
	Eucalyptus tereticornis	Forest Red Gum	x	x	x
	Melaleuca decora	-		x	
	Melaleuca sieberi	-	x		
	Kunzea ambigua	-		x	
Oleaceae	*Ligustrum lucidum**	Broad-leaf Privet		x	
Oxalidaceae	*Oxalis perennans*	-		x	
Pittosporaceae	*Bursaria spinosa*	Blackthorn	x	x	x
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues		x	
Poaceae	*Austrodanthonia* sp.	-	x	x	x
	Austrostipa sp.	-	x	x	x
	*Bromus catharticus**	Prairie Grass	x	x	
	Cymbopogon sp.*	-			x

	*Cynodon dactylon**	Couch	x		x
	Dichelachne micrantha	Shorthair Plumegrass	x		x
	*Ehrharta erecta**	Panic Veldtgrass		x	
	*Eragrostis curvula**	African Lovegrass			x
	Panicum simile	-	x		x
	*Paspalum dilatatum**	Paspalum			x
	*Pennisetum clandestinum**	Kikuyu		x	
	*Setaria parviflora**	Slender Pigeon Grass	x	x	x
	Themeda australis	Kangaroo Grass	x	x	x
Polygonaceae	*Rumex crispus**	Wild Dock		x	
Proteacea	*Grevillea juniperina*	Juniper-leaf Grevillea	x		x
Pteridaceae	*Cheilanthes sieberi*	-	x	x	x
Rosaceae	*Rubus fruticosus*	Blackberry			
Solanaceae	*Cestrum parqui**	Green Cestrum			
	*Lycium ferocissimum**	African Boxthorn			
	*Solanum nigrum**	Black-berry Nightshade		x	x
	Solanum companulatum	-	x		x
Verbenaceae	*Lantana camara*	Lantana			

* denotes exotic

FAUNA LIST

SCIENTIFIC NAME	COMMON NAME	STATUS
Aves		
Acridotheres tristis	Common Myna	E
Anas platyrhynchos domestica	Pekin Duck	E
Ardea ibis	Cattle Egret	N, Mi
Cacatua galerita	Sulphur-crested Cockatoo	N
Chenonetta jubata	Australian Wood Duck	N
Corcorax melanorhamphos	White-winged Chough	N
Corvus coronoides	Australian Raven	N
Cracticus nigrogularis	Pied Butcherbird	N
Dacelo novaeguineae	Laughing Kookaburra	N
Egretta garzetta	Little Egret	N
Egretta novaehollandiae	White-faced Heron	N
Grallina cyanoleuca	Magpie-lark	N
Gymnorhina tibicen	Australian Magpie	N
Hirundo neoxena	Welcome Swallow	N
Malurus cyaneus	Superb Fairy-wren	N
Manorina melanocephala	Noisy Miner	N
Manorina melanophrys	Bell Miner	N
Ocyphaps lophotes	Crested Pigeon	N
Oriolus sagittatus	Olive-backed Oriole	N
Pardalotus punctatus	Spotted Pardalote	N
Porphyrio porphyrio	Purple Swamphen	N
Podargus strigoides	Tawny Frogmouth	N
Pycnonotus jocosus	Red-whiskered Bulbul	E
Rhipidura leucophrys	Willie Wagtail	E
Strepera graculina	Pied Currawong	N
Trichoglossus haematodus	Rainbow Lorikeet	N
Vanellus miles	Masked Lapwing	N
Mammals (Excluding Bats)		
Capra aegagrus hircus	Goats	E
Lama glama	Llama	E
Oryctolagus cuniculus	Rabbits	E
Ovis aries	Sheep	E
Pseudocheirus peregrinus	Ring-tailed Possum	N
Trichosurus vulpecula	Brush-tailed Possum	N
Vulpes vulpes	European Red Fox	E
Bats		
Chalinolobus gouldii	Gould's Wattled Bat	N
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat	V2
Mormopterus norfolkensis	Eastern Freetail Bat	V2
Mormopterus species 2	Mormopterus species 2	N

Nyctophilus spp.	Long-eared Bat	N
Pteropus poliocephalus	Grey-headed Flying Fox	N, V
Scotorepens orion	Eastern Broad-nosed Bat	N
Tadarida australis	White-striped Freetail Bat	N
Vespadelus vulturnus	Little Forest Bat	N
Amphibians		
Litoria fallax	Eastern Dwarf Tree Frog	N
Litoria peronii	Peron's Tree Frog	N
Limnodynastes peronii	Striped Marsh Frog	N
Crinia signifera	Eastern Common Froglet	N
Reptiles		
Varanus varius	Lace Monitor	N
Pseudechis porphyriacus	Red-bellied Black Snake	N
Fish		
Anguilla ssp.	Short/Long Finned Eel	N
Cyprinus carpio	Carp	E
Gambusia holbrooki	Gambusia	E

E=Exotic
N=Native
Mi=Migratory under EPBC Act
V= Vulnerable under the EPBC Act

Appendix D: Likelihood of Occurrence Table

FLORA

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD DURVEY
Dillwynia tenuifolia		V	-	Dillwynia tenuifolia has a core distribution within the Cumberland Plain, where it may be locally abundant within scrubby, dry heath areas within Castlereagh Ironbark Forest and Shale/Gravel Transition Forest on tertiary alluvium or laterised clays (DEC 2005). It may also be common in the ecotone between these areas and Castlereagh Scribbly Gum Woodland (DEC 2005).	Likely	**Yes**
Grevillea juniperina subsp. *juniperina*		V	-	Restricted to red sandy to clay soils – often lateritic on Wianamatta Shale and Tertiary alluvium in Cumberland Plain Woodland and Castlereagh Woodland (OEH 2011). Confined to Western Sydney and known within the area bounded approximately by St Marys, Londonderry and Prospect (*ibid.*).	Likely	**Yes**
Marsdenia viridiflora var. *viridiflora*	*Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2	-	A twining climber to 4 m high. Grows in vine thickets and open shale woodland. Recorded from western Sydney (Prospect, Bankstown, Smithfield, Cabramatta Creek, St Marys), and Razorback Range (DEC 2005).	Potential – nearby records	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD DURVEY
Micromyrtus minutiflora		E	V	Micromyrtus minutiflora is restricted to the area between Richmond and Penrith in western Sydney on the Central Coast. It grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, and open forest on tertiary alluvium and consolidated river sediments (DEC 2005).	Potential – nearby records	No
Pimelea curviflora var *curviflora*		V	V	Occurs in woodlands on ridgetops and slopes, on shale/lateritic soils over sandstone or shale/sandstone transition soils. Previous records are concentrated around the Parramatta River and Illawarra coastal plains. Inconspicuous, fire-tolerant species that flowers October to May (DEC 2005).	Unlikely – site does not support associated vegetation community	No
Pimelea spicata		E	E	In western Sydney, it occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale (DEC 2005). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines (*Ibid.*). Has been located in disturbed areas that would have previously supported CPW (*Ibid.*). Occurs on undulating topography on substrates derived from Wianamatta Shale in areas of Cumberland Plain Woodland Vegetation Community. Recorded from open woodlands and grasslands dominated by *Eucalyptus moluccana*, *E. crebra, E. tereticornis, Bursaria spinosa* and *Themeda triandra* , and in the Illawarra occurs on clay soils on coastal headland in *Themeda triandra* grassland with low native shrubs present (SEWPaC 2011b).	Potential	No
Pterostylis gibbosa	Illawarra Greenhood	E	E	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. Existing populations are known from the Hunter, Illawarra and Shoalhaven regions. The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter and flowers in spring (DEC 2005).	Unlikely – likely locally extinct on Cumberland Plain (DEC 2005).	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD DURVEY
Pterostylis saxicola		E	E	Terrestrial orchid predominantly found in Hawkesbury Sandstone Gully Forest growing in small pockets of soil that have formed in depressions in sandstone rock shelves (NPWS 1997; RBG 2011). Known from Georges River National Park, Ingleburn, Holsworthy, Peter Meadows Creek, St Marys Tower (OEH 2011).	Unlikely – site does not support typical geology	No
Pultenaea parviflora		E	V	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest, Shale Gravel Transition Forest on tertiary alluvium or laterised clays and Castlereagh Scribbly Gum Woodland (DEC 2005). .Often found in association with other threatened species such as *Dillwynia tenuifolia, Dodonaea falcata, Grevillea juniperina, Micromyrtus minutiflora, Persoonia nutans* and *Styphelia laeta* (*ibid.*). Flowering may occur between August and November (*ibid.*).	Potential – nearby records	No
Streblus pendulinus	Siah's Backbone	-	E	Found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest	Unlikely – site does not support associated vegetation community	No
Tetratheca glandulosa	Glandular Pink-bell	V	V	Associated with ridgetop woodland habits on yellow earths (Travers Morgan 1991) also in sandy or rocky heath and scrub (NPWS 1997). Often associated with sandstone / shale interface where soils have a stronger clay influence (NPWS 1997). Flowers July to November.	Unlikely – site does not support typical soils/geology	No

FAUNA

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
			FISH			
Macquarie australasica	Macquarie Perch	E (listed in NSW under FM Act)	E	Habitat for the Macquarie perch is bottom or mid-water in slow-flowing rivers with deep rocky holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods (SEWPaC 2011b).	None – no suitable habitat	No
Prototroctes maraena	Australian Grayling	-	V	Historically, this species occurred in coastal streams from the Grose River southwards through NSW, Vic. and Tas. On mainland Australia, this species has been recorded from rivers flowing east and south of the main dividing ranges. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops but has also been found in muddy-bottomed, heavily silted habitat. Grayling migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous (migratory between fresh and salt waters) species (SEWPaC 2011b).	None – no suitable habitat	No
			FROGS			
Heleioporus australiacus	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (SEWPaC 2011b).	None – no suitable habitat	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
Litoria aurea	Green and Golden Bell Frog	E	V	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DEC 2005). Fast flowing streams are not utilised for breeding purposes by this species (Mahony 1999). Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DEC 2005). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–*Typha* sp. and spikerushes–*Eleocharis* sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (*Gambusia holbrooki*) (DEC 2005).	Potential	No – however, potential habitat available within dams
REPTILES						
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer (DEC 2005).	None – no suitable habitat	No
DIURNAL BIRDS						

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
Anthochaera phrygia (aka *Xanthomyza phrygia)*	Regent Honeyeater	CE	E & M	Inhabits temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts (such as Red Ironbark *E. fibrosa*, White Box *E. albens* and Yellow Box *E. melliodora*) and mistletoes, and riparian forests of River Oak (*Casuarina cunninghamiana*) (Garnett 1993) and Swamp Mahogany (*Eucalyptus robusta*) in coastal areas (NPWS 1999).	Potential – could feed on lerp-affected *Eucalyptus moluccana*, *E. crebra* and *E. tereticornis*, site provides migratory and foraging habitat.	No
Botaurus poiciloptilus	Australasian Bittern	V	E	Terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1993). Reedbeds, swamps, streams, estuaries (Simpson & Day 1999).	Unlikely – site does not support required habitat	No
Daphoenositta chrysoptera	Varied Sittella	V	-	Varied Sitellas are endemic and widespread in mainland Australia. Varied Sitellas are found in eucalypt woodlands and forests throughout their range. They prefer rough-barked trees like stringybarks and ironbarks or mature trees with hollows or dead branches (Birds in Backyards 2011).	Potential – 9 records within 5km	No – potential habitat recorded
Erythrotriorchis radiatus	Red Goshawk	E4A	*V*	Associated with forests and woodlands with a mosaic of vegetation types, an abundance of birds and permanent water. In NSW, this species is thought to favour mixed subtropical rainforest, Melaleuca Swamp Forest, and open eucalypt forest along rivers, often in rugged terrain (Marchant & Higgins 1993; DECC 2005). Across northern Australian south through eastern Queensland to far north-east NSW. The species is very rare in NSW. Most records are from the Clarence River Catchment, with a few about the lower Richmond and Tweed Rivers. (DECC 2005)	Potential – may forage along the river	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
Hieraaetus morphnoides	Little Eagle	V	-	Utilises open eucalypt, sheoak and acacia forest, woodland or open woodland. Builds a large stick nest in winter, in tall trees within remnant vegetation. Lays eggs in spring, and young fledge in early summer. Primarily preys on birds, reptiles and mammals, and occasionally feeds on large insects or carrion (DEC 2005).	Potential – six records within 5km	No – potential habitat recorded
Lathamus discolor	Swift Parrot	E	E	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering eucalypts (Blakers et al. 1984, Schodde and Tidemann 1986). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*) (DEC 2005).	Potential – four records within 5km	No – forgaing habitat recorded
Petroica boodang	Scarlet Robin	V	-	In NSW, occurs from the coast to the inland slopes, with some dispersing to open habitat of lower valleys and plains after breeding in July-January (DEC 2005). In habits dry open eucalypt forest and woodland with a sparse shrub layer. Occasionally occurs in mallee, wet forest, wetlands or tea-tree swamps (DEC 2005).	Potential – 3 records within 5km	No – potential habitat recorded
Pyrrholaemus sagittatus	Speckled Warbler	V	-	Occupies a wide range of eucalypt dominated communities with a grassy understorey, often on rocky ridges or in gullies (DEC 2005). Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy (DEC 2005). Large, relatively undisturbed remnants are required for the species to persist in an area (DEC 2005). Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding (DEC 2005).	Potential – 4 records within 5km	No – required habitat not available on site

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
Rostratula australis (a.k.a. R. benghalensis)	Painted Snipe (Australian subspecies)	E	V	Utilises wet areas with grasses, lignum, low scrub or open timber, including shallow terrestrial wetlands, lakes, swamps, claypans, waterlogged grassland or saltmarsh, dams, rice crops, sewage farms etc. (DEC 2005). Builds sparse ground nest, in shallow wetlands with areas of bare wet mud with shrubs and trees nearby, Breeding can occur year-round, and is often in response to local conditions; most often between August and February (SEWPaC 2011b). Roosts during the day in dense vegetation (OEH 2011). Forages nocturnally on mud-flats and in shallow water on vegetation, seeds, insects, worms, molluscs, crustaceans and other invertebrates (DSEWPAC 2011b, Marchant & Higgins 1993).	Unlikely	No – required habitat not available on site
MAMMALS (EXCLUDING BATS)						
Dasyurus maculatus *Dasyurus maculatus maculatus*	Spotted-tailed Quoll Spotted-tailed Quoll (SE Mainland Population)	V -	- E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DEC 2005), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DEC 2005). Maternal den sites are logs with cryptic entrances, rock outcrops,burrows & tree hollows (SEWPaC 2011b).	Unlikely	No – required habitat not available on site
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Strahan 1995).	Unlikely	No – required habitat not available on site
Phascolarctos cinereus	Koala	V-E2	-	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees. *Eucalyptus tereticornis* is one of the Koala's preferred browsing species.	Unlikely – despite nearby recordings	No – site is too disturbed

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
Potorous tridactylus *Potorous tridactylus tridactylus*	Long-nosed Potoroo Long-nosed Potoroo (SE Mainland Population)	V -	- V	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature (DEC 2005).	Unlikely	No – required habitat not available on site
Pseudomys novaehollandiae	New Holland Mouse	-	V	Recorded as disjunct populations from Queensland to Tasmania,. Habitat include heathland, open woodland with heathy understorey, and vegetated sand dunes, and the home range varies from 0.44 ha to 1.4 ha. This nocturnal species is social and usually shares a burrow with other individuals (DEWHA 2010). Relatively little is known about habitat preferences, and many vegetation types appear to provide habitat, but soil conditions do need to be suitable for burrowing and growth of hypogeal fungi is likely to be a key diet component (DSE 2003).	Unlikely	No – required habitat not available on site
MAMMALS (BATS)						
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998, DEC 2005). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998, DEC 2005).	Potential	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Prefers moist habitats with trees taller than 20m (DEC 2005). Roosts in tree hollows but has also been found roosting in buildings or under loose bark (DEC 2005).	Unlikely – site likely does not support enough moist habitat.	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). It forages above and below the tree canopy on small insects (AMBS 1995, Dwyer 1995, Dwyer 1981). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (DEC 2005, Dwyer 1995).	Known	**Yes**
Mormopterus norfolkensis	Eastern Freetail Bat	V	-	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia 2000; Allison & Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Environment Australia 2000; Allison & Hoye 1998).	Known	**Yes**
Myotis macropus	Southern Myotis, Large-footed Myotis	V	-	Rarely recorded more than 100 km inland, this species forages over streams and pools and utilises a range of habitats from small creeks to large lakes and mangrove lined estuaries. Generally roosts close to waterbodies in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage (DEC 2005).	Potential – nearby recordings	No
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	Known	**Yes**

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 1998). Within denser vegetation types use is made of natural and man made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 1998).	Potential – nearby recordings	No
INVERTEBRATES						
Meridolum corneovirens	Cumberland (Large) Land Snail	E	-	Associated with open eucalypt forests, particularly Cumberland Plain Woodland described in Benson (1992). Found under fallen logs, debris and in bark and leaf litter around the trunk of gum trees or burrowing in loose soil around clumps of grass (NPWS 1997; Rudman 1998). Urban waste may also form suitable habitat (NPWS 1997; Rudman 1998).	Known	No – limited leaf litter available, searches did not detect the species
MIGRATORY TERRESTRIAL SPECIES LISTED UNDER EPBC ACT						
Apus pacificus	Fork-tailed Swift	-	M	Aerial species, recorded over open country, from semi-deserts to coasts, sometimes forests and cities (SEWPaC 2011b).	Potential	No –may fly over the site
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1996, Simpson & Day 2004). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1996).	Unlikely	No – required habitat not available on site
Hirundapus caudacutus	White-throated Needletail	-	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1999, Simpson & Day 2004). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1999).	Potential	No – may fly over the site

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
Merops ornatus	Rainbow Bee-eater	-	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May (Pizzey and Knight 1997). Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (*ibid*). Nest is a chamber a the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (*ibid*).	Unlikely	No – required habitat not available on site
Monarcha melanopsis	Black-faced Monarch	-	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984). May also be found in coastal scrub or damp gullies, and during migration, more open woodland habitats. Breeding migrant that arrives in coastal south-eastern Australia in September and returns north in March (Birds in Backyards 2011).	Unlikely	No – required habitat not available on site
Myiagra cyanoleuca	Satin Flycatcher	-	M	Associated with eucalypt forests, often near wetlands or watercourses but absent from rainforests (DSEWPAC 2011b, Blakers et al. 1984); occurs in open forests, often at height (Simpson & Day 2004). Breed above 600m asl during Nov-Jan, and migrate north for winter (SEWPaC 2011b).	Unlikely	No – required habitat not available on site
Rhipidura rufifrons	Rufous Fantail	-	M	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe 2004). Open country may be used by the Rufous Fantail during migration (Morcombe 2004).	Unlikely	No – required habitat not available on site

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING FIELD SURVEY
MIGRATORY WETLAND SPECIES LISTED UNDER EPBC ACT						
Ardea alba	Great Egret	-	M	The Great Egret is common and widespread in Australia (McKilligan 2005). It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (McKilligan 2005).	Potential	No- potential foraging habitat recorded
Ardea ibis	Cattle Egret	-	M	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (McKilligan 2005). Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leave the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range (McKilligan 2005).	Known	**Yes**
Gallinago hardwickii	Latham's Snipe	-	M	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Higgins and Davies 1996). Occupies a variety of vegetation around wetlands (Higgins and Davies 1996) including wetland grasses and open wooded swamps (Simpson and Day 2004).	Unlikely	No – required habitat not available on site
Rostratula benghalensis (a.k.a. R. australis)	Painted Snipe	-	M	See: *Rostratula australis*	-	-

Appendix E: PBP 2006 Public Road Specifications

PERFORMANCE CRITERIA	ACCEPTABLE SOLUTIONS
The intent may be achieved where:	
• firefighters are provided with safe all weather access to structures (thus allowing more efficient use of firefighting resources)	• public roads are two-wheel drive, all weather roads.
• public road widths and design that allow safe access for firefighters while residents are evacuating an area	• urban perimeter roads are two-way, that is, at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb), allowing traffic to pass in opposite directions. Non perimeter roads comply with Table 4.1 – Road widths for Category 1 Tanker (Medium Rigid Vehicle). • the perimeter road is linked to the internal road system at an interval of no greater than 500 metres in urban areas. • traffic management devices are constructed to facilitate access by emergency services vehicles. • public roads have a cross fall not exceeding 3 degrees. • all roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 metres in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end and direct traffic away from the hazard. • curves of roads (other than perimeter roads) are a minimum inner radius of six metres and minimal in number, to allow for rapid access and egress. • the minimum distance between inner and outer curves is six metres. • maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient. • there is a minimum vertical clearance to a height of four metres above the road at all times.
• the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles.	• the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles (approximately 15 tonnes for areas with reticulated water, 28 tonnes or 9 tonnes per axle for all other areas). Bridges clearly indicate load rating.
• roads that are clearly sign- posted (with easily distinguishable names) and buildings/properties that are clearly numbered.	• public roads greater than 6.5 metres wide to locate hydrants outside of parking reserves to ensure accessibility to reticulated water for fire suppression. • public roads between 6.5 metres and 8 metres wide are

PERFORMANCE CRITERIA	ACCEPTABLE SOLUTIONS
	No Parking on one side with the services (hydrants) located on this side to ensure accessibility to reticulated water for fire suppression.
• there is clear access to reticulated water supply	• public roads up to 6.5 metres wide provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression. • one way only public access roads are no less than 3.5 metres wide and provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression.
• parking does not obstruct the minimum paved width	• parking bays are a minimum of 2.6 metres wide from kerb edge to road pavement. No services or hydrants are located within the parking bays. • public roads directly interfacing the bushfire hazard vegetation provide roll top kerbing to the hazard side of the road.

Appendix F: PBP 2006 Property Access Specifications

PERFORMANCE CRITERIA	ACCEPTABLE SOLUTIONS
The intent may be achieved where:	
• firefighters are provided with safe all weather access to structures (thus allowing more efficient use of firefighting resources)	• public roads are two-wheel drive, all weather roads.
• public road widths and design that allow safe access for firefighters while residents are evacuating an area	• urban perimeter roads are two-way, that is, at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb), allowing traffic to pass in opposite directions. Non perimeter roads comply with Table 4.1 – Road widths for Category 1 Tanker (Medium Rigid Vehicle). • the perimeter road is linked to the internal road system at an interval of no greater than 500 metres in urban areas. • traffic management devices are constructed to facilitate access by emergency services vehicles. • public roads have a cross fall not exceeding 3 degrees. • all roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 metres in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end and direct traffic away from the hazard. • curves of roads (other than perimeter roads) are a minimum inner radius of six metres and minimal in number, to allow for rapid access and egress. • the minimum distance between inner and outer curves is six metres. • maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient. • there is a minimum vertical clearance to a height of four metres above the road at all times.
• the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles.	• the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles (approximately 15 tonnes for areas with reticulated water, 28 tonnes or 9 tonnes per axle for all other areas). Bridges clearly indicate load rating.
• roads that are clearly sign- posted (with easily distinguishable names) and buildings/properties that are clearly numbered.	• public roads greater than 6.5 metres wide to locate hydrants outside of parking reserves to ensure accessibility to reticulated water for fire suppression. • public roads between 6.5 metres and 8 metres wide are

PERFORMANCE CRITERIA	ACCEPTABLE SOLUTIONS
	No Parking on one side with the services (hydrants) located on this side to ensure accessibility to reticulated water for fire suppression.
• there is clear access to reticulated water supply	• public roads up to 6.5 metres wide provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression. • one way only public access roads are no less than 3.5 metres wide and provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression.
• parking does not obstruct the minimum paved width	• parking bays are a minimum of 2.6 metres wide from kerb edge to road pavement. No services or hydrants are located within the parking bays. • public roads directly interfacing the bushfire hazard vegetation provide roll top kerbing to the hazard side of the road.

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

SYDNEY
Suite 604, Level 6
267 Castlereagh Street
Sydney NSW 2000
T 02 9993 0566
F 02 9993 0573

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

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

HUNTER
Suite 17, Level 4
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

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

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

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

BRISBANE
93 Boundary St
West End QLD 4101
T 1300 646 131

WESTERN AUSTRALIA
108 Stirling Street
Perth WA 6000
T 08 9227 1070
F 08 9227 1078

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4254 6699